Regulating for investment and growth

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1 Introduction

The question of how the economic regulation of infrastructure sectors can—or should—best support wider economic growth is a live issue. Across Europe, a broad reassessment is under way of how the regulatory frameworks governing network industries shape not only the performance of those sectors, but also the productive capacity and growth trajectory of the wider economy. This reassessment is being driven by a convergence of pressures: sluggish productivity growth in the years since the global financial crisis, the scale of investment required to deliver net zero transitions across energy, transport and communications networks, and a growing recognition among policymakers that the design of economic regulation, not simply its presence or absence, may be a first-order determinant of whether required infrastructure investment is delivered, and how it translates into durable economic growth.

In the UK, this debate has taken on particular urgency in the context of low productivity growth. This increased focus on the role of infrastructure regulation in driving—or hindering—investment and economic growth can be seen across multiple areas of government, legislative and regulatory activity, including:

- the report by the Independent Water Commission[1] and the government's response to it;[2]
- debates among regulators as to whether incentive-based regulation—developed during the privatisations of the 1980s and 1990s and refined over the subsequent four decades—remains fit for purpose during an era of capital-intensive, long-horizon investment in decarbonisation and digital infrastructure;
- a recent report by the House of Lords Industry and Regulators Committee on regulation and economic growth, which concluded that:

> the Government must provide strategic guidance to regulators that addresses how conflicts between objectives should be prioritised.[3]

At the EU level, the publication of Mario Draghi's 2024 report on European competitiveness brought comparable urgency to the continental debate.[4] The report identified regulatory fragmentation, insufficient infrastructure investment, and weak incentives for private capital deployment in network industries as among the central structural impediments to European productivity and competitiveness. Its call for a substantial scaling-up of investment, alongside regulatory reforms to enable and attract that investment, has reframed infrastructure regulation as a strategic economic policy question rather than merely a sectoral technical matter, and has prompted renewed attention across EU member states on how regulatory frameworks in energy, transport, and digital

[1] Independent Water Commission (2025), 'Final report', July.
[2] UK Government (2025), 'Government initial response to Independent Water Commission's final report', 21 July.
[3] House of Lords (2026), 'Time is money: How regulators can support growth', May, p. 2.
[4] See European Commission (2024), 'The future of European competitiveness', September.

infrastructure can be redesigned to support the infrastructure investment required for long-run growth.[5]

This increasing interest among policymakers as to how regulators should adapt their approach to accommodate growth sits alongside a separate but—somewhat paradoxically—related issue: that is, whether increased intervention from central government may actually be constraining investment in critical infrastructure, which in turn would adversely affect the wider economy. Questions have been raised about whether heightened uncertainty relating to potential government intervention in markets has driven up financing costs for regulated infrastructure companies[6] and—more generally—whether interventions from government in either the regulated sector itself or in closely adjacent markets may be resulting in poor outcomes for consumers and the wider economy. For example, on the latter, some authors have argued that excessive intervention from the UK government in GB electricity generation markets has driven sub-optimal outcomes, with Dieter Helm recently noting that:

> The old dream of the electricity privatisers – that the industry would become an increasingly competitive one, with suppliers shopping around to find the best merchant prices from generators – has been replaced by a monopsony of government buying through CfDs and regulated asset bases (RABs), and passing on these costs... Every party wants government-backed contracts. The market is an ever-decreasing residual. This is the legacy of Ed Miliband's energy market reforms at the end of the first decade of this century. It is a central buyer model.[7]

It should be noted that, while the challenges facing infrastructure regulators have evolved over time, so has the consensus regarding the optimal forms of regulation. For example, when BT was privatised in 1984, the prevailing view (including of Stephen Littlechild) was that price regulation would be a temporary phenomenon that could be dropped after about five years.[8] In practice, however, price regulation of BT continued for much longer than anticipated, with BT Openreach still subject to economic regulation on specific wholesale fixed broadband products over 40 years later.

This briefing paper examines how the approach to the economic regulation of infrastructure sectors has evolved over time, and how regulators operating across sectors and jurisdictions have adapted their approaches in response to new challenges, investment requirements and the needs of the broader economy. It is structured as follows.

- Section 2 provides a brief overview of some of the main shifts seen in utility regulation since the major privatisations of key utilities in the 1980s. In this paper we focus heavily on the experience in the UK (given that it was one of the first European countries to implement widespread privatisation across

[5] The Draghi report made notably specific recommendations in relation to telecoms regulation, including that steps be taken to 'Reduce country-level ex ante regulation, which disincentivises investments and risk-taking, and favour rather ex post competition enforcement in cases of abuse of dominant position or other anticompetitive conducts.' See: European Commission (2024), 'The future of European competitiveness', September, p. 75.
[6] Oxera (2019), 'Risky business: political uncertainty and the cost of capital for regulated firms', October.
[7] Helm, D. (2026), 'What to do about the industrial energy crisis', March.
[8] Stern (2003), 'What the Littlechild report actually said', Regulation Initiative Working Paper No. 55, p. 9.

multiple sectors), although we also draw on insights from other countries, and—in discussion—**we welcome OEC members' perspectives on the sectors and jurisdictions that they know best**.

- In section 3, we build on the history outlined above by examining four quite recent case studies. These case studies highlight how specific challenges facing regulators that operate across distinct sectoral contexts and jurisdictions have led to these regulators changing their approaches to regulation (and, in one case, how different approaches to market design have potentially affected investment outcomes in a significant manner).

- In section 4 we examine what these case studies can tell us about the direction of travel for infrastructure regulation, and—with reference to literature on the relationship between regulation, investment and growth—discuss potential implications for policymakers and regulators.

- Lastly, in section 5 we set out our key questions for discussion at the Oxera Economics Council (OEC) meeting on 2 June 2026.

2 A (short!) history of regulation

In what follows, we provide a brief overview of the history of infrastructure regulation, its impact on investment outcomes, and how consensus has shifted over time. While the focus is primarily on how views have evolved in the UK—partly because the UK was one of the first European countries to undertake large-scale utility privatisations—we also draw on examples and insights from elsewhere in Europe. The purpose of this section is not to offer a comprehensive history of each sector, but rather to identify in broad terms the main changes in regulatory philosophy that have shaped the current landscape.

Before we begin, however, it is worth noting that although much of the modern debate on infrastructure regulation begins around 1980 (when privatisations gathered pace), the underlying assumption that many infrastructure networks are natural monopolies requiring regulatory oversight was itself a relatively recent one. Historically, much utility infrastructure was provided in competitive or largely unregulated markets. Examples include the following.

- **Canals**: the UK canal network was built in the 18th and 19th century, and played a central role in the Industrial Revolution by transporting goods and materials (such as coal) to industrial centres.[9] The canals were built by private individuals such as merchants, aristocrats and bankers,[10] with no regulation (other than requiring Acts of Parliament) and with significant competition between individual routes.[11]
- **Railways**: similarly, the construction of the US rail network from the 1860s, although often funded by the federal government, [12] was broadly unregulated and exhibited competition between operators. This was until the creation of the Interstate Commerce Commission in 1887 in response to concerns over alleged 'predatory practices', which was strengthened in 1906 as price controls were brought in under the Hepburn Act.[13] A similar pattern was seen in c. 19th British railway investment.[14]
- **Electricity (US)**: electricity in the US in the early 20th century was characterised by strong competition between distribution networks. However, amidst rising concerns around monopolisation, Congress passed the Public Utility Holding Company Act in 1935 in a bid to constrain pricing.[15]
- **Electricity (Germany)**: a similar dynamic was playing out in the German electricity market over the late 19th century and early 20th century. Following the founding of Deutsche Edison-Gesellschaft für angewandte Elektrizität (the precursor to AEG) in Berlin in 1883, various other German

[9] Turnbull, G. (1987), 'Canals, coal and regional growth during the industrial revolution', **40**:4, pp. 537-560.
[10] Canal and River Trust, the first canal age (last accessed 22 May).
[11] UK Parliament, Canal Acts (last accessed 22 May).
[12] Library of Congress, Railroads in the late 19th century (last accessed 22 May).
[13] Competitive Enterprise Institute (2012), The sad, early history of railroad regulation: from subsidies to nationalization (last accessed 22 May).
[14] Casson, M. (2009). *The World's First Railway System: Enterprise, Competition, and Regulation on the Railway Network in Victorian Britain*. Oxford: Oxford University Press
[15] Committee on Financial Services of the US House of Representatives (1935), Public utility holding company act of 1935, (last accessed 22 May)

> electricity companies also entered the market (in Berlin and elsewhere in Germany). Competition emerged among these firms through overlapping concession bids, rival AC and DC systems and other factors. There was subsequently a long transitional phase to a 'single-grid natural monopoly' where this competition persisted, interoperability was poor and scale economies were uncertain.[16]

Accordingly, it should be noted that—while there is general consensus today that some infrastructure networks have natural monopoly characteristics (such that economic regulation is warranted)—this has not always been the case. Indeed, historical evidence demonstrates that head to head competition is viable across infrastructure networks and has led to significant levels of infrastructure investment, including in industries which are now served by regional (or national) monopoly providers.

It should also be noted that state-owned monopoly provision of utility services—including ones that we now see as potentially competitive—was widespread in Europe fifty years ago. Monopoly provision was also common in the US, but generally under private ownership. This paper does not much address liberalisation and regulatory reform in the US, but an important landmark to note was the AT&T breakup in 1984 following antitrust intervention.[17]

More recently in western Europe (i.e. from the 1980s onwards), the path of infrastructure regulation can be understood in three broad phases. The first was defined by confidence in privatisation, incentive regulation, and liberalisation to enable the extension of competition wherever possible. The second reflected a more mixed—and in some cases more sceptical—assessment, as practical experience revealed potential limits to competition and exposed tensions between private ownership, public service obligations, and long-term investment needs. The third, which characterises the current period, is marked by a more differentiated and unsettled landscape: in some sectors and jurisdictions competition remains central, while in others there has been a clear movement towards more active state direction, more explicit policy steering, and greater political involvement in regulatory outcomes.

2.1 Phase 1—Initial privatisations, price cap regulation and liberalisation (1980s to early 2000s)

The dominant view during the first phase was that utility industries should be transferred into private ownership, subjected to price regulation, and progressively opened up to competition wherever parts of the value chain were capable of supporting it. Regulation would remain in place only for those elements of the system that were genuine natural monopolies, such as water and wastewater networks, or parts of the energy and telecoms

[16] Hughes, Thomas P. (1983), *Networks of power: Electrification in Western society, 1880–1930*, Johns Hopkins University Press.
[17] Coll, S. (2017), 'The deal of the century: the breakup of AT&T', Open Road Media.

system where duplication of infrastructure would be inefficient.[18] This was, in broad terms, the logic associated with the UK's wider privatisation programme.

The appeal of this framework rested on a combination of economic and fiscal arguments. Privatisation was expected to reduce inefficiency by exposing firms to stronger managerial incentives and harder budget constraints than had typically existed under state ownership. At the same time, it was expected to unlock higher levels of investment, particularly because large infrastructure capital expenditure would no longer be limited by pressures on the public balance sheet.[19] Incentive regulation—particularly in the form of RPI-X price controls—was intended to mimic some of the pressures of a competitive market by rewarding efficiency gains while still protecting consumers from monopoly pricing.

These motivations underpinned the original design of the RPI-X approach, developed in explicit contrast to the 'rate of return' model of regulating private utilities predominant in the USA. Under the US 'rate of return' model, regulators undertook detailed scrutiny of companies cost arrangements and capital plans, resulting in lengthy administrative processes, scope for lobbying and regulatory capture, and incentives to overinvest in capital expenditure.[20] By contrast, the RPI-X approach was intended to be relatively 'light handed', based on estimating a benchmark price formula and relying on companies' incentives to generate improvements in efficiency.[21]

Stephen Littlechild summarises this as follows.[22]

With respect to the key features of RPI-X regulation:[23]
The [regulator] does not have to make any judgement or calculations with respect to capital, allocation of costs, rates of return, future movements of costs and demand, desirable performance etc. [...]

With respect to the role of regulation and competition:[24]
Competition is indisputably the most effective – perhaps the only effective means – of protecting consumers against monopoly power. Regulation is essentially the means of preventing the worst excesses of monopoly; it is not a substitute for competition. It is a means of 'holding the fort' until competition comes.

In the UK, this approach was applied across a wide range of sectors, including telecommunications, energy, water, and rail.[25] More broadly, it reflected a confidence that

[18] Armstrong, M., Cowan, S., & Vickers, J. (1994), 'Regulatory reform: Economic analysis and British experience', MIT Press.
[19] Institute for Government (2017), 'Financing infrastructure', September.
[20] H. Averch, L. Johnson (1962), 'Behaviour Of The Firm Under Regulatory Constraint', American Economic Journal, December, p. 1,053.
[21] While RPI-X and rate-of-return regulation differ conceptually, their incentive properties converge in practice where regulatory resets are infrequent. Under rate-of-return regulation with significant lags, a firm that cannot recover historic cost over-runs at the next reset faces pressures to contain costs that are broadly equivalent to those created by a price cap. See Laffont, J.-J. and Tirole, J. (1993) *A Theory of Incentives in Procurement and Regulation*. Cambridge, MA: MIT Press.
[22] Stephen C. Littlechild (1983), 'Regulation of British Telecommunications' Profitability', February.
[23] Ibid, p. 36.
[24] Ibid, p. 7.
[25] Vickers, J. and Yarrow, G. (1988), 'Privatization: An Economic Analysis', *The Economic Journal*, Volume 98, Issue 393, pp. 1228-1230.

private ownership, disciplined by regulation and supplemented by competition where feasible, would deliver better investment outcomes than vertically integrated state provision, through natural incentives for efficiency as well as private sector discipline and innovation. Importantly, the model was not simply about reducing the role of the state; it was also about redefining that role. Governments would step back from direct ownership and operational decision-making, while regulators would take on a more technocratic role in setting incentives, overseeing monopoly segments, and enabling market opening.

It was not envisaged that each sector would reach the same end-point. While the RPI-X regulatory model was seen as a staging post before the introduction of competition in sectors such as telecoms and much of the energy sector, in other sectors such as the water industry Littlechild did not consider that competition 'in the product market'—i.e. between companies competing to supply customers—would be a significant end state for the market. Instead, it was competition through capital markets—in particular the prospect that inefficiently managed companies would be subject to takeovers by shareholders who could realise efficiency savings—that would place pressure on companies to run businesses efficiently and innovatively.[26]

The privatisation and liberalisation of utilities in this period also led to some competition issues, as entities which were formally under state ownership became privately owned, creating scope for these firms to potentially exploit their market power. This eventually led to a number of high profile abuse of dominance cases across Europe (see Box 2.1 below), highlighting some of the challenges associated with privatising and liberalising utilities given the impact on competing firms operating in similar or adjacent sectors.

[26] Littlechild, S.C. (1986), Economic Regulation of Privatised Water Authorities, HMSO, London, para. 1.14, p. 2.

Box 2.1 European abuse of dominance cases in regulated sectors

DB Station & Service v ODEG **(Case C-721/20)**

Following liberalisation of German railways, vertically-integrated Deutsche Bahn Group retained control of the rail network and competed with downstream passenger and freight services.

The dispute concerned station access charges imposed by DB Station & Service on rival train operators. ODEG (a competing rail operator) argued that the charges—which were subject to regulation—were excessive and contrary to Article 102. The Court of Justice determined that (i) sector regulation does not displace competition law, (ii) the rail regulator must take Article 102 into account when regulating the railway charges, and (iii) Courts ruling on Article 102 must take regulation into account.[27]

Deutsche Telekom margin squeeze (Case 2003/707/EC)

The vertically integrated German fixed telecoms operator, Deutsche Telekom (DT), was required by the German telecoms regulator of the time, RegTP, to offer competitors wholesale access to its network and to set charges that were cost orientated. DT's retail prices were also subject to (loose) price regulation based on baskets of services.

The Commission found that, despite this regulation, DT had the commercial discretion which allowed it to set its (retail and/or wholesale) tariffs so as to squeeze the margins of wholesale access seekers, and chose to do so between 1998 and 2002. Given its dominant position in the relevant markets, this represented an anti-competitive margin squeeze under Article 102 (Article 82 at the time).[28]

Justin Le Patourel vs BT **(Case Number: 1381/7/7/21)**

This more recent UK case before the Competition Appeal Tribunal (CAT)[29] was concerned with whether BT abused its dominant position in the UK telecommunications market by imposing unfair (excessive) retail prices on customers purchasing standalone fixed telephony services.

The CAT ultimately dismissed the case, finding prices were not unfair in themselves or by comparison, in accordance with the *United Brands* test.

Source: Oxera.

2.2 Phase 2—less competition than expected? (Early–mid 2000s to 2010s)

By this time much of the initial privatisation agenda had already been implemented, and competition had emerged in some parts of the value chain across several sectors. However, the extent and durability of that competition often proved more limited than early proponents had anticipated. In some cases, competition developed only in narrower market segments than originally expected.[30] In others, the practical requirements of resilience, investment coordination, or public service delivery pushed policymakers back towards more interventionist arrangements.

Failures in individual sectors also played an important role in shaping this reassessment. The collapse of Railtrack in the UK, for example, became an important symbol of the limits of a particular form of privatised governance and reinforced the idea that some networks could not as easily be managed through the same regulatory and institutional logic as others.[31] The failure of British Energy in 2002 led to energy policy makers viewing the liberalised electricity market as being unable to deliver major new investments, particularly in non-fossil fuel technologies.[32]

The 2007 House of Lords report on the role of regulators noted that, over twenty years since the introduction of regulation, there was significant divergence between sectors in the scope and success of introducing competition. The House of Lords considered that the telecoms and energy sectors had made the most progress in introducing competition, the water sector the least (perhaps unsurprisingly given Littlechild's original prognosis for the sector),[33] with rail, post and airports falling between these two extremes.[34]

[27] Gerber, A. (2023), 'Overlap Between Article 102 TFEU and Sector Regulation: Case C-721/20 DB Station & Service v ODEG', Journal of European Competition Law & Practice, 14:2, 9 March, 98–100. Ronzano, A. (2023), 'Railways: The Court of Justice of the European Union rules that Article 30 of Directive 2001/14 does not preclude national courts from applying Article 102 TFEU provided that the sectoral monitoring body has ruled on the lawfulness of the fees in question and that those courts take account of the decisions handed down by that body (DB Station & Service/ ODEG)', Concurrences 1.
[28] European Commission (2003), Commission decision of 21 May 2003 relating to a proceeding under Article 82 of the EC Treaty (Case COMP/C-1/37.451, 37.578, 37.579, 21 May.
[29] https://www.catribunal.org.uk/sites/cat/files/2024-12/13817721%20Justin%20Le%20Patourel%20v%20BT%20Group%20PLC%20-%20Judgment%20%2019%20Dec%202024_0.pdf
[30] Florio (2013), 'Network Industries and Social Welfare', June.
[31] Crompton, G. and Jupe, R. (2003), '"Such a silly scheme": The privatisation of Britain's railways 1992–2002', Critical Perspectives on Accounting, Volume 14, Issue 6, pp. 617-645.
[32] Although this view was not universal, see Taylor, S. (2008), Nuclear Power and Deregulated Electricity Markets: Lessons from British Energy, University of Cambridge EPRG Working Paper 0808.
[33] Littlechild, S.C. (1986), Economic Regulation of Privatised Water Authorities, HMSO, London, para. 1.14, p. 2.
[34] House of Lords Select Committee on Regulators (2007), *UK Economic Regulators*, HL Paper 189, Session 2006–07, The Stationery Office, London, https://publications.parliament.uk/pa/ld200607/ldselect/ldrgltrs/189/18902.htm (last accessed 22 May 2026).

At the same time, the broader policy context was changing. Questions of decarbonisation, security of supply, affordability, and system resilience became more prominent—particularly in energy.

Over time, the changing policy context made it harder to rely on a simple model in which regulators focused primarily on efficiency and competition, while governments remained relatively distant from sectoral outcomes. As policy goals multiplied, the distinction between technical economic regulation and strategic direction from government became less clear-cut. This emerging lack of clarity—and the risks therein—was summarised within the 2007 House of Lords report on the role of regulators:[35]

It is also important that regulators' remits are not continuously expanded. We were told that there is a danger that regulators could become overloaded and unfocused as a result of ongoing extensions to their remits, often not related to their economic function but to social and environmental concerns. […] In particular, it was felt that government should be very careful in ensuring that it is not expanding the remits of regulators to avoid tackling politically sensitive issues itself. […] When the original privatisation statutes were put in place, the regulators' duties were more focussed than they are now on their economic roles of regulating monopolies, promoting competition and setting prices. […] there is now a less clear distinction between what policy issues should be dealt with by government and which by regulators. Such an expansion of duties, along with a lack of clarity about the respective roles of government and regulators, can arguably reduce the effectiveness of the regulator, create regulatory uncertainty and risk compromising the independence of the regulator.

In the UK, these pressures were especially visible in energy. Government intervention in the electricity sector increased significantly over this period, with both direct and indirect impacts on the sector regulator, Ofgem. As successive energy departments created and adapted subsidy schemes for renewable electricity generation, a growing share of the market for electricity generation became increasingly reliant on subsidies (through the Renewable Obligation (RO) scheme from 2002–17, the Feed-in-Tariff scheme from 2010–19 and the Contracts for Difference (CfD) scheme from 2014 to the present). In addition, the nature of subsidy support evolved over time—what started as technology agnostic subsidies for clean power generation up to 2009 became differentiated by technology, with the government setting different support levels for different generation types within the RO scheme from 2009—and continuing this differentiation by technology into the CfD auctions.[36]

Energy policymakers responded to changes in political and societal objectives, particularly following the Climate Change Act 2008, to deliver additional investment in non-fossil fuel generation. By 2011/12 the share of electricity generation receiving a government subsidy had risen to 10.26%,[37] growing to 42.8% by 2022–23.[38] In 2011, the Government's Electricity Market Reform White Paper set out a major set of policy interventions—including replacing the RO with the CfD regime, and introducing Capacity Markets to incentivise a new round of generation capacity expansion. Subsequent interventions would include introducing

[35] Ibid.
[36] Department for Energy, Security and Net Zero (2016), 'Contracts for Difference', November.
[37] Ofgem (2013), Renewables obligation: annual report 2011-12, footnote 20.
[38] Ofgem (2024), Renewables obligation: annual report 2022-23, figure 3.1.

price regulation for new nuclear generation capacity, price regulated and government-subsidised carbon capture and storage networks and a heavy reliance on a modified form of price regulation (cap and floor regimes) for new assets such as interconnectors and long duration electricity storage. The nationalisation of the electricity system operator (previously part of the transmission operator National Grid) and conferment of responsibility for system planning to a now public body was completed in October 2024—marking the evolution of a market that was described by Ofgem as 'the most competitive energy market in Europe' in 2007[39] to one that appeared more akin to the Central Electricity Generating Board in the 1960s.[40]

In 2017, Dieter Helm led a review on behalf of the UK energy department on the cost of energy. Helm's summary of the energy market captures the centrality of policy to how markets function:[41]

> The cost of energy is profoundly influenced by the detail of energy policy. There are multiple energy policy interventions across the full supply chain. These include taxes on inputs and outputs, VAT, and the tax treatment of investments and R&D. The planning system influences the type and timing of investments. Capacity auctions and feed-in tariffs (FiTs) and contracts for difference (CfDs) are determined by government. The government provides guarantees. The networks are regulated, and supply prices are subject to some explicit and lots of implicit controls. There is no 'free market' in electricity; nor will the industry ever approximate a free competitive market. Rather the challenge is to maximise competition within a policy framework. The cost of energy is determined by the interaction between markets and the state, and the challenge for energy policy is to get this mix right.

These have significantly changed the nature of the energy sector that Ofgem regulated—with direct impacts on some markets (such as wholesale generation) and significant indirect impacts on others (such as regulated electricity networks). Over the same period, increasing levels of concern emerged around the returns earned by price regulated energy networks over the RIIO-1 period (2013–21/2015–23).[42] This has been an enduring issue with the implementation of RPI-X in theory—the logical consequence of the model is that some firms will achieve persistent outperformance over the course of a regulatory period. Although this is desirable from the perspective of the economic framework—as it means firms are achieving efficiencies that can be passed on to consumers in future price reviews—it opens regulators up to intense political and public criticism and, where the response is to more closely regulate the returns made by utilities, it risks dampening investment incentives. Similar issues led Ofwat to re-open the first water price control 5

[39] House of Lords Select Committee on Regulators (2007), *UK Economic Regulators*, HL Paper 189, Session 2006–07, The Stationery Office, London, para. 7.4, https://publications.parliament.uk/pa/ld200607/ldselect/ldrgltrs/189/18902.htm (last accessed 22 May 2026).

[40] The Central Electricity Generating Board (CEGB) was a vertically integrated, state-owned statutory monopoly which operated from 1958-1990. It functioned as a vertically integrated, state-owned statutory monopoly responsible for all electricity generation and transmission in England and Wales, selling bulk electricity to twelve regional Area Boards for onward distribution to consumers. See: Domah, P. and Pollitt, M. G. (2000), 'The Restructuring and Privatisation of the Electricity Distribution and Supply Businesses in England and Wales: A Social Cost Benefit Analysis', July.

[41] Helm, D. (2017), *Cost of Energy Review*, independent review for the Department of Business, Energy and Industrial Strategy, October, https://assets.publishing.service.gov.uk/media/5a749c26ed915d0e8e39997a/Cost_of_Energy_Review.pdf (last accessed 22 May 2026).

[42] Ofgem (2018), 'Review of the RIIO framework and RIIO-1 performance', March, p. 5.

years early in 1999[43], and would play a significant role in Ofgem's re-calibration of its approach to regulation in the 2020s.[44]

In contrast to the energy sector, the water sector moved in the opposite direction. While the House of Lords report found the water sector to have delivered the least progress against competition by 2007, the early 2010s proved the catalyst for opening up competition in the business retail market, and moving towards a more 'outcomes based' model of regulation from PR14.[45] However, these fell far short of Ofwat's ambitions to expand competition to household retail, bioresources and water resources—and many of the regulatory changes would be later found to have contributed to adverse results in the 2025 Cunliffe review.[46]

It is notable that during this period, Ofwat's approach to regulating water companies appeared to be influenced by pressure from the UK government, resulting in downward pressure on investment, to the detriment of long term consumer and wider economic interests. The Independent Water Commission highlighted how Ofwat used the period of low interest rates since the financial crisis to put downward pressure on bills (rather than using this to finance new investment), and concluded that:

During Price Review 09, the messaging was around keeping bills low to help ease cost of living issues following the Global Financial Crisis. This came from both the government and Ofwat. This was followed up with action: for example, both government and the regulators rejected proposals for building new reservoirs. The rejection of new reservoirs continued into Price Review Price Review 14's Strategic Policy Statement also made it clear that bills should remain low. The headline message coming from Price Review 14 Final Determinations had a clear focus on bill levels…

… Overall, the Commission does see evidence that there was pressure from government and the regulator to keep bills low in Price Reviews between 2009 and 2024. It is difficult to say, with certainty, how much of the huge expansion of investment in Price Review 2024 could and should have been foreseen by government or the regulators, or how much companies were discouraged by both from bringing forward investment in line with a forward-looking interpretation of their licence responsibilities. But, while there also appears to have been a range of other factors at play during this period, the Commission believes that **government and regulator pressure on bills played an important role in what can now be seen as underinvestment over this period**.[47]

Telecoms regulation during this period also began to meaningfully diverge from traditional utilities regulation. The concept of the 'ladder of investment'[48]—whereby entrants are initially provided with regulated access to the incumbent's network near the retail level before being incentivised to move up the 'ladder' (value chain) to deploy more of their own network, while regulation of the lower rungs of the ladder is gradually removed—was popular in fixed telecoms regulation across Europe in this period, and led to interventions that created some (limited) investment in network infrastructure from competing networks

[43] Parliament UK website, 'Memorandum from the Office of Water Services (Ofwat)', accessed May 2026.
[44] Oxera (2021), 'RIIO-2 appeals: CMA Final Determination', November.
[45] Ofwat website, 'PR14: Final determinations', accessed May 2025.
[46] Independent Water Commission (2025), 'Final report', July.
[47] Independent Water Commission (2025), 'Final report', July, pp. 201-202
[48] Cave, M. (2006), 'Encouraging infrastructure competition via the ladder of investment', Telecommunications Policy, **30**:3-4, pp. 223-237.

across parts of the value chain, such as the unbundling of local loops. However, overall competitive outcomes were limited and, while the sector remained the clearest example of a competition-oriented regulatory framework, the interventions failed to provide the investment in end-to-end network competition that had initially been envisaged.[49]

During this period, the only material end-to-end competition in infrastructure provision in fixed telecoms came from historic cable operators (for example, NTL/Virgin Media in the UK and UPC/Ziggo in the Netherlands). Although these companies provided retail competition to the incumbent players, they did not provide wholesale competition for both technical and commercial reasons.[50]

In contrast, mobile telephony remained broadly unregulated throughout Europe (aside from wholesale mobile termination rates), reflecting regulators' views that the sector does not have natural monopoly characteristics. In fact, throughout this period, telecoms regulators and competition authorities were focused on promoting competitive entry from mobile network operators through the structuring of mobile spectrum auctions—for example, by reserving key spectrum allocations for entrant firms.[51] This coincided with significant investment in mobile telecoms networks (alongside spectrum investments).

Overall, this period can be characterised as one of partial revision of regulators' approach to regulation rather than wholesale reversal, driven by the introduction of multiple policy goals, such as decarbonisation, resilience and affordability. The competition-and-regulation model was not abandoned, but it became harder to sustain the idea that competition would steadily displace regulation as a means of achieving investment outcomes alongside competing policy objectives, or that regulators could remain largely insulated from wider strategic and political objectives. In some cases, these additional policy objectives competed for focus with investment goals since, for example, a focus on affordability could reduce the scope for regulated firms to invest in their networks. Experience also suggested that some infrastructure sectors may be more politically sensitive and dependent on coordination with other parts of government than had been assumed in the initial phase of privatisation.

2.3 Phase 3—where we are today (late 2010s–2020s)

The current phase is more difficult to describe through a single unifying consensus. If anything, the defining feature of the present moment is that the earlier settlement has become even more fragmented. In the UK, for example, Ofcom has in many respects remained more committed to a 'competition first' approach,[52] whereas Ofgem and the UK government appear to have moved more clearly towards a model involving greater

[49] Oxera (2008), Set free by competition? Transitional access regulation of telecoms incumbents, February, (last accessed 25 May).
[50] BEREC (2010), Next generation access - implementation issue and wholesale products, March, footnote 20.
[51] For example, the 2000 3G auction in the UK reserved spectrum in the 2100MHz band for a new entrant. This was acquired by Three who entered the market as an aggressive competitor to the other mobile operators.
[52] Oxera (2015), 'Competition policy and regulation in converging telecoms and media markets: how can they work together?', July.

regulatory direction, more active system planning, and a stronger role for government in shaping outcomes.[53]

This shift reflects several overlapping developments. First, there is now widespread recognition that many infrastructure sectors require very large-scale investment over sustained periods, and a view that this investment is in pursuit of objectives that markets will not reliably deliver on their own. Water networks in both the UK and elsewhere in Europe require substantial renewal and upgrading.[54] Energy systems face the very large capital demands associated with decarbonisation, electrification, network reinforcement, and new forms of system balancing.[55] AI is requiring significant investment in data centres, with associated impacts on demand for other infrastructure, such as energy and water.[56] Telecoms networks across Europe face growing demand for high speed services and require large investments in network upgrades required to meet this demand. Given this context, the earlier view that the state could mainly set the rules and then step back to allow the market to deliver the infrastructure investment needed looks increasingly difficult to maintain.

Second, political intervention in regulation has become more visible. In the UK in particular, governments have placed more explicit pressure on regulators to support growth, facilitate investment, and respond to concerns over household bills,[57] while contemporaneously pushing for a 'reduced regulatory burden'.[58] This does not necessarily amount to a rejection of the ability of independent regulation to promote infrastructure investment, but it does indicate that the political system is less willing to treat regulatory bodies as fully insulated from wider distributional and strategic choices. In practice, this may mean a narrowing of the space for a purely technocratic model of regulation, especially in sectors where outcomes are highly salient to voters and are closely linked to national economic strategy.

Elsewhere in Europe, the French government intervened in the energy sector to fully nationalise EDF over concerns with finances at the energy company, and to shore up investment in domestic energy supplies,[59] while in the broader EU energy market, the Commission has moved from a position of enhanced competition through the Third Energy Package (which stipulated the separation of energy companies' generation and sales operations from their transmission networks and strengthened consumer protection rules)[60], to the introduction of further policy objectives, for example through its focus on

[53] Department for Energy, Security & Net Zero (2026), 'Ofgem Review: final report', April.
[54] Department for Environment, Food & Rural Affairs (2026), 'A new vision for water', February. WAREG – European Water Regulators (2025) *4th European Forum on the Regulation of Water Services: EFRWS25 Summary*. Brussels, 4 December 2025. See: WAREG website, 'EFRWS25 Summary', accessed May 2026.
[55] International Energy Agency (IEA), 'World Energy Outlook 2025', pp. 78-85.
[56] Environmental and Energy Study Institute (2025), 'Data centers and water consumption', 25 June, (last accessed 24 May).
[57] Financial Times (2025), 'Rachel Reeves steps up pressure on UK regulators to scrap anti-growth rules', January.
[58] See HM Treasury (2025), 'New approach to ensure regulators and regulation support growth', 22 October (last accessed 24 May).
[59] National Assembly (2024), 'Bill aimed at nationalizing the Electricite de France group', (last accessed 24 May). The Guardian (2022), 'France to pay nearly €10bn to fully nationalise EDF', 19 July (last accessed 24 May).
[60] European Commission (2011), 'Questions and answers on the third legislative package for an internal EU gas and electricity market', 2 March (last accessed 24 May).

strategic autonomy in its post-COVID industrial strategy and prioritising price stability, resilience and decarbonisation in electricity market reform.[61] These developments potentially risk investment outcomes, as ensuring compliance with additional regulations (and policy objectives) risk reducing companies' focus on, and ability to sustain, high levels of infrastructure investment.

However, there are some advocates for moving in the opposite direction, away from greater and more intrusive regulation. For example, the Draghi report recommends a focus on competition and competition policy to drive growth in the EU:[62]

> Evidence that industrial policies can be effective under certain circumstances is growing. But to avoid the pitfalls of the past – such as defending incumbent companies or picking winners – these policies must be organised according to a set of key principles which embed best practice. Among others, the focus of such policies should be on sectors rather than companies; public support should be continuously evaluated, underpinned by a rigorous monitoring exercise; and market failures should be clearly specified and public authorities should avoid duplicating what the private sector would already do. The interaction with competition authorities is also critical for success. For priority sectors, the EU should aim as far as possible to be competitively neutral and **regulation should be designed to facilitate market entry. The evidence is overwhelming that competition stimulates productivity, investment and innovation**.

Third, public trust in regulated utilities appears to have weakened, at least in some sectors and perhaps especially in the UK.[63] Concerns about service quality, environmental performance, affordability, and perceived excess returns have all contributed to a less stable public consensus around the legitimacy of the existing model. This matters because the durability of the post-privatisation settlement depended not only on efficiency arguments, but also on a broader belief that private provision under regulation would produce acceptable public outcomes. Where that belief weakens, pressure grows either for tougher regulation or for more fundamental institutional change, including renationalisation.[64]

2.4 Summary

The discussion above illustrates that over the past 30 years, the approach to regulation across different sectors and European countries has evolved considerably: broadly-

[61] European Commission (2020), 'A New Industrial Strategy for Europe', 10 March (last accessed 24 May) and European Union (2024), 'Directive 2024/1711 of the European Parliament and of the Council of 13 June 2024 amending Directives (EU) 2018/2001 and (EU) 2019/944 as regards improving the Union's electricity market design' 26 June (last accessed 24 May).
[62] Draghi, M. (2024), The future of European competitiveness, September (last accessed 24 May). [Emphasis added].
[63] National Audit Office (2025), 'Regulators have failed to deliver a trusted and resilient water sector', April.
[64] Various polls indicate that (i) the majority of UK citizens are consistently in favour of train operating companies being nationalised (prior to nationalisation occurring under the 2024 Passenger Railway Services (Public Ownership) Act 2024)—see https://yougov.com/en-gb/trackers/should-train-operating-companise-be-brought-back-into-public-ownership, (ii) the proportion of UK citizens strongly supporting the nationalisation of energy companies has increased from 23% in Aug 2019 to 35% in March 2026—see https://yougov.com/en-gb/trackers/support-for-bringing-energy-companies-back-into-public-ownership, and (iii) the proportion of UK citizens supporting the nationalisation of water companies has increased from 59% in May 2017 to 82% in June 2024—see YouGov (2024), 'YouGov Survey Results', June.

speaking from initial privatisation—where expectations regarding the scope for de-regulation and eventually competition were high—to a consensus that the degree of competition anticipated had in fact failed to materialise, to a mixture of different regulatory designs today. At the core of this evolution has often been the objective of policymakers to design a regulatory framework that most effectively promotes infrastructure investment, whether by initial privatisations, incentive regulation (as a conduit to eventual competition), rate of return regulation, directly promoting competition, or government subsidy. There have been mixed results along the way and—at times—legitimate but competing objectives (e.g. focusing on affordability) are likely to have had the opposite effect of dampening investment levels.

Policymakers are still grappling today with how they can best incentivise infrastructure investment, in a manner that is both consistent with achieving wider policy outcomes and economic growth. In different sectors and contexts we see that both regulatory approaches and outcomes are diverging, and there are differing views on the degree of regulatory intervention required in each sector.

In the following section, we explore four case studies which highlight how different regulatory approaches in different sectors and geographies have sought to deliver higher levels of infrastructure investment, while also aligning with wider public policy priorities.

3 Recent challenges in infrastructure regulation—four case studies

3.1 Introduction

The last section of our report provided a high level overview of some of the major developments to infrastructure regulation following the privatisations of the 1980s. This helps to illustrate the broad shifts which have taken place in recent decades, and how these changes have been driven by a combination of sector specific challenges (e.g. the drive for net zero), evolving political priorities (e.g. a focus on affordability pressures) and shifts in the institutional consensus regarding the optimal forms of regulation for different sectors. Across sectors there has been a trend towards rising need for new investment, raising questions as to whether regulation (and the balance between regulation and competition) has evolved in a manner conducive to ensuring this investment.

We now build on the history outlined in section 2 by examining the following four relatively recent case studies in detail.

1. **Incentivising full fibre broadband roll-out**. This explores Ofcom's approach to facilitating the roll-out of full fibre networks through regulatory changes designed to encourage competition from alternative network providers.

2. **Scaling up investment in electricity transmission**. This explores how Ofgem has re-prioritised competing policy objectives to facilitate expansion of the electricity transmission network in Great Britain.

3. **Building hydrogen networks**. This examines how the German utility regulator BNetzA evolved its approach to price regulation to unlock construction of the first hydrogen network across Germany.

4. **Connecting data centres**. Finally, this case study examines recent findings from the US, which indicate that States characterised by vertically integrated electricity utilities appear to be outperforming States with vertically separated electricity markets in connecting new data centre capacity to the electricity grid.

These case studies highlight how specific challenges facing regulators operating across distinct sectoral contexts and jurisdictions have led to adaptations in regulatory approaches and (in the fourth case study), how different approaches to market design appear to have impacted wider economic outcomes in a potentially significant manner. The insights from these case studies are used to draw out broad implications for policymakers, which we discuss in section 4.

3.2 Case study 1: delivering full fibre roll-out through introducing competition in the UK telecoms market

3.2.1 Overarching policy and context

Historically, the focus of fixed telecoms regulation in the UK (consistent with other countries) has been to:

- protect internet service providers (or ISPs—i.e. retail broadband providers which do not own their own network such as Sky and TalkTalk), from the incumbent wholesale provider, Openreach, from setting excessive wholesale access prices; and,
- incentivise Openreach to invest in its network when the need has arisen.

This approach changed significantly around 2018, when Ofcom identified that the UK was falling behind other countries in the roll-out of the new full fibre (or 'FTTH/fibre to the home') technology. Ofcom took the view that it would seek to incentivise investment in UK FTTH networks by promoting infrastructure investment from potential competitors (e.g. CityFibre and Hyperoptic), rather than solely Openreach.[65]

3.2.2 Implications for regulation

Ofcom introduced a suite of regulatory remedies (across 2018, 2021 and 2026) to operationalise its strategy. These included the following.

- **Moving cost-reflective regulation upstream** to Openreach's duct and poles, effectively lowering the barriers to entry for possible infrastructure competitors who could use regulated access to these assets to deploy their own networks.[66]
- **Imposing geographically-targeted remedies** at the wholesale access level of the value chain (where price regulation had previously been focused). In geographies where Ofcom assessed that there was prospective competition from alternative networks, it loosened wholesale access price regulation to give the entrants which were deploying their own infrastructure headroom to recover the cost of their investments. This ensured that if they wanted to offer wholesale access to ISPs themselves, the entrants were not squeezed by low regulated access prices (which they would have to compete with for access customers). This represented a trade-off between the potential risk of (short-term) price increases and incentives for alternative operators to build their own networks.[67]
- **Introducing new regulation of the commercial terms** charged by Openreach to its customers, to restrict its ability to foreclose entry to potential

[65] Ofcom (2018), Wholesale Local Access Market Review: Statement - Volume 1, 28 March, 1.13-1.15.
[66] Ibid, 1.17.
[67] Ofcom (2021), Promoting competition and investment in fibre networks: Wholesale Fixed Telecoms Market Review 2021-26, 18 March, 2.46-2.48.

alternative networks (by preventing them from winning wholesale customers). This includes a prohibition of Openreach targeting wholesale access discounts by geography.[68]

Given the long-term nature of investments in telecoms infrastructure, Ofcom also indicated that it would seek to retain this strategy for multiple market review periods (i.e. at least 10 years), and would only amend its approach if there were material changes within the market that warranted changes in its approach.[69] In practice, it has now implemented the strategy across three market reviews (2018, 2021 and 2026), and has indicated in its most recent decision that this approach to regulation will persist.

3.2.3 Insights from case study

Ofcom's shift in regulatory approach in 2018 took place in the context of a significant technological shift. Whereas previous technological iterations of residential broadband in the UK were effectively incremental upgrades to the historic copper-based phone network (with only parts of that network gradually being replaced with fibre), the shift to full fibre networks was significant, since it required a substantial investment to replace the final connection from the broadband network into the customer premises with a fibre cable (known as the 'local loop').

In 2018, the UK was falling behind other countries in the deployment of FTTH networks, so Ofcom took a policy decision to promote greater investment in the technology.[70]

Despite its policy objectives for fibre roll-out, Ofcom determined that Openreach did not have the incentives to undertake this investment, since: (i) it had only recently invested in upgrading its network to the precursor technology (FTTC/'fibre to the cabinet'); (ii) end customers were broadly content that the capabilities offered by FTTC met their requirements, and (iii) it was under no competitive pressure to move quickly to invest in FTTH. Ofcom therefore deemed it necessary to consider alternative options.

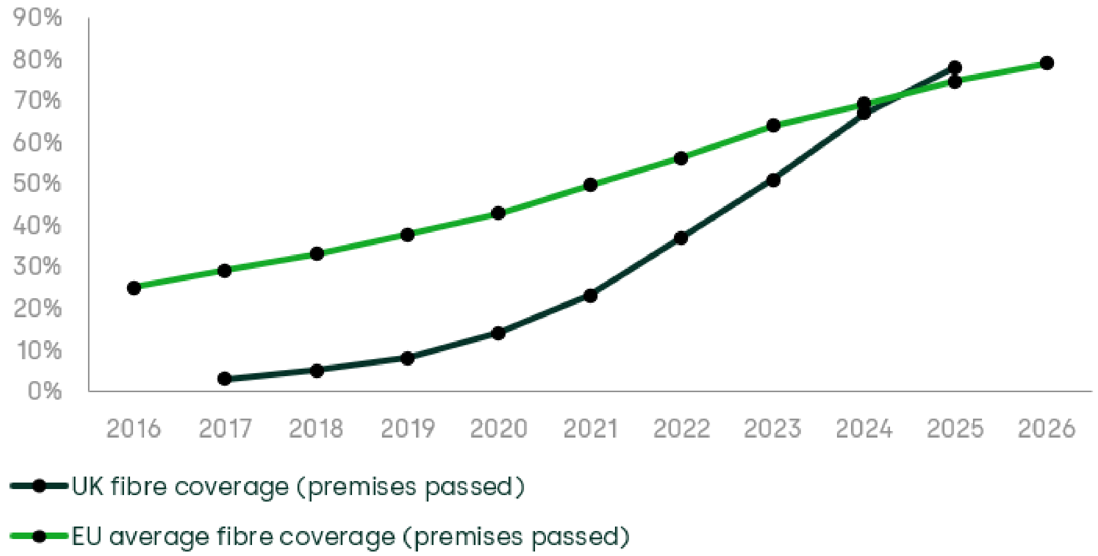
As we set out above, the set of regulatory interventions imposed by Ofcom were intended to promote competitive entry from network providers, who would both build telecoms infrastructure themselves, and provoke a competitive response from Openreach. In undertaking this intervention, Ofcom explicitly traded off the risk of short term wholesale price increases from Openreach (as a result of strict cost-based price controls being eased) against prospective increases in infrastructure investment and the expectation that in the medium- to long-term, prices would fall again as a result of the competition introduced into the market.

It is generally accepted that Ofcom's regulation has been successful in promoting investment in UK fibre telecoms networks. Ofcom reports that there are now over 100

[68] Ofcom (2021), Promoting competition and investment in fibre networks: Wholesale Fixed Telecoms Market Review 2021-26: Volume 3, non-pricing remedies, 18 March, section 7.
[69] Ofcom (2018), Wholesale Local Access Market Review: Statement - Volume 1, 28 March, 1.44-1.48.
[70] Ibid, section 1.

competing fibre networks of varying sizes in the UK[71] and there has been a significant increase in the number of households that have access to full fibre broadband in the UK—increasing from 3% of UK households in 2017[72] to 78% in 2025, and catching up with comparator countries over that period, as depicted in Figure 3.1.[73]

Figure 3.1 UK and average EU fibre broadband coverage (premises passed, 2016–26)



Source: Oxera analysis of Ofcom Connected Nations reports 2018 to 2025, Eurostat Broadband internet coverage by technology, and FTTH Council Europe (2025), European FTTH/B market panorama 2025

This increase in fibre coverage represents an investment in a technology that increases the performance of consumers' broadband networks, leading to faster download and upload speeds. Given the link between faster broadband speeds and economic growth found in academic literature,[74] we could reasonably expect that this increase in FTTH coverage has been beneficial to economic growth in the UK.

Although outcomes in the UK—and similar roll-outs elsewhere in Europe—have demonstrated that fixed telecoms is not a natural monopoly, there are still significant fixed costs involved in constructing telecoms networks and a widely-accepted minimum efficient scale. Broadband networks estimate that they need to connect approximately

[71] Ofcom (2026), Promoting competition and investment in fibre networks: Telecoms Access Review 2026-31, 17 March, para. 2.35.
[72] Ofcom (2018), Wholesale Local Access Market Review: Statement - Volume 1, 28 March, 1.18.
[73] Ofcom (2026), Promoting competition and investment in fibre networks: Telecoms Access Review 2026-31, 17 March, Table 1.
[74] See Koutroumpis (2018), 'The economic impact of broadband: evidence from OECD countries,' April (last accessed 7 May).

30% of customers within an area to remain commercially viable in the long run.[75] The question therefore for Ofcom and industry now is whether these outcomes—a market characterised by over 100 networks, some of which 'overbuild' each other, and with declining retail prices[76]—are sustainable. Indeed, Ofcom has recognised that fibre roll-out has been more 'fragmented' (i.e. undertaken by a larger number of smaller operators) than it previously anticipated[77] and we have already observed consolidation in the market, including the recently announced £2bn acquisition of Netomnia by nexfibre.[78]

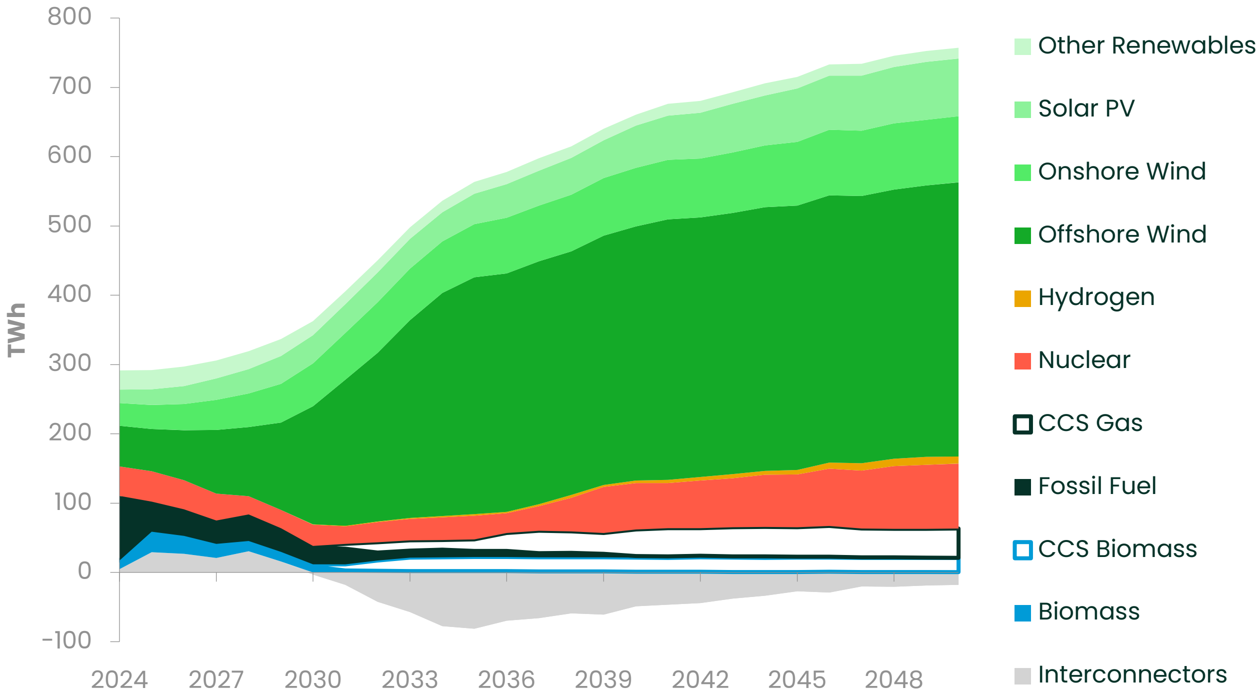
3.3 Case study 2: pricing regulation—adapting the regulatory framework for GB electricity transmission operators

3.3.1 Overarching policy and sectoral context

The energy system operator for GB (NESO), is projecting a significant increase in the amount of electricity consumed and significant changes in how that electricity is generated by 2050. Figure sets out the total change in electricity supplied, broken down into constituent generation types. It can be seen that—according to NESO forecasts—between 2024 and 2030 the proportion of electricity generated through gas is projected to reduce by c. 70%, while the amount of electricity produced by wind and solar is projected to increase by 250% over the same time period. Wind and solar together are projected to constitute 75% of the total generation mix by 2030.[79]

[75] See Light Reading (2024), Netomnia spies chance to dethrone CityFibre as primo UK 'altnet' (last accessed 21 May)
[76] Ofcom (2026), Promoting competition and investment in fibre networks: Telecoms Access Review 2026-31, Figure 2.1 and 2.2.
[77] Ofcom (2026), Promoting competition and investment in fibre networks: Telecoms Access Review 2026-31, para 2.35.
[78] Virgin Media O2 (2026), InfraVia, Liberty Global and Telefonica acquire Substantial Group for £2 billion through their existing joint venture, nexfibre, 18 February (last accessed 18 May).
[79] The credibility of NESO's forecasts has been the subject of public debate, with concerns raised regarding the affordability and intermittency challenges associated with high renewables penetration. See UK Parliament (2025), 'Net-zero Emissions Target: Affordability', Volume 845: debated on Thursday 3 April 2025.

Figure 3.2 NESO projections of GB electricity supplied, by source (2024–50)



Source: https://www.neso.energy/document/364541/download.

This has significant implications for the quantity of electricity transmission infrastructure—both to accommodate the increase in load and to facilitate connecting to new sources of clean generation further away from urban centres. As a consequence, the electricity grid requires significant expansion to ensure that electricity can be supplied to the rest of the economy. A failure to sufficiently build out the grid at pace will lead to:

- **delayed electrification**, as current households, new developments and businesses face longer queues to connect; and
- **higher unit electricity prices**, as relatively fixed generation costs (contracts for difference, nuclear RAB) are spread over a smaller base of demand—and as constraint costs[80] rise and are passed on to customers through higher bills.

Taken together, these impacts will tend to reduce economic growth, as delays to access and higher prices supress economic activity. Delays to grid expansion will also lead to increased carbon emissions, as greater quantities of gas generation are called upon to offset curtailed renewable generation.

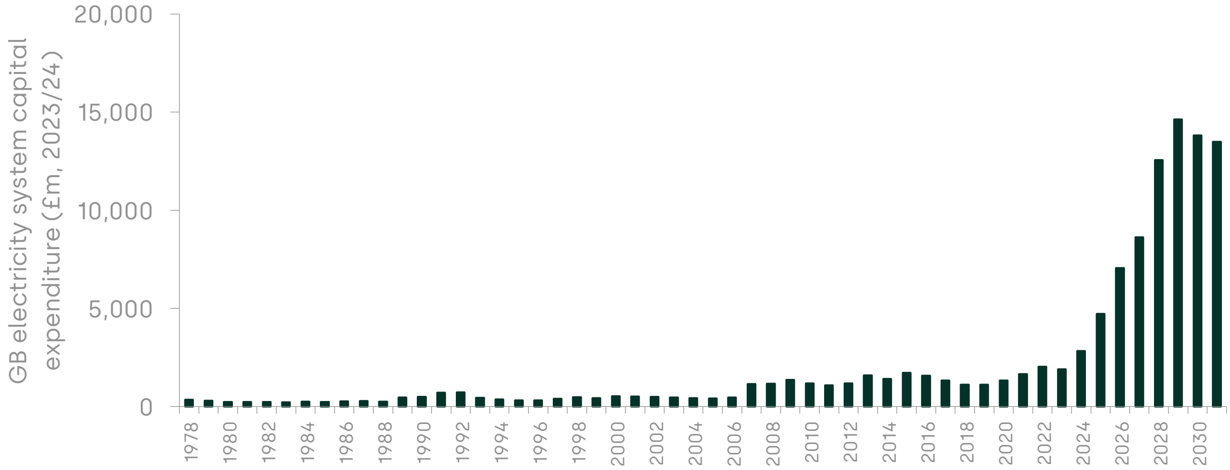
[80] The cost associated with managing physical constraints on the network—in particular paying generators to vary their output to ensure that physical limits in the power that can be transported are not breached. https://www.neso.energy/energy-101/electricity-explained/how-do-we-balance-grid/what-are-constraints-payments.

To focus on one specific benefit of expanding transmission infrastructure output, constraint costs provide a rare empirical window onto the economic cost of delivering infrastructure below its optimal level. Constraint costs arise when the transmission network cannot move electricity from where it is generated to where it is consumed, such that the system operator must pay generators to reduce output in constrained areas and increase output elsewhere—costs that are ultimately passed through to consumers. These costs are significant: constraint costs totalled £2.7bn in 2024/25, and are forecast to reach up to £8bn annually by 2030 in the absence of transmission expansion.[81] This highlights a key form of downstream economic harm driven by network underinvestment.

3.3.2 Implications for regulation

In its role as economic regulator of the electricity transmission network, Ofgem's regime for RIIO-ET3[82] is critical to facilitate the expansion of the transmission network required to support the wider economy. The scale of new transmission investment planned to facilitate expansion of the clean power grid is set out in the figure below.

Figure 3.3 Transmission capital expenditure (CAPEX), £m 1978–2031



Source: Oxera analysis of transmission company capital expenditure.

This figure demonstrates how policy imperatives (including decarbonisation of the energy grid) and technological changes (including broader economy wide electrification), are driving a greater need for capital investment in the electricity transmission network.

[81] https://www.neso.energy/document/362561/download
[82] RIIO-ET3 refers to the price controls applicable to GB Transmission networks, which run from 1 April 2026 to 31 March 2031.

To facilitate this expansion in network capacity, Ofgem has recalibrated its regulatory regime for electricity transmission—moving away from RPI-X regulation and towards the stronger investment protection characteristic of rate of return regulation. This has taken the form of weaker cost-efficiency incentives, lower sharing rates,[83] and expanded uncertainty mechanisms that de-risk large capital programmes. The direction of travel is clear: the regime has been recalibrated to prioritise investment delivery over productive efficiency, reflecting the current economic reality that the need for large volumes of new transmission infrastructure to be delivered at pace exceeds the benefits of strong incentives to deliver any given investment at the lowest possible cost.

These changes should not be overstated—Ofgem's regime still subjects transmission operators' business plans to scrutiny and efficiency incentives remain, and available evidence from RIIO-T1 and RIIO-T2 suggests that efficiency scores have not exhibited a clear deteriorating trend across a period in which incentive power has reduced.[84] However, it does demonstrate a clear example of regulation adapting to meet the wider needs of the economy through promoting infrastructure expansion at the cost of reduced efficiency incentives within the infrastructure sectors.

Ofgem argued that the benefits of these changes (along with its wider price control decisions) included:

- lower net electricity bills, due to offsetting savings in wholesale generation and constraint costs;
- strategic benefits associated with the transition towards net zero, such as security of supply and avoiding inherent volatility of global energy markets;
- the contribution of network build to support the move to a clean power system, thus reducing the amount of carbon emissions from the generation of electricity; and
- the impact of higher activity in the electricity transmission sector on economic growth.[85]

3.3.3 Insights from case study

The shift in Ofgem's move away from more 'purist' RPI-X regulation towards a more rate of return style framework was driven by the need to deliver a step change in electricity transmission investment over a relatively short period of time. This need, in turn, was driven by a combination of i) over-arching policy priorities (including decarbonising the electricity grid) and ii) a wider shift in the needs of the economy, given increasing electrification.

[83] 'Sharing rates' refers to the amount of cost overruns which is actually borne by a regulated company (as opposed to passed on to customers through higher tariffs). Lower sharing rates means companies bear a smaller proportion of any cost overrun (and retain a smaller proportion of any cost savings).
[84] Under Ofgem's RIIO-T3 price controls, transmission companies still bear 25% of any cost overruns (and conversely retain 25% of any cost savings) up to 5% of their overall cost allowances. The sharing rate is gradually reduced thereafter, such that companies' incremental exposure to cost risk is gradually reduced. See: Ofgem (2025), 'RIIO-3 Final Determinations – Electricity Transmission', December, p. 200.
[85] These points were highlighted in Ofgem's impact assessment of the RIIO-3 framework: see Ofgem (2025), 'RIIO-3 Draft Determinations Impact Assessment', July.

Ofgem's shift in approach reflected a change in how it balanced two competing objectives—namely:

1 a desire to incentivise efficiency among transmission companies; vs
2 the need to unlock an unprecedented step-change in capital investment in a relatively short timeframe.

In essence, the change in approach reflected a view that the risk of inefficient costs being passed on to consumers was—at the margin—outweighed by the risk of delays to network expansion. In light of this, the regulatory adaptations implemented were perhaps unsurprising.

It is notable how this evolution in the regulatory regime sits alongside the broader shift in energy regulation highlighted in section 2. The unprecedented increase in CAPEX transmission companies now plan—and indeed have been funded—to deliver can be traced back to the forecasts of the energy generation mix outlined by NESO: a government owned company. Those forecasts, in turn, have been significantly influenced by direct interventions from the UK government in energy generation. As such—although the networks remain in private ownership—the specific investments which privately owned transmission networks make are increasingly being determined through decisions ultimately taken by central government.

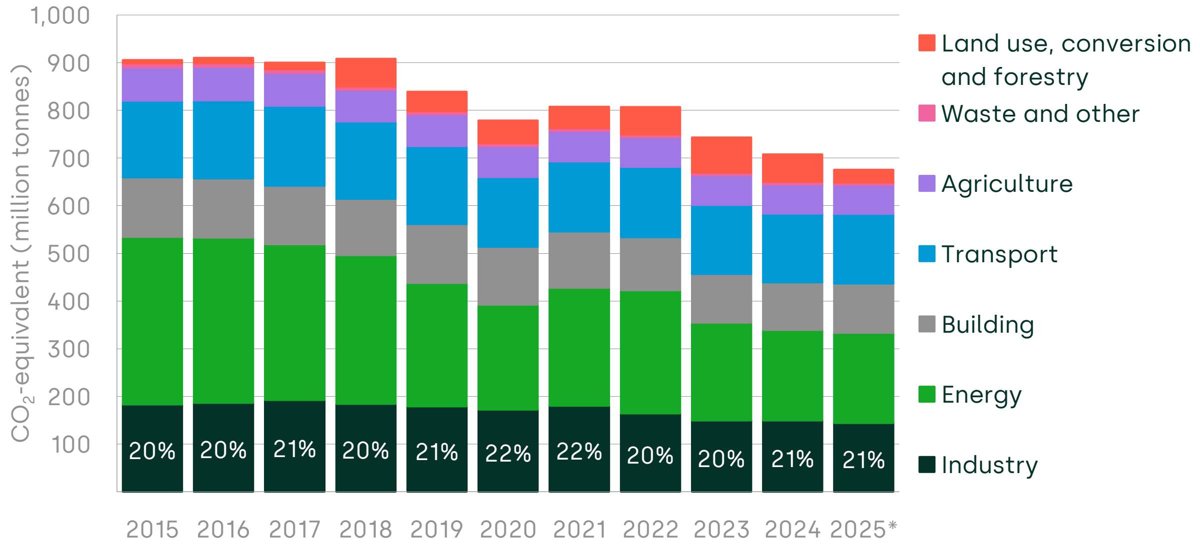
3.4 Case study 3: pricing regulation—promoting growth of hydrogen networks in Germany

3.4.1 Overarching policy and sectoral context

Industry has historically played an important role for the German economy, accounting for about a quarter of total gross value added in 2025.[86] In 2021 (i.e. before the Russian invasion of Ukraine), industry accounted for 29% of overall energy consumption in Germany, of which around one third was based on natural gas. Industry relies on natural gas for process heat, on-site electricity generation, and its use as a feedstock. Electricity, petroleum products and coal also play an important role in industrial production.[87] Given this reliance on fossil energy sources, the industry sector is also one of the major contributors to Germany's greenhouse gas emissions. Figure 3.4 shows the development of Germany's greenhouse gas emissions by sector.

[86] Statista (2026), 'Verteilung der Bruttowertschöpfung in Deutschland nach Wirtschaftsbereichen im Jahr 2025', available at: https://de.statista.com/statistik/daten/studie/36846/umfrage/anteil-der-wirtschaftsbereiche-am-bruttoinlandsprodukt/ (last accessed 21 May 2026).
[87] Destatis (2026), 'Bedeutung der energieintensiven Industriezweige in Deutschland', available at: https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Industrie-Verarbeitendes-Gewerbe/produktionsindex-energieintensive-branchen.html (last accessed 21 May 2026).

Figure 3.4 The share of greenhouse gas emissions from industry has been relatively stable at around 20% over the past ten years

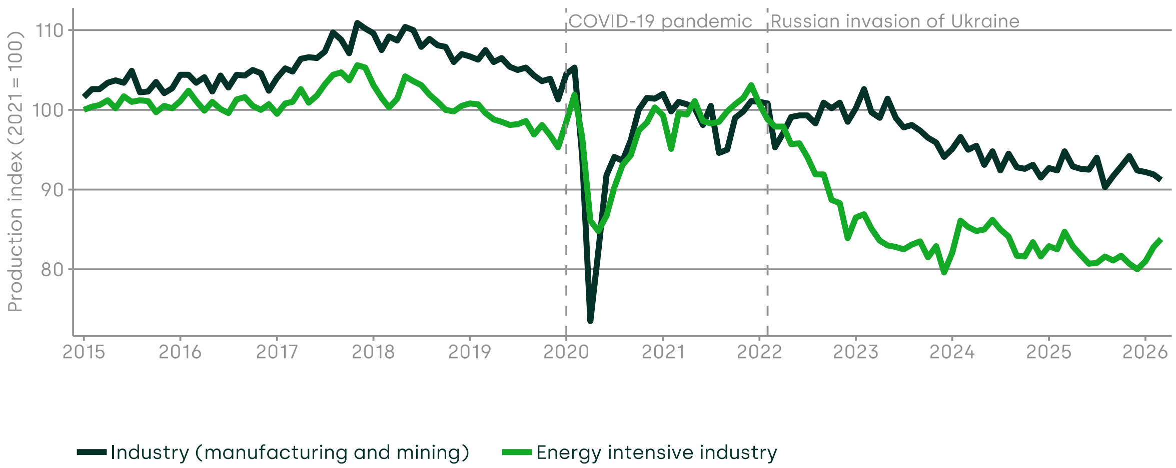


Note: Yearly greenhouse gas emissions (million tonnes of CO_2e) in Germany by sector of the German Climate Protection Act (KSG). Percentage labels indicate the yearly share of greenhouse gas emissions by the industry sector in the overall yearly emissions in Germany.
* Values for 2025 are preliminary.
Source: Umweltbundesamt, May 2026.

While absolute emissions from the industry sector have decreased from 183m tonnes to 144m tonnes of CO_2 equivalent since the Russian invasion of Ukraine in 2022, this decline coincides with—and is likely at least in part driven by—a sharp increase in energy prices which has caused a fall in production, particularly noticeable in the energy intensive sectors (see Figure 3.5 below).[88]

[88] Destatis (2026), 'Bedeutung der energieintensiven Industriezweige in Deutschland', available at: https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Industrie-Verarbeitendes-Gewerbe/produktionsindex-energieintensive-branchen.html (last accessed 21 May 2026).

Figure 3.5 Industrial production in Germany has almost continuously declined since the Russian invasion of Ukraine in 2022



Note: The production index for energy-intensive industries is calculated as a weighted average of the industrial production indices for the relevant economic sectors (chemical products; metal production and processing; glass, ceramics, and the processing of stone and earth; paper, paperboard and related products; coking and petroleum processing). The weights correspond to the relative gross value added at factor cost in the base year 2021.
Source: Oxera based on Destatis (2026), 'Bedeutung der energieintensiven Industriezweige in Deutschland', available at: https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Industrie-Verarbeitendes-Gewerbe/produktionsindex-energieintensive-branchen.html (last accessed 21 May 2026).

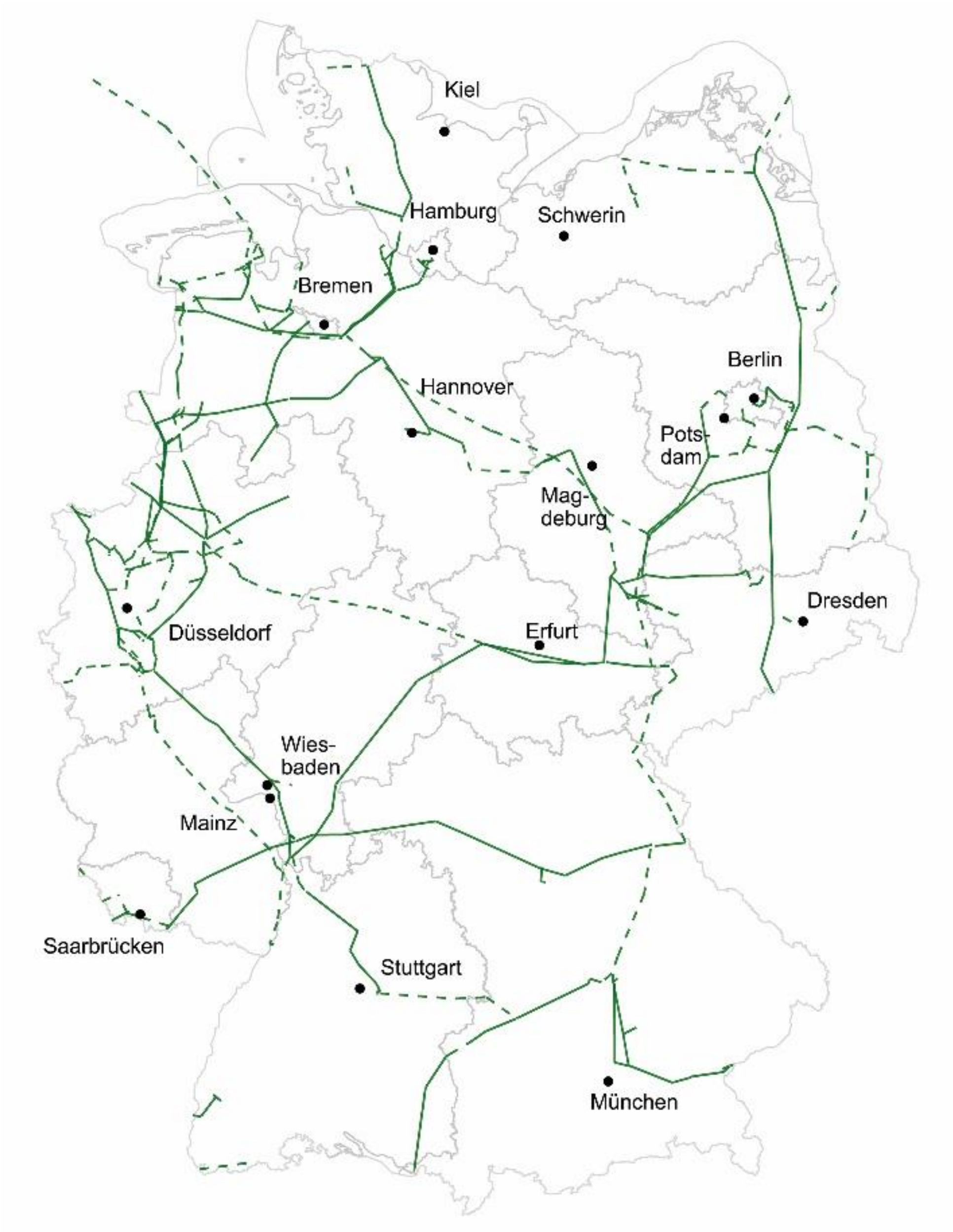
Despite this decline in the level of industry emissions, the share of industry emissions in total emissions has remained relatively stable at around 20% over the past ten years (see Figure 3.4). Decarbonising industry—especially energy-intensive sectors such as chemicals and metals, which together accounted for more than three quarters of total industrial energy use in 202[89]—therefore remains a serious challenge for policymakers seeking to meet the country's climate neutrality target by 2045.[90]

Against this wider backdrop, hydrogen has emerged as a central part of Germany's response to the decarbonisation challenge. The Federal Government's National Hydrogen Strategy places hydrogen at the heart of efforts to decarbonise industrial processes that cannot easily be electrified.[91] A key pillar of that strategy is the development of a 'hydrogen

[89] Destatis (2026), 'Bedeutung der energieintensiven Industriezweige in Deutschland', available at: https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Industrie-Verarbeitendes-Gewerbe/produktionsindex-energieintensive-branchen.html (last accessed 21 May 2026).
[90] Umweltbundesamt (2026), 'Treibhausgasminderungsziele Deutschlands', available at: https://www.umweltbundesamt.de/daten/klima/treibhausgasminderungsziele-deutschlands (last accessed 21 May 2026).
[91] Bundesministerium für Wirtschaft und Klimaschutz (2023), 'Fortschreibung der Nationalen Wasserstoffstrategie', July, p.19, available at: https://www.bundeswirtschaftsministerium.de/Redaktion/DE/Wasserstoff/Downloads/Fortschreibung.pdf?__blob=publicationFile&v=1 (last accessed 21 May 2026).

core' network—a planned 9,040 km pipeline system, to be built and operational by 2032, connecting production sites with major industrial consumption centres and forming part of Europe's broader hydrogen infrastructure (see Figure 3.6 for a map of the planned network).[92]

Figure 3.6 Germany's approved hydrogen core network



92 KfW (2025), 'Wasserstoff-Kernnetz', available at: https://www.kfw.de/%C3%9Cber-die-KfW/Newsroom/Aktuelles/Wasserstoff-Kernnetz.html (last accessed 21 May 2026).

Note: Approved network as at 22 October 2024. Solid lines indicate existing gas infrastructure that is to be repurposed for hydrogen. Dotted lines indicate dedicated new build.
Source: Bundesnetzagentur (2024), 'Wasserstoff-Kernnetz', available at: https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/Wasserstoff/Kernnetz/start.html (last accessed 22 May 2026).

The hydrogen core network is expected to comprise around 60% repurposed gas pipelines and 40% new build, with total investment costs estimated at €18.9bn.[93] It is to be built and operated by the private sector (gas transmission network operators), with costs ultimately recovered through network charges paid by hydrogen users.[94]

3.4.2 Implications for regulation

The proposed plan, however, faces two structural challenges in the ramp-up phase.

- **Investment risk**—first, both supply and demand for hydrogen remain uncertain: the market is nascent, and neither producers nor consumers can be confident about future volumes or prices, which creates considerable market risk. Additional investment risks arise from regulatory and policy uncertainty, as well as construction risks intrinsic to large-scale infrastructure projects and operational risks stemming from the technical challenges of hydrogen transport, including the need to prevent leakage and comply with stringent safety protocols.
- **Narrow and uncertain customer base**—second, the number of initial users will be small, making it difficult for grid operators to recover infrastructure costs without charging prohibitively high rates to customers.

Taken together, these factors give rise to what might be described as a 'chicken-and-egg' problem: network developers are reluctant to invest given the small and uncertain customer base, while potential customers are reluctant to switch to hydrogen given uncertainty over future supply. Without intervention, neither side moves first.

To overcome this coordination problem, the government has set up an intertemporal financing mechanism, known as the 'hydrogen amortisation account', which addresses both the uncertain pace of hydrogen uptake and the risks facing network developers. Under this mechanism, the German federal network regulator Bundesnetzagentur (BNetzA) sets network tariffs that network operators can charge to their customers artificially low—i.e. below cost reflective levels)—in order to facilitate customer uptake. To bridge the resulting financing gap between initial network revenues and investment costs, network operators receive annual compensation payments from the amortisation account which is backed by a €24bn credit line from the German state development bank KfW. The amortisation account is to be settled at the latest by 2055, as the hydrogen market matures and network

[93] BNetzA (2025), 'Wasserstoff-Kernnetz', available at: https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/Wasserstoff/Kernnetz/start.html (last accessed 21 May 2026).
[94] KfW (2025), 'Wasserstoff-Kernnetz', available at: https://www.kfw.de/%C3%9Cber-die-KfW/Newsroom/Aktuelles/Wasserstoff-Kernnetz.html (last accessed 21 May 2026).

revenues grow with the expanding customer base.[95] Should the account ultimately remain in deficit—for instance, because hydrogen uptake falls short of expectations—the residual financing risk is shared between the government and network developers: developers bear 24% of any unrecovered amount, with the government absorbing the remaining 76%.[96]

The use of this type of regulator intervention has been agreed at European level, modelled substantially on the German mechanism. As a result we may see more regulatory intervention to encourage hydrogen network investment across Europe.[97]

3.4.3 Insights from case study

The German hydrogen amortisation account illustrates a broader shift in the philosophy of economic regulation: from a model focused primarily on constraining market power to one that uses regulatory and financial instruments proactively to catalyse investment in nascent markets.

The most striking feature of the German approach is the scale of explicit government intervention it entails. The design of the amortisation account reflects a deliberate policy judgement that the risk of *not* building hydrogen infrastructure—and thereby foreclosing Germany's path to industrial decarbonisation—outweighs the risk of building infrastructure that might ultimately be underutilised. In other words, policymakers concluded that the cost of potential stranded assets was an acceptable price to pay for avoiding the greater economic and strategic cost of being left without the infrastructure needed for a hydrogen economy. This is not a marginal adjustment to an existing regulatory framework; it is a substantial commitment of public funds, with taxpayers ultimately standing behind 76% of any unrecovered losses.

The case also illustrates how growth objectives and climate objectives can be deeply intertwined, and how difficult it is in practice to separate them. The rationale for hydrogen investment is framed primarily around decarbonisation, reducing industrial reliance on fossil fuels in line with Germany's 2045 climate neutrality target. Yet the urgency of that investment is inseparable from concerns about the competitiveness and future viability of Germany's industrial base. A country whose energy-intensive industries cannot access affordable low-carbon energy faces not just an environmental problem but an economic one. Regulation in this context is as much about preserving growth as it is about meeting climate targets.

Finally, this case is a clear example of how the direction of regulatory policy is increasingly set at the level of central government rather than emerging from arm's-length regulatory institutions. The BNetzA implements and oversees the mechanism, but the fundamental

[95] KfW (2025), 'Wasserstoff-Kernnetz', available at: https://www.kfw.de/%C3%9Cber-die-KfW/Newsroom/Aktuelles/Wasserstoff-Kernnetz.html (last accessed 21 May 2026).
[96] H2AMK (2025), 'Wie funktioniert das Amortisationskonto?', available at: https://www.h2amk.de/ (last accessed 21 May 2026).
[97] European Union Agency for the Cooperation of Energy Regulators (ACER) (2025), 'Recommendation No 02/2025', 28 July, available at: https://www.acer.europa.eu/sites/default/files/documents/Recommendations/ACER-Recommendation-02-2025-Inter-temporal-cost-allocation.pdf (last accessed 21 May 2026).

architecture—including the public guarantee and the explicit risk-sharing arrangement—was designed and legislated by the Federal Government. Regulatory institutions are, in effect, being asked to operationalise political choices about industrial strategy.

3.5 Case study 4: vertical separation and integration—implications for data centre connectivity in US states

3.5.1 Overarching policy and context

The rapid growth of artificial intelligence and cloud computing has driven an unprecedented increase in demand for data centre capacity across advanced economies. In the USA, data centres consumed approximately 176 TWh of electricity in 2023—equivalent to 4.4% of total US electricity consumption—and are projected to consume between 325 and 580 TWh annually by 2028, representing between 6.7% and 12% of total US demand.[98] As with the electricity transmission case study set out in section 3.3 earlier, this shift in the energy requirements of the economy necessitates a significant increase in the capacity of the energy system.

Unlike the GB transmission case however—where the investment imperative is driven by a broad economy-wide decarbonisation transition—this case study concerns a more concentrated demand shock: a specific and rapidly growing sector placing exceptional new requirements on electricity infrastructure across a broader segment of the value chain, encompassing generation capacity as well as network connections.

Across different states, the electricity sector is organised under materially different market structures, ranging from vertically integrated regulated utilities that own generation, transmission and distribution under a single regulated entity, to vertically separated competitive markets in which generation is unbundled from network infrastructure and supplied through competitive retail markets.

The USA therefore provides a rare natural experiment: a single country, a single demand shock, and a spectrum of regulatory and market structures whose differential performance can be observed contemporaneously.

3.5.2 Implications for regulation and growth

The ability of different market structures to accommodate the data centre demand shock turns on a specific coordination problem: namely, a data centre developer seeking to connect large new load—typically several hundred megawatts, delivered within 18 to 24 months—requires simultaneous commitment across three interdependent layers of the electricity value chain:

- generation capacity sufficient to serve the load;

[98] Shehabi, A. et al. (2024), 2024 United States Data Center Energy Usage Report, Lawrence Berkeley National Laboratory (LBNL-2001637), pp. 5–6.

- transmission and distribution infrastructure to physically connect it to the grid; and
- an interconnection agreement that coordinates the timing and cost of both.

These investments are strongly complementary—the substation is worthless without the generation, while the generation commitment is unbankable without the grid connection—and highly relationship-specific, in the sense that some of the infrastructure built to serve a specific data centre may have limited alternative use.

Vertically integrated (VI) regulated utilities—which own generation, transmission and distribution under a single regulatory compact, with a statutory obligation to serve new loads in their territory—are structurally well-placed to provide this commitment. When a data centre developer approaches a VI utility, a single entity can file for regulatory approval of the required generation and network investment as a unified programme, receive a binding determination from the state regulator, and make a bankable bilateral commitment to serve the load. The regulatory compact absorbs the stranded asset risk—if demand does not materialise as forecast, cost recovery is subject to regulatory determination rather than market risk—which is precisely what makes the commitment credible and the investment financeable.

Vertically separated (VS) competitive markets, by contrast, fragment this coordination across multiple entities with different obligations and incentives. A network-only transmission or distribution utility can study what network upgrades are required to connect a new load, but holds no generation obligation and cannot guarantee that sufficient generation will exist to flow down the upgraded network. Generation investment is left to competitive wholesale market signals, which, as Joskow (2008) demonstrates, can be structurally insufficient to incentivise new entry at the pace and scale required by a sudden large demand shock.[99] The result is that no single entity in a deregulated market can make the bilateral generation-plus-network commitment that a data centre developer requires to reach financial close on a large campus investment. This is not a market design failure that can be straightforwardly corrected—it is a structural consequence of vertical separation itself, which by design removes the unified planning authority that makes such entering into such commitments far simpler.

It is worth noting that the coordination problem identified above is not an intrinsic and permanent feature of vertically separated market structures—it is a contingent one that only becomes binding when infrastructure is scarce relative to demand. When generation and network capacity are abundant, a data centre developer in a deregulated market can sign a power purchase agreement with an existing generator and connect to a grid with available headroom—no bilateral commitment problem arises, no new coordinated investment is required, and the productive efficiency advantages of competitive market structures identified by Cicala (2022) dominate.[100]

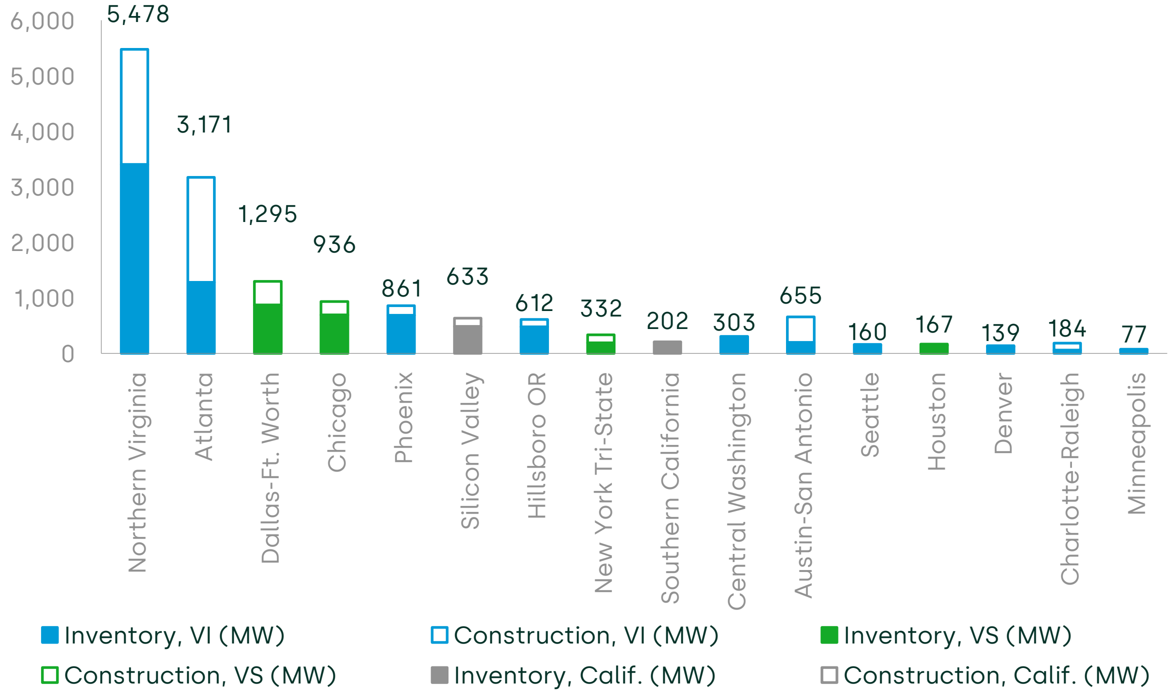
[99] Joskow, P. L. (2008), ‘Capacity Payments in Imperfect Electricity Markets: Need and Design’, Utilities Policy, 16:3, September, pp. 59-170.
[100] Cicala, S. (2022), 'Imperfect Markets versus Imperfect Regulation in U.S. Electricity Generation', American Economic Review, 112:2, February, pp. 409–41.

3.5.3 Insights from case studies

This theoretical finding—that vertically integrated regulatory structures are better placed to accommodate large, lumpy and time-sensitive demand shocks—appears to be broadly consistent with the available empirical evidence, though establishing clean causal identification is difficult given the methodological challenges inherent in classifying market structures and controlling for confounding factors such as historical clustering of data centre activity.

Analysis of primary market data compiled by CBRE across the largest US data centre markets suggests that existing and under-construction data centre capacity is concentrated in areas served by vertically integrated regulated utilities.

Figure 3.7 Data centres tend to be disproportionately located in areas served by regulated, vertically integrated utilities



Note: PG&E (Silicon Valley) and SCE/SDG&E (Southern California) are nominally vertically integrated but operate within CAISO's competitive wholesale market; retail choice has been suspended since 2001. Shown separately given this ambiguity—and the range above reflects whether the Californian clusters are categorised as vertically integrated or separated.
Source: CBRE (2025), 'North America Data Center Trends H1 2025', CBRE Research, CBRE Data Center Solutions.

Vertically integrated utility territories account for between 74% and 80% of existing data centre inventory and between 86% and 88% of capacity currently under construction. This overrepresentation is consistent across both established markets—where Northern Virginia, served by Dominion Energy, accounts for the single largest concentration of data centre capacity globally—and smaller but fast-growing markets, such as Georgia. Even within Texas—which features one of the most competitive electricity markets in the US—it is municipalities served by vertically integrated utilities (Austin and San Antonio) that are able to accommodate higher data centre growth. This finding is corroborated by Wood Mackenzie's analysis of disclosed utility commitment data, which finds that 91% of the 17 GW of data centre capacity currently under construction in the USA is located in vertically integrated utility territories.[101]

The observed concentration of data centre capacity in vertically integrated territories is not solely explained by regulatory and market structure. Northern Virginia's dominance as a data centre location predates the AI boom—reflecting decades of accumulated fibre infrastructure, federal government proximity, and first-mover advantages that are independent of electricity market structure.[102]

However, whether the concentration of data centre activity in VI territories reflects developers actively preferring VI structures, or simply being unable to obtain the generation commitments they need in VS markets, the policy-relevant observation is the same: in the specific case of a large, discrete demand shock, vertically integrated regulated utilities appear to be better suited to addressing the coordination challenges associated with connecting new users to electricity grids than the competitive market mechanisms available in vertically separated systems.

The forward-looking question is whether vertically separated markets can adapt to close this gap. If vertically separated market structures are to be retained, regulators need to consider what combination of new market mechanisms and regulatory coordination are required to replicate within competitive market structures the coordination properties that vertically integrated utilities provide naturally.[103]

The finding that connecting new data centres—seen as a key driver of economic growth—is easier to achieve with vertically integrated regulated utilities is also interesting when considered against the history summarised in section 2 earlier. Indeed, this finding sits in stark contrast to the regulatory philosophy which prevailed during the first phase of privatisation: namely, that better outcomes for customers and the wider economy were likely to be delivered by limiting regulation to the core monopoly networks, while opening up other parts of the value chain to competition where feasible.

[101] Wood and Mackenzie (2025), 'US utilities have committed to 116 GW of large load capacity growth, equal to 15.5% of current US peak demand', 04 September, last accessed 19 May 2026.
[102] Kotkin, J., Adams, S., Deriso, T., and Brint, S. (2019), 'How Virginia became the data capital of the world', Viginia Economic Review, 4, pp. 30—39.
[103] One example of market mechanisms could be capacity markets, where an entity (potentially the transmission system operator) runs auctions to purchase generation capacity to have on standby at a future date, which can then be activated in the event that it is needed.

4 Takeaways from case studies and potential implications for policymakers and regulators

4.1 What these case studies tell us about the direction of travel for infrastructure regulation

Viewed individually, the rationale behind each of the regulatory decisions examined across the four case studies is coherent in its particular context. In each instance, the regulator faced a specific and identifiable challenge in facilitating new infrastructure investment, and adapted the prevailing regulatory framework accordingly. Specifically:

- Ofcom—wanting to encourage investment in full-fibre roll-out—made targeted changes to regulation to enable greater infrastructure investment;
- Ofgem—recognising the need to ramp up transmission CAPEX quickly—accepted the trade-off of potentially reduced efficiency in order to ensure rapid delivery;
- BNetzA—responding to a government determination that a hydrogen core network was needed—jointly developed a regulatory framework with the government, and industry stakeholders which enabled this to happen;
- (though not a specific regulatory decision it itself)—the observed concentration of data centre connectivity in US states with vertically integrated utilities can be understood in light of the coordination advantages those structures provide when aligning commitments across the value chain, in particular electricity generation and networks.

What is striking, however, is how these individual decisions—each at least arguably internally logical—sit against the broader history of infrastructure regulation outlined in section 2, and what this may tell us about the direction of travel in regulatory consensus regarding how best to facilitate investment in response to technology and policy shifts.

The UK's full-fibre story is broadly consistent with the regulatory philosophy of the 1980s: that markets, properly enabled, would deliver higher levels of investment (and better outcomes).

The Ofgem and BNetzA case studies present a sharply different picture. In contrast to the philosophy of the 1980s—but aligned with the trends that emerged towards the end of the historical arc outlined in section 2—both involve substantially greater intervention from government, with markets taking more of a back seat in determining major investment decisions.

In the GB electricity transmission case, the change in approach reflected a view that the risk of inefficient costs being passed on to consumers was, at the margin, outweighed by the risk of delays to sufficient network expansion. The investment envelope now being pursued by transmission companies is itself a function of NESO's generation forecasts, which in turn reflect direct government decisions about the future energy mix. Although the networks remain in private ownership, the specific investments which privately owned transmission networks make are increasingly being determined through decisions ultimately taken by central government. The regulatory framework has, in substance, become an instrument for implementing a centrally determined allocation and investment programme: a considerable distance from the efficiency-focused, market-proximate model envisaged at privatisation.

The German hydrogen case represents an even more explicit form of directed investment. The 'chicken-and-egg' problem facing hydrogen network developers (whereby network operators are reluctant to invest given a small and uncertain customer base, while potential customers are reluctant to switch to hydrogen given uncertainty over future supply), could not be resolved without intervention. Reflecting government concern about broader risks to industry, the solution adopted—artificially suppressed network tariffs combined with a €24bn government-backed financing facility provided through KfW—represents another example of a shift in the approach to regulation driven to a large extent by changing policy imperatives emanating from central government.

Finally, whether the observed concentration of US data centre activity in vertically integrated utility territories reflects developers actively preferring those structures, or simply being unable to obtain the generation commitments they need in vertically separated markets, the policy-relevant observation is the same: in the case of a large, discrete demand shock, vertically integrated regulated utilities appear better suited to addressing the coordination challenges associated with connecting new users to electricity grids than vertically separated ones. This sits in stark contrast to the regulatory philosophy which prevailed during the first phase of privatisation: that unbundling and limiting regulation to the core monopoly networks—while opening up other parts of the value chain to competition—was more conducive to delivering increased investment.

Taken together, three of the four case studies—GB electricity transmission, German hydrogen, and US data centres—point towards a common theme: that where infrastructure investment must be delivered at pace, at scale, in conditions of significant market uncertainty or which account for wider economic implications, the mechanisms through which market-based regulation typically operates (competitive entry, efficiency incentives, price signals) may be insufficient on their own to deliver required investment.

4.2 Potential implications for policymakers and regulators

The finding above—that there may be limits to the role of market mechanisms in delivering capital-intensive, policy-driven investment—raises an important question: if infrastructure investment is increasingly being determined through what might be described as ‘re-regulation’, does this suggest that a more *dirigiste* approach is better suited to the complex investment needs of the modern economy? (Potentially driven by positive externalities which are simply not priced by the market, and where Pigouvian subsidies and/or taxes are not feasible?) Or does it reflect regulation having gone awry—with the boundary between economic regulation and industrial policy having become dangerously blurred?

First, it is important to recognise that there is an extensive body of research which highlights how economic regulation shapes infrastructure investment, and what kinds of regulatory design tend to support it. The relationship has been examined extensively in classical literature, including contributions by Laffont and Tirole,[104] Vickers and Yarrow,[105] and Helm and Tindall[106]. These classical contributions, alongside a growing body of more recent empirical work—including Cambini and Rondi (2010, 2011),[107] Bortolotti et al. (2011)[108] and Bastianin et al. (2018)[109]—broadly support the finding that independent economic regulation of infrastructure sectors, combined with effective regulatory frameworks, tends to be associated with higher levels of investment.

Perhaps most importantly for present purposes, the stability and credibility of the regulatory framework itself is central. Independent and accountable regulators reduce regulatory risk and commitment problems, thereby encouraging long-term, capital-intensive investment; discretionary or unstable regulation raises uncertainty and may delay or distort investment decisions.[110] This would suggest that a move towards 're-regulation' is unlikely to be conducive to delivery of long-term infrastructure investment, and that steering regulation towards more market based mechanisms may be preferable. We note that the relative merits of relying on ex post competition law enforcement versus ex-ante regulation remains live, with the Draghi report recommending that the Commission:

> Reduce[s] country-level ex ante regulation, which disincentivises investments and risk-taking, and favour[s] rather ex post competition enforcement in cases of abuse of dominant position or other anticompetitive conducts.[111]

At the same time however, it is clear from the case studies examined that infrastructure regulation is often adapting in ways that do not neatly align with the recommendations from academic research or the Draghi report. There is an interesting question as to whether this shift is being driven by:

1 technology shocks, which mean the required level and type of infrastructure provision (and hence new investment) may have shifted dramatically, and that the previous frameworks for evaluating optimal regulatory interventions are therefore no longer appropriate;

[104] Laffont, J. and Tirole J. (1993), 'A Theory of Incentives in Procurement and Regulation', MIT Press.
[105] Vickers, J., and Yarrow, G. (1991), 'Economic Perspectives on Privatization', Journal of Economic Perspectives, American Economic Association, vol. 5(2), pages 111-132, Spring.
[106] Helm, D. and Tindall, T. (2009), ' The Evolution of Infrastructure and Utility Ownership and its Implications', Oxford Review of Economic Policy, Vol. 25, Issue 3, pp. 411-434, doi: http://dx.doi.org/grp025
[107] Cambini, C. and Rondi, L. (2010) 'Incentive regulation and investment: evidence from European energy utilities', *Journal of Regulatory Economics*, 38(1), pp. 1–26. Cambini, C. and Rondi, L. (2011) *Regulatory Independence, Investment and Political Interference: Evidence from the European Union*. EUI Working Papers – RSCAS 2011/43. Florence: European University Institute.
[108] Bortolotti, B., Cambini, C., Rondi, L. and Spiegel, Y. (2011) 'Capital structure and regulation: do ownership and regulatory independence matter?', *Journal of Economics & Management Strategy*, 20(2), pp. 517–564.
[109] Bastianin, A., Castelnovo, P. and Florio, M. (2018) 'Evaluating regulatory reform of network industries: a survey of empirical models based on categorical proxies', *Utilities Policy*, 55, pp. 115–128.
[110] There is extensive evidence that regulatory instability deters infrastructure investment in practice. For example in the England and Wales water sector, the National Audit Office concluded in 2025 that the regulatory framework had 'contributed to worsening investor perception of the sector', with the sector having failed to attract the investment needed to meet environmental and supply objectives (NAO, *Regulating for Investment and Outcomes in the Water Sector*, HC 853, April 2025).
[111] European Commission (2024), 'The future of European competitiveness', September, Part B, page 75

2 a greater degree of state intervention in markets which—whether warranted or not—necessitate adaptations in the approach to infrastructure regulation (potentially coupled with a change in the regulatory consensus or philosophy/culture of sector regulators); or

3 some combination of the above.

A recent survey of infrastructure investment in an uncertain global environment suggests the role of the first two factors may be key.[112] It argues that in a period characterised by geopolitical fragmentation, climate transition pressures, and rapid technological change, infrastructure investment delivers the greatest long-run returns when it is aligned with structural transformations—such as digitalisation and decarbonisation—while overly rigid or misallocated investments risk locking economies into suboptimal development paths. This emphasises how the optimal approach to regulation (i.e. that which is most conducive to facilitating the right investment and—by extension—growth), is highly state-dependent and shaped by uncertainty and structural change.

The importance of this is reinforced by the view that European economic growth is being held back by its infrastructure sectors.[113] A longstanding and substantial body of work highlights the historically contingent nature of infrastructure's economic role, particularly in the context of general purpose technologies (GPTs). For example, Bresnahan and Trajtenberg (1995) argue that GPTs such as steam engines and electric power generate sustained growth only when they trigger 'innovational complementarities' across sectors, thereby producing reinforcing feedback loops of technological progress.[114] Extending this perspective, David (1990) illustrates how the productivity effects of electrification in American industry depended not only on the availability of electricity, but also on the organisational and infrastructural reconfiguration it enabled—such as the shift from centralised steam power to decentralised electric motors.[115] Together, these studies underscore that the growth impact of infrastructure evolves alongside technological change – such as decarbonisation technologies, broadband and AI – and depends on how effectively economies adapt to new enabling systems, including sectoral regulation.

A growing body of literature suggests that pressures on infrastructure regulators to adapt their approach in response to evolving political priorities are not merely ad hoc, but reflect a structural challenge for regulatory design. An OECD study from (2024)[116] found that only c. 40% of economic regulators out of 184 economic regulators surveyed had explicit sustainability objectives in their mandates, yet they were all increasingly expected to deliver green transition outcomes—creating a mismatch that required closer alignment between government policy direction and regulatory implementation (OECD, *The Role of Economic Regulators in the Green Transition*, 2024). Pollitt, Duma and Covatariu (2024) similarly argue that net-zero uncertainty necessitates the development of 'adaptive

[112] Boston Consulting Group (BCG) (2026), 'Infrastructure Investment in an Uncertain World', January.
[113] Allianz (2025), 'Current infrastructure slows down economic growth', (last accessed 25 May).
[114] Bresnahan, T. F. and Trajtenberg, M. (1995), 'General purpose technologies 'Engines of growth'?,' Journal of Econometrics, Elsevier, vol. 65(1), pages 83-108, January.
[115] David, P. (1990), 'The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox', American Economic Association, May.
[116] OECD (2024), 'The Role of Economic Regulators in the Green Transition', October.

regulation', in which regulators anticipate and respond to future structural change rather than merely applying stable rules.[117]

These studies highlight how the approach to regulating infrastructure investment necessarily evolves alongside technology shocks and shifts in wider public policy. The challenge for policymakers is how to accommodate such shifts with suitable adaptations to regulation that are coherent with evolutions in technology and shifting public policy priorities, but which also ensure that the benefits of regulatory stability and use of market-based interventions are not lost in the process.

[117] Pollitt, M.G. et al. (2024), 'Uncertainty, Regulation and the Pathways to Net Zero', July.

5 Questions for the OEC

1 Looking back at privatisation and regulatory reform before 2000, what are leading examples of (a) success; and (b) failure in utility/network industries in delivering efficient outcomes and required investment?

2 To what extent are the themes explored in this paper representative of broader shifts over time in infrastructure regulation across Europe? For example, are we witnessing 're-regulation' across energy and other network industries?

3 To what extent is 're-regulation' potentially a problem? Has it gone too far?

4 What would smarter regulation look like—focusing on ensuring sufficient (but not excessive) investment? Is there scope for better outcomes to be delivered through a radical shake-up of regulation, with a much greater focus on efforts to harness competition?

5 Are the challenges facing infrastructure regulators today fundamentally different from those in the past, in either economic and/or political terms? Does the need for decarbonisation and/or AI investment require a different approach to that taken previously, and—if these investments have significant positive but uncertain externalities—does this create inevitable pressure for greater regulation/intervention?

6 Given the trends observed, is there a case for greater independence of regulators, or potentially better structured engagement with government and elected representatives? If so, what should this look like?

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