GSMA

RETHINKING SPECTRUM RENEWALS



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Published: November 2026

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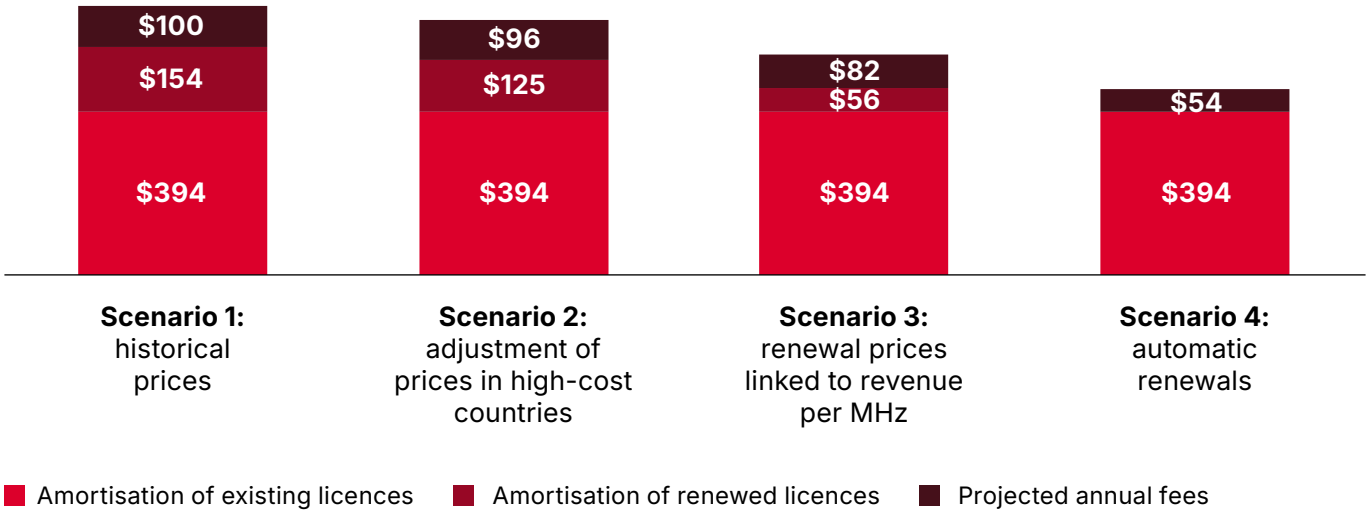
EXECUTIVE SUMMARY



By 2035, over 1,500 spectrum licences will have expired globally, accounting for 68% of all currently active licences with a total historical cost of $440 billion. This presents a strategic challenge for regulators as they seek to maximise the economic and social value of spectrum during the next licence cycle. Renewals provide an opportunity to ensure continued efficiency of spectrum use and to achieve public connectivity objectives. The policy question is, therefore, what approach to renewals can best maximise socioeconomic benefits.

Aggregate cost of spectrum by component during 2026–2035 (billion)



Rationalisation of spectrum cost will bring improved connectivity and economic growth

	Improvement to network speeds (% increase relative to scenario 1: historical prices)	**Economic impact** ($bn of additional GDP relative to scenario 1: historical prices)
Scenario 2: adjustment of prices in high-cost countries	1-3%	$90-270BN
Scenario 3: renewal prices linked to revenue per MHz	2-10%	$260-1,260BN
Scenario 4: automatic renewals	4-20%	$410-2,440BN

Note: GSMA Intelligence estimates. Based on a group of countries where data could be obtained.

Licence renewal reform

When spectrum cost does not reflect its underlying value, it distorts incentives for operators to invest in their networks. Conversely, adjusting spectrum cost to reflect its changing commercial value ensures financial viability of network upgrades and improves consumer experience through better network coverage and speeds. Aligning renewal charges more closely with the changing fundamentals of spectrum value can reverse the historical trend of rising spectrum costs. This will deliver better-quality networks and strengthen the global economy.

The different approaches to renewals and their potential impacts are outlined below:

- **Renewals at historical prices or outdated benchmarks** reduce social benefits, as this will artificially keep spectrum cost elevated, disincentivising investment, and lead to suboptimal consumer outcomes.
- **Renewals that are priced to reflect the decline in revenue per megahertz** would rationalise spectrum cost to 5% of operator revenue, which could stimulate network deployment, bringing up to 10% higher network speeds and at least $260 billion to global economic output.
- **Automatic renewals with no additional fees** can reduce spectrum cost to 3% of operator revenue in 2035. Some cost will remain as operators will continue to incur the cost of licences that do not expire until after 2035. Compared to the scenario of historical prices, automatic renewals could boost investment in improved networks, resulting in up to 20% higher network speeds and at least $410 billion in economic benefits globally.

Reform of spectrum pricing is a necessity given the established evidence linking lower spectrum costs with better consumer outcomes, such as higher speeds and improved coverage. Therefore, the prioritisation of direct government revenue from spectrum fees should be weighed against the opportunity cost of lower investment and slower digital development.

In the last decade, mobile operators have expanded their spectrum holdings to support higher-capacity networks, but revenues per megahertz have declined by more than 60%. As a result, the revenue-generating potential of each megahertz of spectrum has fallen, while the accumulated burden of spectrum costs continues to rise. The average cost of spectrum now accounts for 7.2% of operator revenue, up from 5.1% in 2015. When spectrum costs exceed their underlying commercial value they can reduce incentives for network investment, slow improvements in quality and ultimately weaken the economic and social benefits of mobile connectivity.



Maximising the benefits of spectrum

Spectrum licence renewals offer an opportunity to rationalise spectrum prices for another licence cycle. But there are also other renewal approaches, including:

- allowing operators to commit to service quality and further investment in exchange for reduced-cost or free-of-charge renewals
- automatic renewals (with a conversion to indefinite tradeable licences).

Rationalised pricing and these alternative approaches can all can support efficient use, but the outcomes depend heavily on how the policy is designed and whether it reflects the wider social benefits of mobile connectivity:

Renewals in exchange for commitments to improved networks can be an effective alternative to fees when delivering benefits that the market would not otherwise provide.

Regulators can ensure that the money saved from spectrum fees translates into network upgrades, for example to advance digital inclusion and regional development. However, obligations offer an improvement only where their costs do not exceed their incremental social benefits. Overly demanding targets risk imposing costs that are greater than the benefits, which would crowd out productive investment or result in unused spectrum.

Market mechanisms can support effective obligation setting and connectivity goals.

Allowing operators to voluntarily opt in and commit to network improvements in exchange for a reduction in fees can reveal the true cost of obligations and enable them to be assigned to the operators best placed to meet them. Allowing obligations to be fulfilled independently of spectrum ownership (unbundling from particular bands) can enable more efficient outcomes at lower cost. Similarly, the flexibility to commit to an improvement of service in particular geographic locations promotes efficiency and value for money.

Where market mechanisms are not used, obligations should be set conservatively and paired with discounts that preserve commercial viability.

Spectrum fee reductions should reflect the actual cost of compliance. Bundled and onerous obligations should be avoided because they risk returned spectrum.

Indefinite tradeable licences offer a fully market-driven route to efficiency.

Converting licences to indefinite (non-expiring) terms eliminates periodic renewal processes, while tradability ensures spectrum can move to higher-value uses. This approach achieves strong efficiency incentives with lower regulatory involvement, though effectiveness depends on ensuring low barriers to trading.

1. SPECTRUM RENEWAL OPTIONS

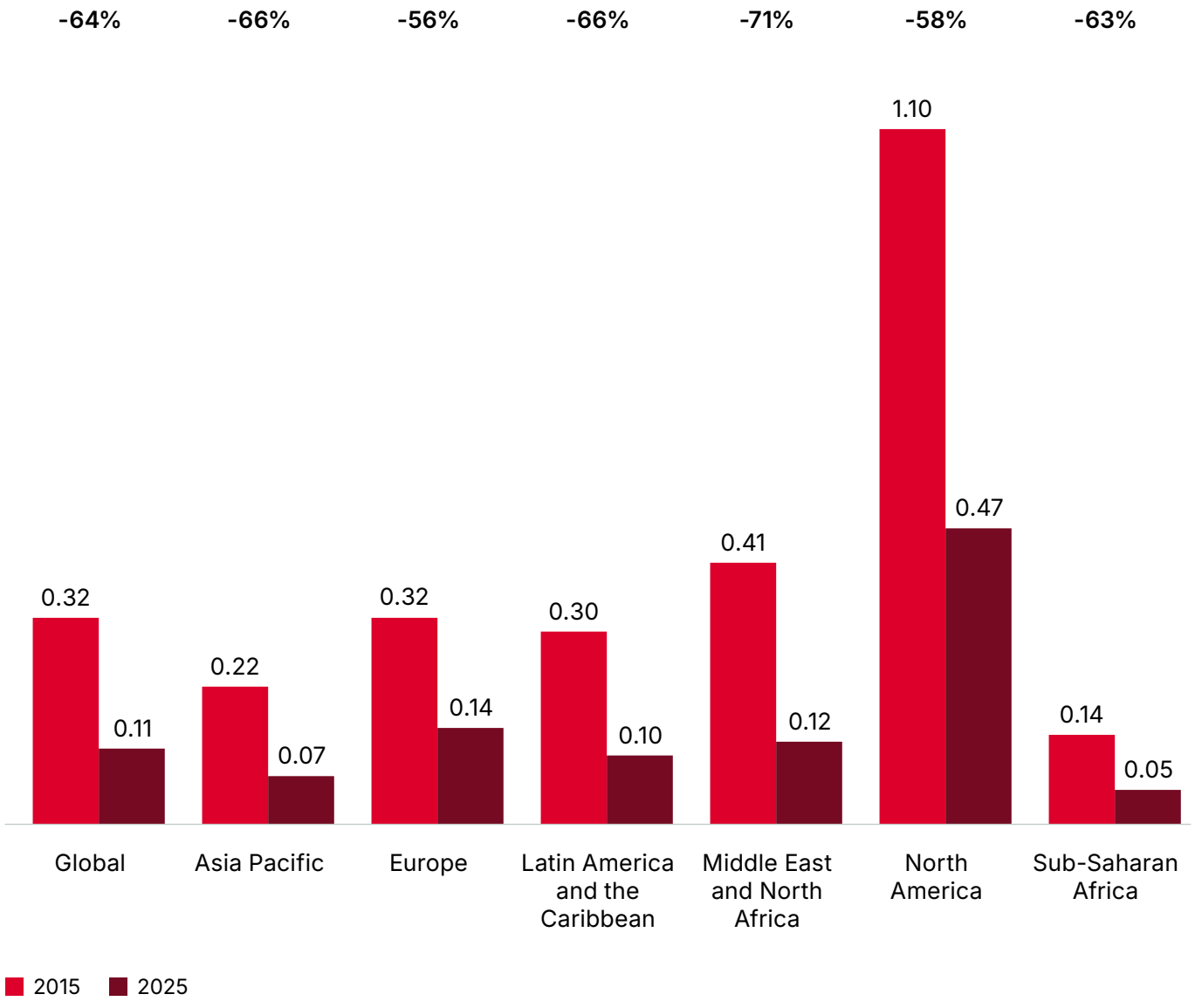


1.1 The changing fundamentals of spectrum value

In the past decade, operators have expanded their spectrum holdings to support high-capacity advanced networks. In parallel, revenues per connection have fallen by more than 60%, resulting in a steep decline in the revenue-generating potential of each megahertz of spectrum (see Figure 1). This means that the commercial value of spectrum has declined and spectrum prices therefore need to adjust to reflect this new reality.

Figure 1
Average revenue per MHz per connection by region

USD/MHz/connection/year, inflation-adjusted to 2024 prices



Source: GSMA Intelligence

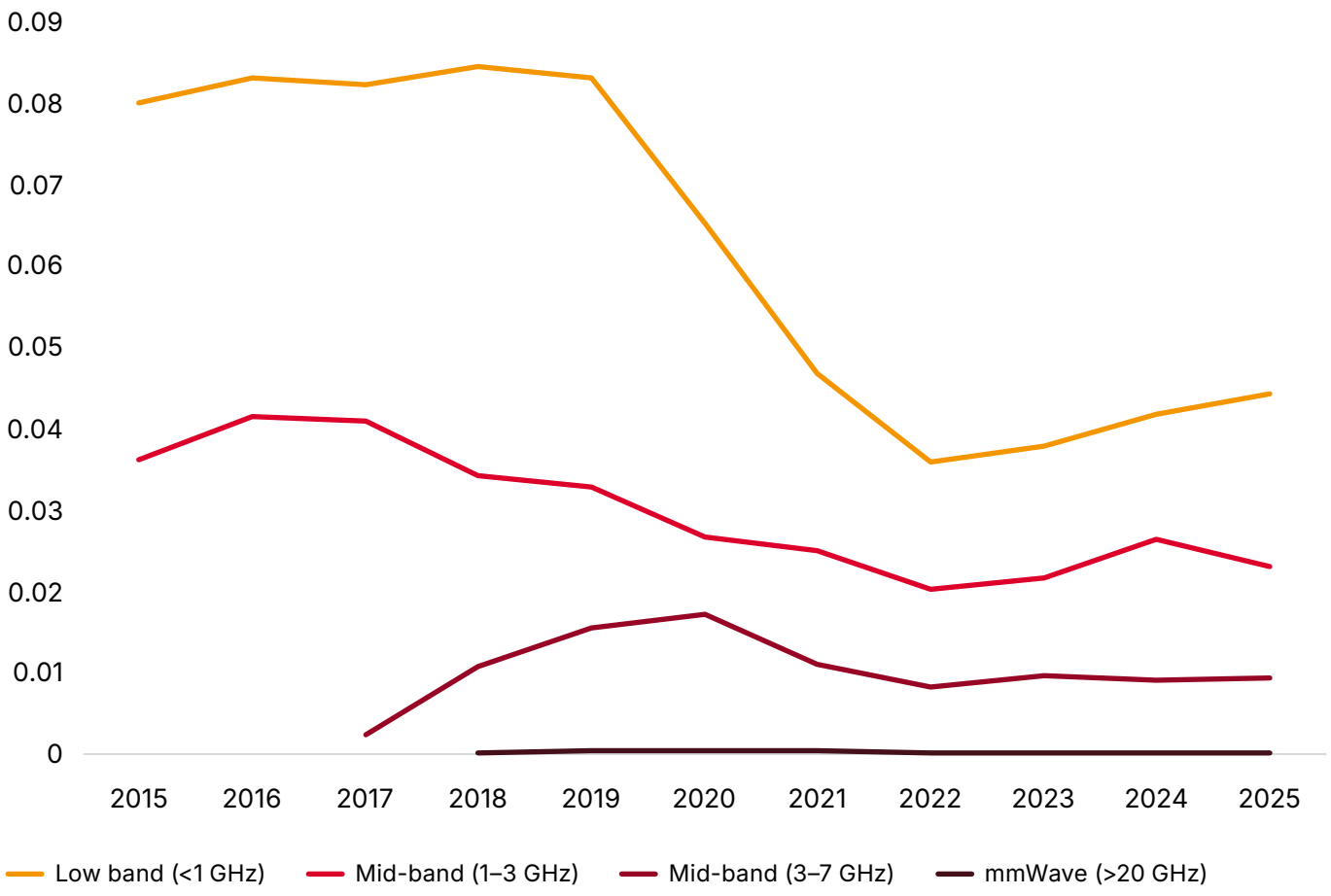
While spectrum prices (per megahertz) have been declining (see Figure 2), they have not fully adjusted to current market realities, as policy decisions frequently influence spectrum prices:

- Fees are often set by regulators. This is particularly common during licence renewals, where auctions are used less frequently. In the case of auctions, prices can still be driven up by scarcity and high reserve prices, which frequently become the actual prices paid by operators.[1]
- Besides upfront fees, regulators and authorities charge annual licence fees, which add to the cost of spectrum ownership. These can be set in per megahertz terms or based on other factors that do not necessarily reflect the true commercial value of spectrum.

Figure 2

Average spectrum prices per megahertz per unit of population

USD/MHz/year/population, inflation-adjusted to 2024 prices



Source: GSMA Intelligence

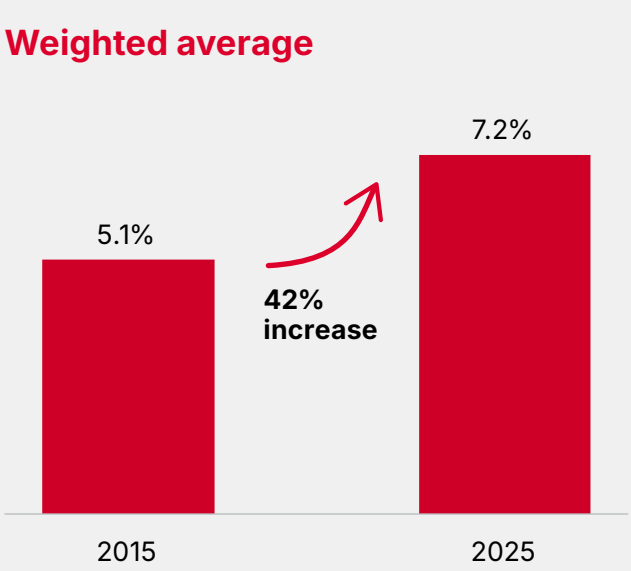
Note: Presented as a three-year moving average, outliers removed using upper fence thresholds.

1. Global Spectrum Pricing, GSMA, 2025

The acquisition of additional spectrum and changing prices have affected the aggregate spectrum cost (see Figure 3). The average cost of spectrum has increased from 5.1% of operator revenue in 2015 to 7.2% in 2025 (based on countries with sufficient data).[2] This was caused by the acquisition of additional spectrum and policies that prevented prices from being adjusted to reflect the true market value.

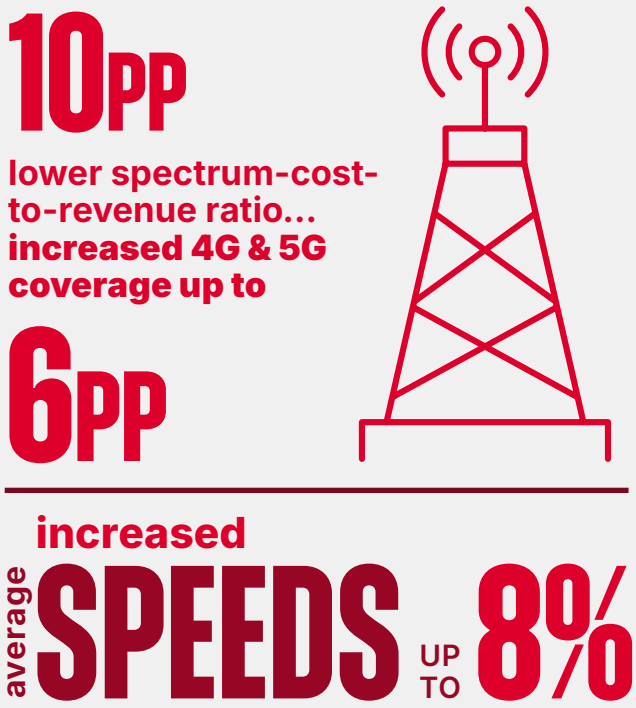
When spectrum cost does not reflect its underlying value, it distorts incentives for operators to invest in their networks. Conversely, adjusting spectrum cost to reflect its changing commercial value ensures financial viability of network upgrades and improves consumer experience through better network coverage and speeds (see Figure 4).

Figure 3
Global average spectrum-cost-to-revenue ratio



Source: GSMA Intelligence

Figure 4
Impact of spectrum cost on network deployment



Source: GSMA

How to measure spectrum cost accumulation

The spectrum cost burden is measured through the spectrum-cost-to-recurring-revenue ratio (cost-to-revenue ratio or CRR). This provides an aggregate estimate of accumulated spectrum cost based on all active licences, taking into account upfront fees (amortised over the licence duration) and any annual fees, where applicable. It does not consider any other fees, such as operating licences or the cost of meeting obligations attached to licences.



2. See the appendix for further details

1.2 Demonstrating continued value of spectrum use

Spectrum is used efficiently when it delivers the greatest possible social and economic value. As spectrum licences approach expiry, regulators can use several tools to ensure that the social value of spectrum continues to be maximised.

One option is renewal pricing, where licence holders pay a fee, which serves as a signal that the existing user continues to generate value. Another is to renew licences in exchange for commitments to network improvements instead of, or alongside, renewal fees. A third approach is to convert licences to indefinite terms and allow spectrum trading, enabling market transactions to help spectrum move to its highest-value use over time.

Each approach incentivises operators to show that they can continue to generate value from spectrum in different ways.

In contrast to new licences, when licences are renewed there is more certainty about how the spectrum will be used and what benefits it will bring. Existing licence holders have typically already deployed the technology and infrastructure, with consumers actively using the services these enable. As a result, the benefits are relatively clear and measurable, influencing the suitability of each approach to renewal.

Table 1
Approaches to spectrum licence renewal

	Renewal pricing (auction or administrative)	Renewal in exchange for commitment to network improvements	Indefinite tradeable licences
Maximises spectrum value?	Yes, but not fully if market decisions do not reflect all benefits or if high pricing discourages investment. Additionally, it creates uncertainty about long-term access and future pricing, which may result in underinvestment.[3]	Yes, if designed correctly to promote consumer outcomes and set at a level that addresses externalities and achieves the right cost–benefit balance.	Yes, as it directly incentivises transfers to more efficient users. However, it may not work optimally if there are barriers to trade (e.g. regulatory uncertainty, annual fees) or if markets do not reflect full social benefits.
Easy to implement?	Varies depending on the approach to price setting (e.g. market-driven, administrative).	Varies depending on the approach (e.g. market-driven, administrative) and how the obligations are set. Monitoring can be costly.	Yes, but scale of trading and its ability to incentivise changing ownership outcomes can be uncertain. Monitoring of use, compliance and dispute frameworks may be necessary.

Source: GSMA Intelligence

3. Mobile spectrum renewals – the case for regulatory pre-commitment, Ihle and Kharti, 2026

Rationalisation of pricing during licence renewals

Renewals of existing licences provide an opportunity for regulators to address some of the spectrum cost challenges over the next decade. By 2035, over 1,500 licences will expire, accounting for 68% of all currently active licences with a total historical cost of close to $440 billion. Renewal pricing will directly shape the future cost of spectrum. High spectrum costs can reduce operators' incentive to invest in networks, slow the rollout of new technologies and, in some cases, lead to spectrum remaining unused. Renewal pricing should seek to address the growing divergence between high historical costs and the falling commercial value of spectrum (see Table 2).

Table 2

Potential approaches to spectrum pricing during licence renewals

Approach	Description and rationale	Spectrum cost
Renewal at historical prices	Maintains continuity but keeps spectrum costs high. Prices do not reflect the declining commercial value of spectrum, which can limit operators' ability to invest in networks or lower prices for users. This approach prioritises government revenue but risks slower network improvements and possible spectrum returns.	Very high
Renewal using an international benchmark	Uses recent international prices as a reference. This can result in lower or higher prices depending on the country, but benchmarks are still retrospective. They may not reflect future conditions or the local market and can still lead to elevated costs or unsold spectrum.	High
Renewal price adjusted in line with declining revenue per megahertz per connection (local indexing)	Aligns spectrum cost with operators' reduced revenue per unit of spectrum. A gradual decline in spectrum cost leads to improved investment incentives. However, the past trends in revenues may not be a good proxy of the future value of spectrum. Hence, some risk remains that this approach can still elevate future spectrum cost.	Medium
Re-auctioning of licences	Re-auctions existing licences to find more efficient users and reveal current values. However, this risks major disruption to existing services, very high prices and reduced investment, as uncertainty is high.	Uncertain but likely high/very high
Conversion to indefinite tradeable licences with no additional renewal fees	Leads to a possibility for fast reduction in spectrum costs. Can be combined with commitments to network improvements to support connectivity goals. Encourages greater investment and long-term economic benefits. Operators may still be liable to pay annual fees to recover regulatory costs.	Low

Source: GSMA Intelligence

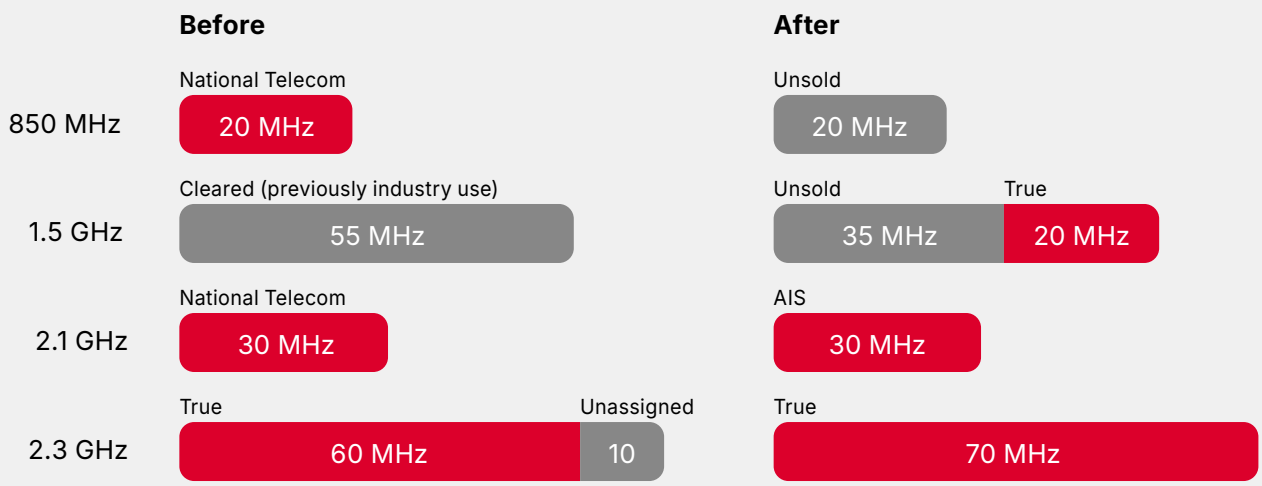
Case study

Re-auctioning of expiring licences in Thailand: high reserve prices and unsold lots

Thailand has become a regional 5G leader in recent years, with 95% population coverage and nearly 50% market penetration of 5G connections.[4] However, high spectrum costs and limited spectrum availability are now slowing improvements, and Thailand is falling behind countries such as Malaysia in 5G speeds.[5,6]

In 2025, Thailand re-auctioned a number of expiring licences, though large parts of it remained unsold, representing the worst possible outcome for public value. Unused spectrum in the 850 MHz and 1.5 GHz bands represents a major lost opportunity, as this capacity could have been used to improve networks. Parts of spectrum previously owned by National Telecom (a smaller state-owned operator) have been reassigned to two leading operators (AIS and True), though these operators were already using this spectrum as part of their partnerships with National Telecom.

Figure 5
Distribution of spectrum before and after Thailand's 2025 auction



Source: GSMA Intelligence

Spectrum costs in Thailand were already very high, representing around 15% of operator revenue in 2023. Additional costs are likely to reduce future investment and may lead to slower or downscaled network upgrades. The 2025 renewal auction aimed to promote efficient and fair access to spectrum, but high reserve prices ultimately limited spectrum supply. Unsold spectrum has been difficult to easily resolve. The same issue occurred with 70 MHz in the 1800 MHz band, which remained unsold in both 2018 and 2020 due to high reserve prices.[8,9] This has reduced government revenue and resulted in nearly a decade of missed benefits from valuable unused spectrum.

1. https://data.gsmaintelligence.com/data
2. Accelerating 5G and 5G-Advanced in Thailand: A roadmap for success, GSMA and Windsor Place Consulting, 2024
3. 6 GHz in APAC Mobile evolution in 6.425–7.125 GHz, GSMA, 2026
4. "Thai spectrum auction raises $1.3B", Mobile World Live, June 2025

Case study

Australia and the UK rely on benchmarking to set renewal prices, but methodologies and conclusions differ

Australia renews directly with the existing holders

The Australian Communications and Media Authority (ACMA) cited the benefits of service continuity and greater certainty, which support ongoing investment. The regulator concluded that obligations were unlikely to improve coverage, as the market had already achieved strong population coverage.[10] Instead, ACMA chose to set prices administratively based on estimated market value. This relied on benchmarking against recent comparable spectrum sales and auctions, both in Australia and overseas, with prices in dollars per megahertz per person.[11]

In its initial proposals, ACMA planned to adjust historical benchmark prices using an index based on mobile service revenue. This would have linked future prices to the expected commercial value of spectrum. The approach was later changed to adjust prices using general consumer inflation instead. This resulted in a significant increase in the total renewal price, from AUD5.0–6.2 billion to just over AUD7.3 billion.[12]

The UK's revision of renewal fees

Conversely, in 2025 the UK regulator (Ofcom) reduced annual fees for renewed licences. Evidence showed that spectrum values had grown more slowly than general consumer prices.[13] Ofcom's review acknowledged lower prices in recent UK and international auctions, reflecting a higher overall supply of mobile spectrum. According to the findings, the market value of spectrum lagged behind consumer price index (CPI) increases. As a result, Ofcom lowered fees – for example, by 26% for 900 MHz spectrum and by 18% overall. This approach differed from Australia's use of general inflation as the main adjustment factor for historic price benchmarking.

Implications for regulators

Both regulators were satisfied that use by existing licence holders continues to maximise the social value of spectrum. However, higher renewal fees still add costs for operators. These extra costs can affect investment decisions and network deployment, as shown in earlier modelling.

The differences between the two countries highlight how much the final price depends on the assumptions and methods used in benchmarking. Given the risk that high prices can lead to spectrum being returned (with negative effects on network quality), a prudent approach is to set renewal prices towards the lower end of credible estimates.



8. "Thai 1800MHz sale prompts licence term rethink", Mobile World Live, August 2018
9. "Thailand raises more than THB 100 billion in 5G spectrum auction", Telecompaper, 2020
10. Expiring spectrum licences (stage 2) – information gathering, and views on uses of frequency bands and alternative licence conditions, ACMA, 2024
11. Expiring spectrum licences, stage 3 consultation paper, ACMA, 2025
12. "ACMA releases pricing for expiring spectrum licences", ACMA, May 2026
13. Review of Annual Licence Fees, Ofcom, 2025

Using commitments

Commitments to network improvement (obligations) are often considered together with spectrum licensing and can be a viable alternative to pricing when the cost of meeting the obligations is reflected in the renewal offer. This is because an operator's ability to meet the obligations/targets depends on having access to spectrum, so decisions about obligations and spectrum are often taken at the same time.

Obligations aim to ensure that spectrum provides demonstrable benefits to society and are usually set above the current service level. This guarantees improved network availability and quality in the future, delivering continued and growing benefits to users.

From the operators' point of view, meeting obligations creates additional costs. This is because the required service quality or investment level is normally higher than the operator would choose to provide if there were no obligations. These extra costs go beyond what the operator expects to recover from the market alone. As a result, meeting obligations incurs a cost in a similar way to renewal fees.

Opt-in obligations can be a viable alternative to fees when they are designed to deliver benefits that markets would otherwise underprovide. Whether obligations improve or reduce overall welfare depends on several factors:

- **When obligations can improve on market outcomes:** Mobile networks exhibit strong scale benefits through network effects: the more people connected, the greater the value to all users. Expanding availability can therefore boost overall adoption and equity, generating significant social benefits beyond what market outcomes would deliver. Additionally, improved mobile availability and quality deliver non-market benefits, from education to healthcare. These help in achieving inclusion and regional development goals, but are not fully reflected in consumer willingness to pay. As such, well-designed incentive-based obligations can deliver a net social gain.

- **When obligations can reduce efficiency:** Obligations can be damaging if the target is set too high, as the cost of meeting it can exceed the combined private and social benefits. This leads to inefficiency, such as when operators return spectrum or when other more productive investments are pushed aside. In addition, obligations create extra costs for monitoring and enforcement, and it can be difficult to align them with benefits that are spread across many users.

Therefore, the use of obligations as part of spectrum policy requires a good understanding of the market outcomes, the potential social benefits and the costs imposed on network operators.

Indefinite tradeable licences

In contrast to pricing and obligations, indefinite (non-expiring) tradeable licences take a fully market-driven approach and provide the same efficiency incentives without additional regulatory cost burden. The conversion of licences to indefinite terms removes the need for a periodic administrative process. Indefinite licences are typically tradeable, which ensures continued efficiency, as spectrum can be purchased by a new entrant or an existing operator that generates more value from it. The degree to which this guarantees efficiency in spectrum use depends on transaction costs: uncertainty about transactions being blocked, lengthy approval processes and legal costs could be barriers to trading.

Where indefinite licences are used, they often necessitate continued value generation from spectrum. These criteria are specified in general terms. In the US, for example, licensees must show they have and will continue to provide commercial products to the public.

The flexibility and efficiency that spectrum trading offers are not limited to transactions among private companies. In some instances, regulators could also support efficiency by allowing operators to swap any holdings for available spectrum, either upon expiry or during the licence term. Swapping spectrum can allow operators to change the composition of their spectrum holdings to match their evolving needs. Allowing operators to return spectrum that is no longer required could also promote more efficient future use, especially if there are barriers to spectrum trading among private entities (e.g. fragmentation, transaction costs).



Case study

Tradeable indefinite licences in the US, UK and Estonia

US: a market-driven approach

The US Federal Communications Commission (FCC) issues licences with a right of renewal, making them effectively indefinite. The US has strongly encouraged spectrum trading since the early 2000s to ensure efficient use. The secondary market is active and has seen several large transactions in recent years:

- In 2026, AT&T bought around 50 MHz of spectrum in the 600 MHz and 3.5 GHz bands from EchoStar (Dish) for $23 billion.[14]
- Also in 2026, Verizon acquired spectrum assets from UScellular for around $1 billion. The FCC stated that the deal would improve network coverage, capacity and performance, helping meet growing customer demand.[15]
- In 2023, T-Mobile agreed to a lease-to-own deal with Comcast for up to $3.3 billion in 600 MHz, which it will potentially acquire by 2028.[16]

Ultimately, these spectrum assets can generate more value when used by the acquiring mobile operators. Many transfers in the US concerned spectrum that was initially assigned to smaller players with preferential treatment.

UK: indefinite licences with annual fees

The UK also operates a tradeable and indefinite licence system. In 2025, Virgin Media O2 bought nearly 80 MHz of spectrum from VodafoneThree for £343 million. The transaction was designed to correct the spectrum imbalance that resulted from the Vodafone–Three merger. Unlike the US, the UK charges annual fees on indefinite licences, which add a significant ongoing cost of ownership.

Estonia: low-cost annual reissuing

In Estonia, licences are extended annually, provided the annual fees are paid. These fees are set at a very low level compared with auction prices.[17] The regulator can only refuse renewal for specific legal reasons, such as interference, health or environmental concerns, national security or inefficient use.[18] Although trading is permitted, it is rarely observed except when linked to the sale of an entire business. Mobile spectrum holdings are relatively balanced among the country's three operators.



14. "AT&T Closes Acquisition of Spectrum Licenses from EchoStar", AT&T, July 2026
15. "FCC approves Verizon's $1 billion spectrum purchase", Reuters, May 2026
16. "T-Mobile US poised to spend big on Comcast spectrum", Mobile World Live, September 2023
17. "Riigilõivumäärad numbriloa ja sagedusloa andmise ning kehtivusaja pikendamise eest", Riigi Teataja, April 2019
18. "Elektroonilise side seadus", Riigi Teataja, August 2026

2. THE ECONOMIC IMPACT OF PRICING RENEWALS



2.1 Pricing renewals to encourage network investment

Rationalisation of pricing during renewals can help deliver network investment and improve consumer outcomes such as network speeds. The impact of different pricing approaches on the quality of mobile infrastructure extends to the global economy, as better connectivity leads to economic growth. An analysis of four representative pricing approaches shows how policy choices can drive spectrum cost, consumer outcomes and economic growth.[19]



As a whole, the cumulative spectrum cost between 2026 and 2035 could reach over $600 billion if prices are not rationalised. Even in scenarios that assume adjustment, the cumulative cost will exceed $400 billion due to amortisation of existing licences and annual fees.

We outline four scenarios below:

Scenario 1:
historical prices

Renewing licences based on past prices would incur an annual cost of $60–70 billion, maintaining elevated spectrum cost at 7% of operator revenue.

Scenario 2:
adjustment of prices in high-cost countries

Price adjustment to recent benchmarks in high-cost countries could partially prevent rising costs, but still results in an annual cost in excess of $60 billion, or 6% of operator revenue.

Scenario 3:
renewal prices linked to revenue per megahertz

If renewal prices are indexed to revenue per megahertz values, the cost will gradually decline to about $47 billion a year, or just under 5% of operator revenue.

Scenario 4:
automatic renewals

If licences were renewed automatically with no additional charges, spectrum cost would gradually decline to around $30 billion a year by 2035 (3% of operator revenue), with the remaining cost due to licences with expiry dates after 2035 and annual fees.

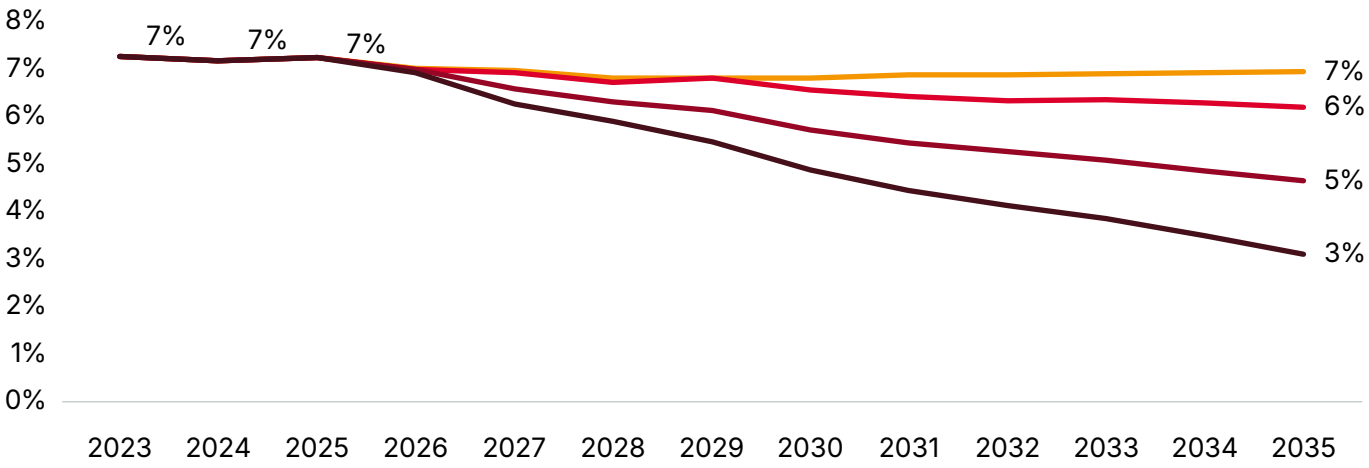
19. See the appendix for the full methodology

2.2 Impact on spectrum-cost-to-revenue ratio

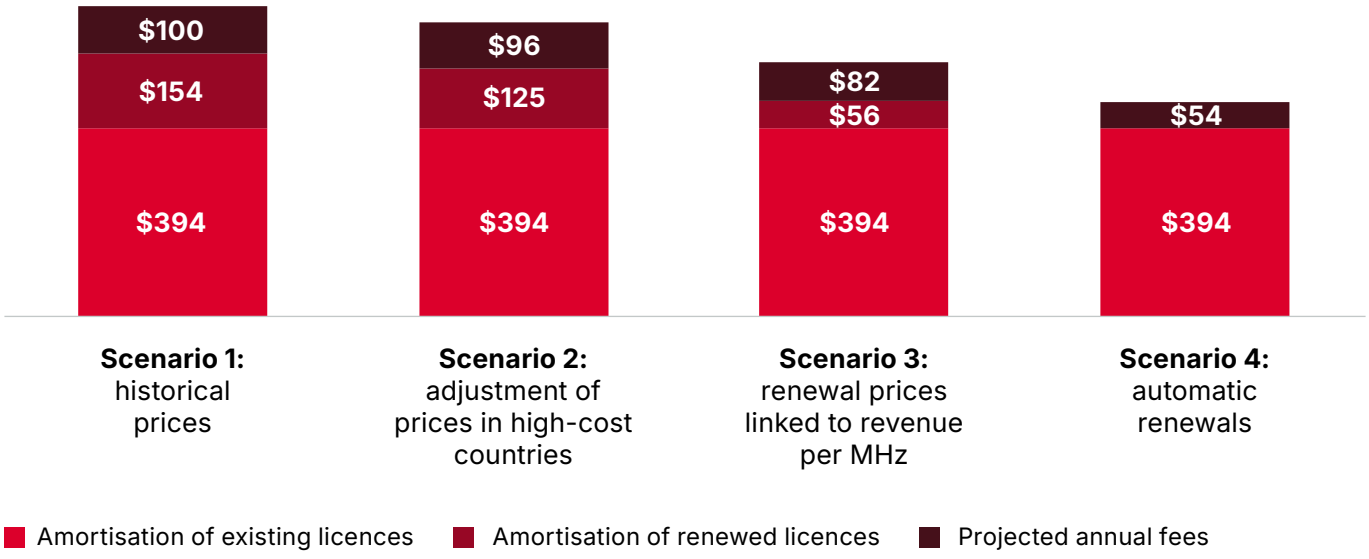
Spectrum renewal reform has the potential to reduce the impact of spectrum costs relative to operator revenues (see Figure 6). Rationalisation of pricing could free up to $200 billion, allowing operators to redirect funds to invest in networks improvements.

Figure 6
Global average spectrum-cost-to-revenue ratio and monetary cumulative cost projections

Spectrum-cost-to-revenue ratio



Aggregate cost of spectrum by component during 2026–2035 (billion)



Source: GSMA Intelligence estimates
Note: Based on a group of countries where data could be obtained.

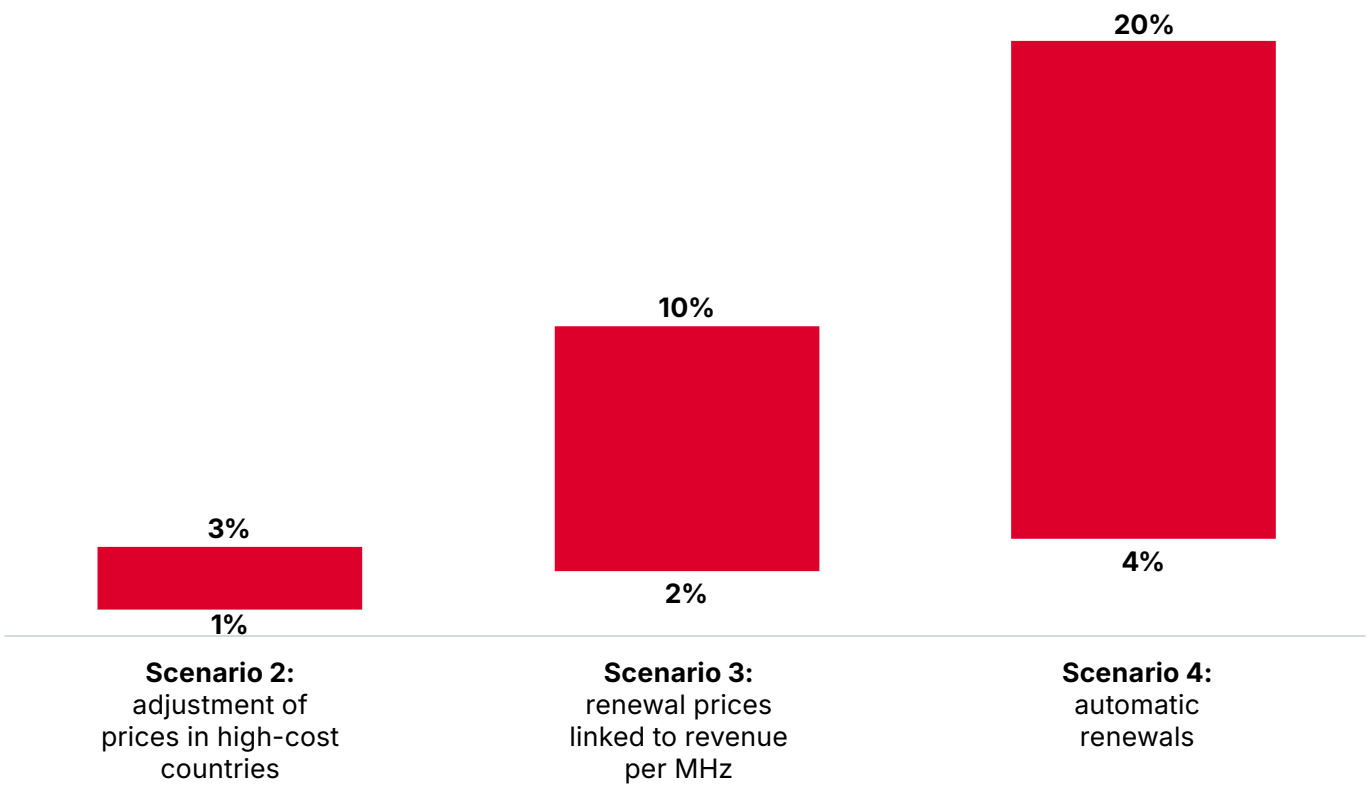
2.3 Impact on network speeds

Lowering spectrum costs encourages network investments, which leads to network improvements for consumers and businesses.

Taking scenario 1 (historical prices) as the worst case scenario, each of the other scenarios can demonstrate a measurable improvement in speeds (as modelling uncertainty exists, this is shown as a range):

- **Adjustment of prices in high-cost countries** could improve speeds by 1–3%.
- **Renewal prices linked to revenue per megahertz** could improve speeds by 2–10%.
- **Automatic renewals** could improve network speeds by 4–20%.

Figure 7
Modelling results: the impact on average network speeds in 2035 compared to scenario 1: historical prices



Source: GSMA Intelligence estimates

Note: For each scenario, figures are presented as a range to indicate the uncertainty arising from the choice of parameters used in modelling. The range reflects lower and upper bounds based on the empirical literature that quantifies the impact of spectrum costs on network quality. Based on countries where reliable spectrum cost data could be obtained.

2.4 Economic impact

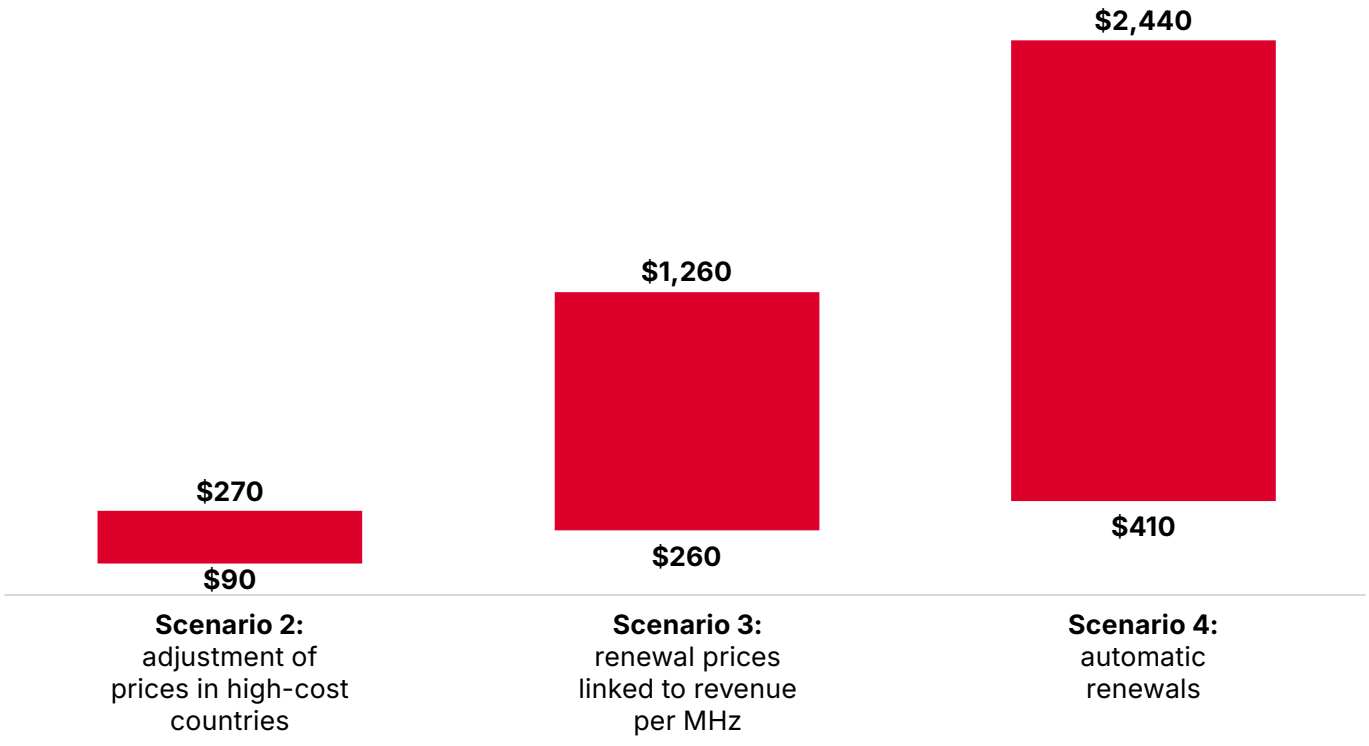
Adjusting spectrum pricing to avoid the build-up of spectrum costs can subsequently have an impact on economic growth.

As better networks enhance economic productivity, the impact in relation to scenario 1 is as follows:

- **Adjustment of prices in high-cost countries** would bring a moderate increase in global GDP of at least $90 billion.
- **Renewal prices linked to revenue per megahertz** would boost global GDP by at least $260 billion.
- **Automatic renewals** would drive the greatest economic benefits of at least $410 billion.

Figure 8:
Modelling results: cumulative 2026–2035 GDP impact of improved network quality compared to scenario 1: historical prices

Billion, inflation-adjusted to 2024 prices



Source: GSMA Intelligence estimates

Note: For each scenario, figures are presented as a range to indicate the uncertainty arising from the choice of parameters used in modelling. The range reflects lower and upper bounds based on the empirical literature that quantifies the impact of spectrum costs on network quality. Based on countries where reliable spectrum cost data could be obtained. Figures are rounded to the nearest 10 billion.

Case study

Enabling investment with renewals and longer licence durations in France and Spain

France's 'New Deal' in 2018

In 2018, France renewed licences in the 900, 1800 and 2100 MHz bands. Instead of charging renewal fees, the regulator (Arcep) required operators to accelerate 4G rollout in rural areas and improve coverage nationwide.

By December 2025, the decision had contributed to significant improvements in network and consumer outcomes:

- 99.5% of targeted 'white zone' sites had 4G.
- The share of land covered by all four operators with 4G rose from 45% to 88%.
- The share of land in 4G 'white zones' decreased from 11% to 2%.
- Almost two thirds of the population now had access to 30 Mbps or faster (up from 37%).

This showed that removing or reducing spectrum costs in exchange for coverage commitments can drive significant investment in rural networks.[20]

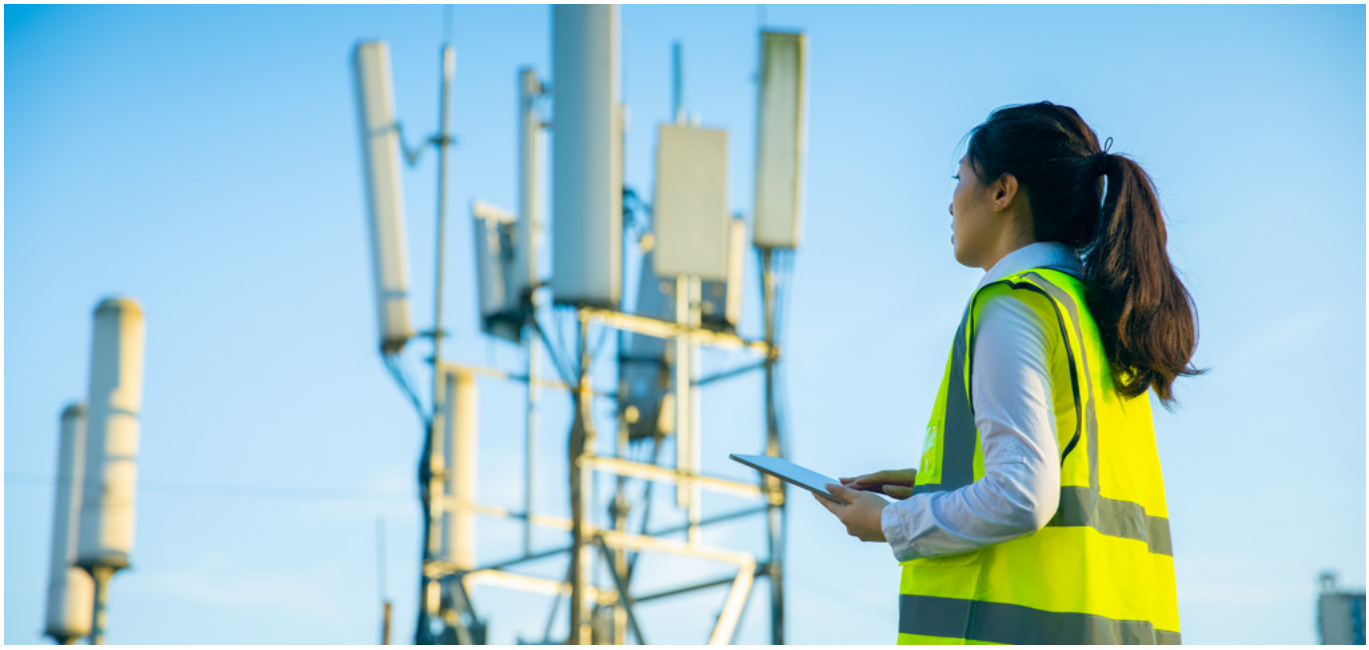
Spain's approach to licence renewals and universal coverage

In 2022, Spain extended all existing mobile licences by 10 years (up to a maximum of 40 years) with no extra costs beyond the current annual fees and no obligations. The government expected this to stimulate network investment and give operators certainty for long-term planning, especially for bands being refarmed for 5G.

Instead of attaching obligations to licences, Spain subsequently launched the UNICO 5G programme in 2023 to fund rural 5G rollout. Key parts included:

- up to €508 million to deploy over 7,000 rural 5G sites, covering more than 1.8 million people and 30,000 km of roads
- an extra €161 million awarded in 2025 for 2,000 additional sites.[21]

The initial outcomes from this decision are positive. Between 2023 and 2024, overall 5G coverage rose by 3.5 percentage points (pp), driven mainly by rural areas, where coverage increased by 11 pp to over 80% of the rural population.[22]



20. "Suivi du New Deal Mobile", Arcep, 2026
21. "Spain's big-three take home extra rural 5G SA cash — report", TelcoTitans, December 2024
22. Cobertura De Banda Ancha en España en el Año 2024, State Secretariat for Telecommunications and Digital Infrastructures, 2025

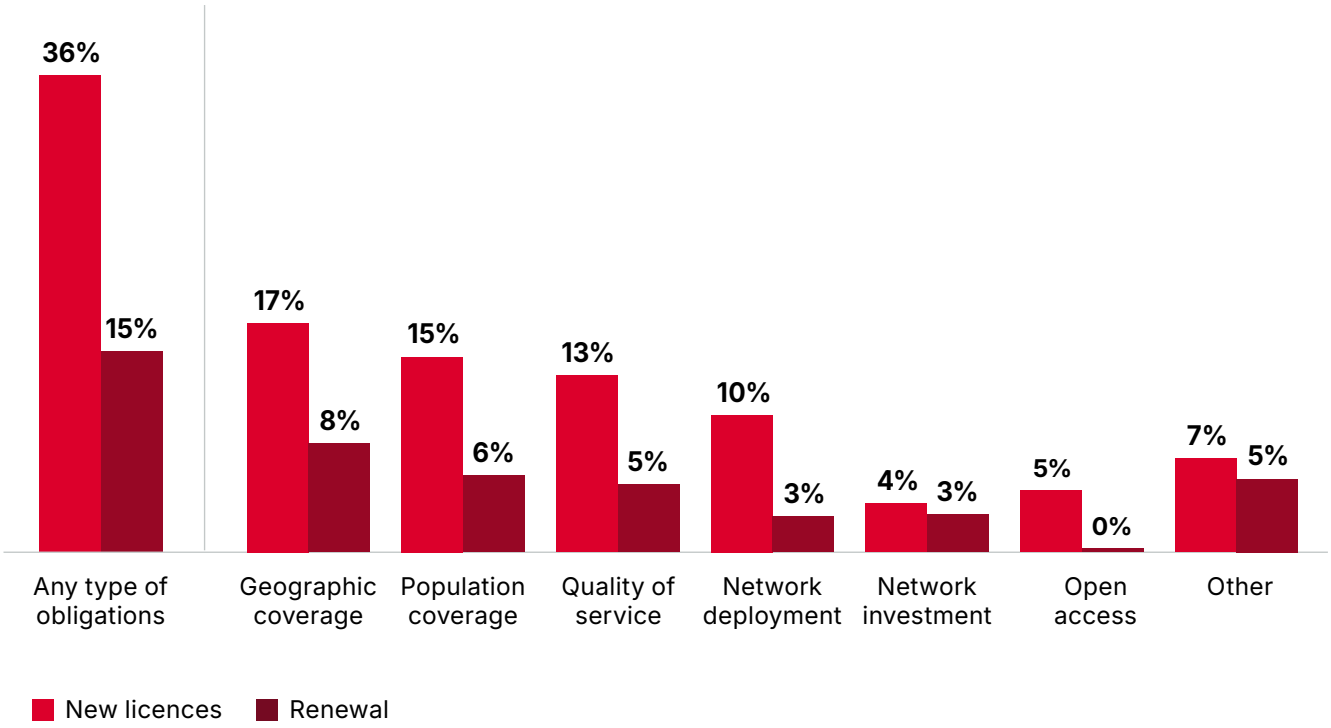
3. BEST PRACTICE IN DESIGNING OBLIGATIONS



Besides setting spectrum prices, regulators also place obligations in spectrum licences with a view to ensuring that the value of spectrum is maximised. This creates a burden on the licence holder and obligations should therefore be designed carefully. Where they are poorly designed, this can even lead to higher regulatory costs or inefficient investments, potentially resulting in returned spectrum.

Obligations have historically been used more often in awards of new spectrum than during licence renewals (see Figure 9).[23] Among licences assigned to an operator for the first time, 36% included at least one obligation, compared with 15% of renewals. However, part of this difference may also be due to the lower availability of information on renewed licences.

Figure 9
Frequency of the use of obligations



Source: GSMA Intelligence Spectrum Navigator Database

Note: New licences include licence transfers. Percentages do not add to totals as some licences have multiple types of obligations attached. Sub-national licences were aggregated to national.

23. Spectrum Navigator, GSMA Intelligence

We find examples of the following:

- **Coverage obligations** (geographic and population) dominate as the most common type.
- **Obligations related to service quality and network rollout** are also relatively frequent on new licences. Network deployment obligations typically concern targets such as physical deployment of a particular generational upgrade (e.g. 5G, 5G standalone) or a launch of consumer services supported by it.
- **Network investment obligations** concern monetary investment targets, sometimes also expressed in terms of the number of base stations deployed. They are the least used among the major categories.
- **Open access requirements** are relatively rare and appear to be almost exclusively applied to new licences or transfers. They typically seek to ensure offering of fair terms to MVNOs or to ensure that industries can lease capacity in geographic areas where spectrum is not fully utilised by operators.
- **Other obligations** include, among other examples, requirements to provide social and discounted tariffs or to provide services and devices to the public sector. In many cases, the ability to fulfil these obligations is not dependent on spectrum ownership. Hence these objectives should generally not be considered as a matter of spectrum regulation.

Given the range of targets and approaches, a thorough process is required to ensure that obligation targets are closely aligned with economic and social objectives, and that the terms maximise the chance of success (see Figure 10).

Figure 10
Setting obligations in three steps

1

Define the objective and shortlist obligation types that closely target the ultimate goal

- Clearly define the policy objective that justifies imposing the obligation (e.g. addressing rural underprovision or improving road coverage).
- Identify and compile a focused shortlist of feasible obligation types (e.g. coverage obligations, quality-of-service targets) that could address the policy objectives.
- Favour targets that closely follow the desired outcome, rather than intermediate metrics (e.g. coverage outcomes rather than the number of base stations).

2

Value costs and benefits to choose the right level of obligation and incentive to operators

- Use economic modelling to quantify the expected benefits for different levels of obligation. Use technical modelling to understand the level of investment required by operators, to avoid setting obligations too high and risk unsold spectrum or no uptake.
- Evaluate the cost-benefit ratio against the relevant thresholds and choose the right target level.

3

Provide flexible choices and maximise the chance of success

- Rely on optional incentive-based commitments to improved network quality in exchange for low-cost renewal.
- Use conservative targets to ensure operator participation. Allow consortia to form and promote efficient fulfilment of obligations.

Source: GSMA Intelligence

3.1 Objectives and obligation types

In the initial step, economic principles can be applied to assess the case for obligation use. Obligations can improve market outcomes when the market does not fully account for all benefits and costs (see Table 3).

Table 3
Assessing obligations against market-driven outcomes

1 Identify potential externalities (effects not priced in by economic actors)	Mobile connectivity brings positive externalities, such as the network and spillover effects, and can deliver further public benefits through digital inclusion in areas such as education, health, safety and national security. Hence, obligations that improve access and quality can improve market outcomes. They work best for network externalities where social benefits are diffuse and hard to monetise privately.
2 Assess whether networks are underprovisioned due to the difference between the private and social discount rate	Operators access capital from markets and undertake investment only when they are able to recover its initial cost. Governments and society usually take a much longer and broader view. Better connectivity can support jobs, education, business growth and quality of life for many decades. Because of this difference in time horizons, private markets often invest less in networks than would be best for society overall. The gap is especially large for projects that take many years to become profitable, such as rural mobile networks. Mobile networks typically have long payback periods. As a result, the level of investment undertaken by operators can be lower than the level that would maximise benefits for society.

Source: GSMA Intelligence



Obligations can target different outcomes through a number of metrics, but the general guiding principles are to define targets and monitoring in a way that encourages maximum cost efficiency and flexibility (see Table 4). Each type of target also comes with specific challenges related to how it is defined and how the progress is measured to closely track the ultimate objectives.

Table 4

Obligation targets and monitoring principles

Obligation type	Targets and monitoring
Population and geographic coverage 	The ability to meet wide coverage targets is closely linked to lower-frequency spectrum (below 1 GHz). These obligations are therefore usually considered along the renewal or award of sub-1 GHz licences. Coverage targets and monitoring should be based on real-world technical performance. For example, the signal strength thresholds should be aligned with typical real-world performance requirements. When obligations are used to improve coverage in specific areas, targets should be set as a share of the population rather than 100% coverage. This is because the cost of reaching the final 1% or 0.1% of the population rises sharply. The same principle applies to coverage of transport corridors (road, rail and waterways): targets should allow operators to exclude the most difficult and least-used sections, where the cost would outweigh the benefits. Monitoring should use sampling over reasonably large areas and longer time periods so that results can be averaged.
Network quality (speeds and latencies) 	Speed and latency targets should reflect the needs of use cases and the extra benefits that higher quality would deliver. While more detailed geographic areas and frequent measurements can allow more precise monitoring, very small areas and short time periods are easily affected by temporary fluctuations. This can increase compliance costs without improving outcomes. Therefore, sufficiently large measurement areas and longer time periods should be used to allow for averaging and more efficient network deployment. Measurements can be affected by the mode of collection (drive-by, crowdsourced or self-reported by operators). It is important to understand how these can affect the readings and adjust targets accordingly.
Network deployment and investment 	Investment and deployment targets should be kept as flexible as possible. Where practical, operators should be allowed to choose which locations to build in and in what order. This leads to more efficient use of resources. Operators naturally tend to expand first into areas that will see the greatest uptake and are therefore close to becoming commercially viable. This usually aligns well with maximising social benefits, as these areas also exhibit the highest incremental benefits. When obligations target specific locations or timelines, flexibility can be increased by allowing operators to agree among themselves which operator can bring services to specific localities and by permitting infrastructure sharing.

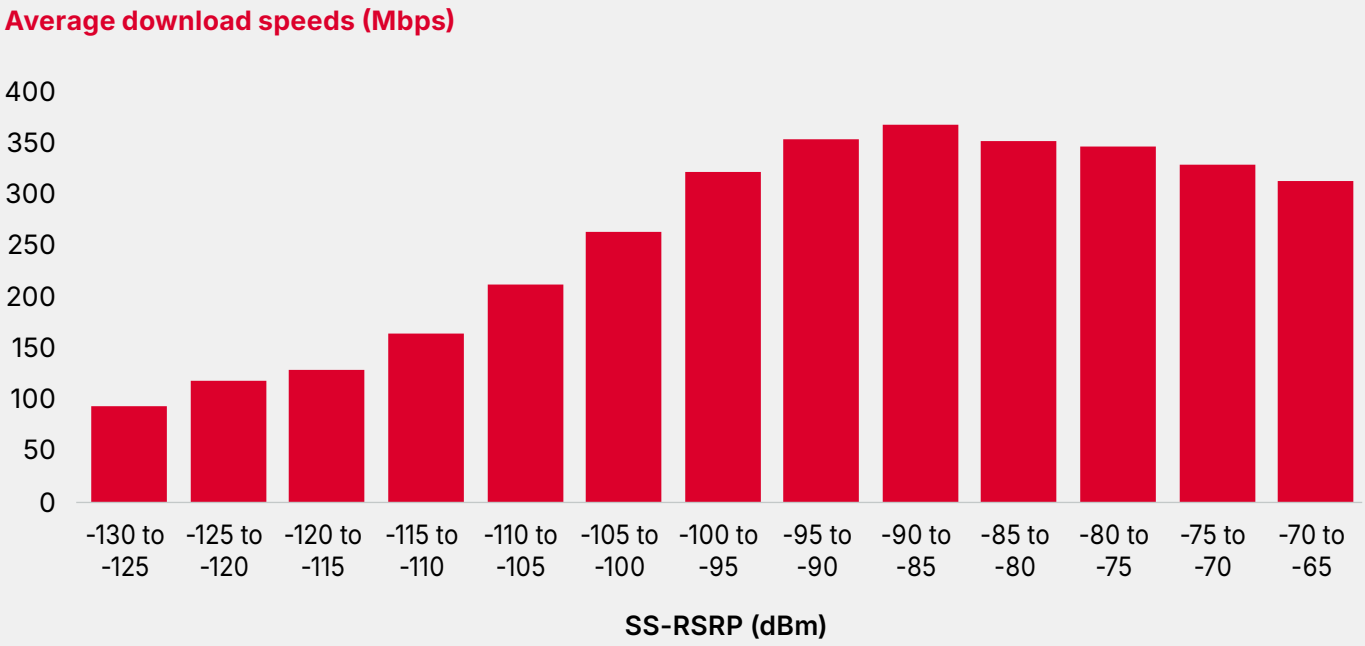
Source: GSMA Intelligence

Case study

Signal strength thresholds in coverage obligations

Signal strength thresholds in coverage obligations should be based on real-world performance data. In simple terms, an area is considered covered if the signal strength exceeds a set level. Common measures include reference signal received power (RSRP) and synchronisation signal reference signal received power (SS-RSRP). These thresholds should reflect the signal strength needed to deliver acceptable speeds and reliability for everyday use (see Figure 11).

Figure 11
5G network speeds by signal strength threshold



Source: GSMA Intelligence analysis of Ookla® Mobile Network Performance Dataset
Note: Arithmetic average based on selected regions of Australia, Brazil and the UK (2024 data).

Why thresholds matter

In Benin, the regulator set a very strict 4G signal strength threshold, at −90 dBm.[24] Reaching 99% population coverage at this level was estimated to cost one large operator around $900 million due to the need for many more sites. More realistic thresholds would deliver very similar experience and benefits at a much lower cost of around $80 million. With additional policies to boost consumer adoption, the extra cost could fall further to around $10 million.

The case of Benin clearly shows that above a certain level, meeting the stringent availability and quality obligations becomes too costly and is unlikely to generate sufficient benefits. In such cases, the policy may have the opposite effect to what it aimed to achieve. If obligations are too demanding, the costs may be passed on to consumers or lead to reduced investment in network improvements.

24. Driving digital transformation of the economy in Benin, GSMA, 2024

Case study

Land, population and transport infrastructure obligations in Germany

In March 2025, Germany's regulator (BNetzA) extended spectrum usage rights in the 800, 1800 and 2600 MHz bands until 2030. The extension aligned expiry dates across bands and introduced obligations covering land area, population and transport infrastructure to encourage wider use of spectrum. A potential drawback of the relatively short five-year extension is that it may not provide enough long-term certainty for major network investments.

The obligations include three main elements, each designed to provide a degree of flexibility for operators:

- **Land service quality:** Each operator must deliver at least 50 Mbps downlink across 99.5% of Germany's surface area by 2030. Operators can choose where to deploy to minimise costs.
- **Population service quality:** Operators must provide a minimum downlink speed to at least 99% of households in thinly populated municipalities within each federal state. This targets equity while allowing operators to prioritise cost-effective areas.
- **Transport infrastructure:** Targets vary by road type. Main roads require 100 Mbps, while more difficult short sections (under 300 m) can be excluded if continuous service is maintained through technical solutions.

Operators are encouraged (but not required) to cooperate through infrastructure or spectrum sharing, except on certain rail routes. Progress is monitored through operator reporting, supported by independent drive tests. Overall, the obligations aim to balance wider social benefits with operational flexibility, though the short extension period may limit incentives for very long-term investment.



25. Decision on not ordering award proceedings and on extending spectrum rights at 800 MHz, 1800 MHz and 2600 MHz and decision on carrying out competitive proceedings at a later point in time, BNetzA, 2025

3.2 Valuation of benefits and costs

Once the preferred policy objectives and targets have been identified, the benefits of different types and levels of obligations need to be measured in a common unit, typically in monetary terms. These can then be compared to the opportunity cost to allow for a cost–benefit analysis. Different types of obligations require different approaches and supporting evidence (see Table 5).

Table 5
Examples of evidence supporting a cost–benefit analysis

Obligation type	Evidence
Population and geographic coverage 	A 1 pp increase in overall mobile network coverage contributes 0.018–0.023 pp to GDP growth.[26] A 10% rise in mobile adoption increases GDP by 0.5–1.2%.[27]
Network quality (speeds and latencies) 	A 10% increase in mobile broadband speed is associated with 0.2% increase in labour productivity.[28] A 10% substitution from 2G to 3G raises GDP per capita growth by 0.15 pp. 4G could add 0.5–0.7% to annual GDP (via time savings/productivity). Doubling mobile data use (tied to speed upgrades) added 0.5 pp to growth in some analyses.[29]
Network deployment and investment 	Intermediate analysis is required to examine how meeting obligations will impact relevant populations and change adoption and/or quality of experience. Additionally, some indirect and induced economic benefits may be quantified using input–output analysis to reflect the wider economic activity stimulated through investment undertaken to meet the obligation.

Source: GSMA Intelligence review

26. Mobile Phones and Local Economic Development, Mensah, Justice Tei, 2023
27. Mobile technology: two decades driving economic growth, GSMA Intelligence, 2020
28. The economic impact of mobile broadband speed, H. Edquist, 2022
29. The impacts of mobile broadband and 5G, Deloitte, 2018



The approach to understanding the cost of meeting different levels of obligation can depend on whether the regulator intends to use an administrative process to assign obligations or to rely on markets:

- Administrative approaches place a heavy burden on the regulator, particularly when obligations are mandatorily bundled with spectrum licences. The regulator should develop detailed, accurate estimates of both benefits and costs to set feasible obligation levels and associated incentives. Errors in these estimates can lead to obligations that are either too burdensome (causing spectrum handback or reduced investment) or too weak (failing to deliver desired societal outcomes). This approach requires the regulator to possess or commission extensive specialist technical and economic modelling.
- Market-based approaches significantly reduce the regulator's need for precise, detailed cost analysis. For example, during a reverse auction operators have the strongest incentive to reveal their true costs and the most efficient technological or operational solutions, drawing on their own specialist knowledge and commercial incentives. Regulators still benefit from a good understanding of likely costs and benefits when setting the initial obligation level and incentive size, but they no longer need to replicate operators' detailed internal modelling.

A suitable level of obligations can be chosen based on cost–benefit ratios. As costs often rise sharply for higher coverage and speed targets, regulators should test different obligation levels to identify the best value for money and compare the benefits against standard public-sector investment benchmarks.

Case study

Austria unbundles coverage obligations and uses a reverse auction

In 2020, the Austrian Regulatory Authority for Broadcasting and Telecommunications (RTR) held an auction for the 700, 1500 and 2100 MHz bands. It combined multiple approaches to obligations (see Figure 12).[30]

Figure 12
Obligations in Austria's multiband auction in 2020



Source: RTR

For hard-to-reach communities, operators bid on how much of a discount on spectrum fees they would accept to cover them. This approach allowed the market to reveal the true cost of covering hard-to-reach areas. In some cases, obligations were not assigned because the cost would have exceeded the available discount and the likely benefits.

All available spectrum was sold and coverage obligations for 1,702 underserved communities were assigned through the reverse auction. One operator, Telekom Austria, acquired no 700 MHz spectrum but took on obligations to cover 349 communities, showing that different operators can be best placed to deliver different types of obligations.[31] Overall, operators met their obligations in all but 46 communities and were fined a total of €1.8 million for the shortfalls.[32]

The auction demonstrated that using market mechanisms to separate spectrum awards from the costliest coverage obligations can improve efficiency and reduce the risk of spectrum going unsold or obligations remaining unmet.

30. Coverage obligations, RTR, 2020
31. For further details, see Auction results, RTR
32. Communications Report 2024, RTR, 2024

Case study

A quasi-market approach to obligations in Portugal's renewal of 2.1 GHz licences

In 2016, Portugal's regulator (ANACOM) renewed the 2.1 GHz licences for three operators for 15 years.[33] As a condition of renewal, it imposed mobile broadband coverage obligations in 588 parishes where commercial rollout was unlikely. In each parish, at least 75% of the population had to receive speeds of 30 Mbps or more. No major upfront fees were charged.

Instead of assigning the parishes itself, ANACOM gave the operators one year to voluntarily agree on how to divide them. The operators reached full agreement in 2017 and ANACOM accepted the distribution.[34] This approach allowed operators to allocate parishes according to their existing networks and costs, reducing overall compliance costs while still meeting the regulator's targets. Bilateral swaps were later permitted with approval.

A 2022 compliance check showed strong results: 134 out of 135 sampled parishes were compliant, with 93.6% population coverage at 30 Mbps or above, well above the 75% target.[35]

Portugal's 2016–2017 renewal demonstrates a pragmatic hybrid model: regulatory imposition of socially desirable coverage obligations tied to valuable spectrum rights, combined with a light-touch, negotiation-based implementation that leveraged operators' commercial incentives. The voluntary parish-distribution mechanism proved effective, delivering efficient outcomes with minimal regulatory micromanagement.



33. "ANACOM imposes obligation to extend mobile broadband coverage to a further 588 parishes", ANACOM, March 2016
34. "Agreement for distribution of the 588 parishes", ANACOM, May 2017
35. "ANACOM verifies compliance with mobile broadband coverage obligations", ANACOM, January 2023

3.3 Offering incentives and flexibility to encourage operator participation

Lastly, the preferred obligation type and level should be translated into an offer to operators. This step is critical to ensure participation and, ultimately, determine whether these obligations will support policy goals or become counterproductive.
The following factors help make offers flexible and attractive:

1 Favour incentive-based opt-in obligations over mandatory targets for operators	Mandatory targets for licence holders should generally be avoided, as overly ambitious targets risk operators returning spectrum, reducing competition and undermining efficient spectrum use. Incentive-based obligations work best, as they provide incentives for operators (e.g. discounts on renewal fees or direct payments), which agree to meet a given target. This ensures that the net cost to operators does not exceed the incentive value. If bids are insufficient, the obligation is not assigned, avoiding uneconomic commitments.
2 Unbundle obligations from spectrum licences	The operator best placed to use a spectrum lot is not always the one that can fulfil an obligation at lowest cost. Separating the two reduces overall costs and maximises societal value. Incentives (fee reductions or payments) should therefore be available to any operator, not just operators whose licences are nearing expiry. However, operators still need spectrum access certainty when committing to specific targets, so obligations and licences can be simultaneously examined even if unbundled.
3 Use market-based and non-market approaches where appropriate	Obligations can be awarded via market mechanisms, similar to spectrum auctions. A reverse auction for optional obligations lets operators reveal true costs through bidding, encourages efficient solutions (including consortia and innovation) and reduces the need for detailed regulatory cost modelling while ensuring benefits exceed costs.
4 Offer flexible, well-packaged options	Obligations should be presented as a menu of clear options (e.g. packages for coverage/quality in specific areas or user groups) rather than rigid requirements. Consortia and any technology that meets the outcomes should be allowed. This lowers compliance costs, boosts participation and ensures obligations are delivered at minimal societal cost.

To deal with uncertainties, targets should be set cautiously and implementation should be flexible:

- **Obligation levels need to be set conservatively.** At high target levels, the cost can exceed the benefits, especially due to costs being frequently underestimated (optimism bias). Poorly designed obligations could impose an even greater cost than the initial price operators paid for spectrum. At the same time, discounts on spectrum fees need to be set at a level that encourages operators to take up the obligations while reducing the risk that spectrum will be returned or operators will not commit. Therefore, targets should be set cautiously to increase the social value of spectrum.
- **Flexibility is preferred.** Regulators frequently use market-based approaches to decide the best level of obligations. They also give operators the flexibility to choose whether or not to accept them. Proposals are usually published and consulted on in advance. This allows stakeholders to provide evidence and to challenge or support the assumptions being used.

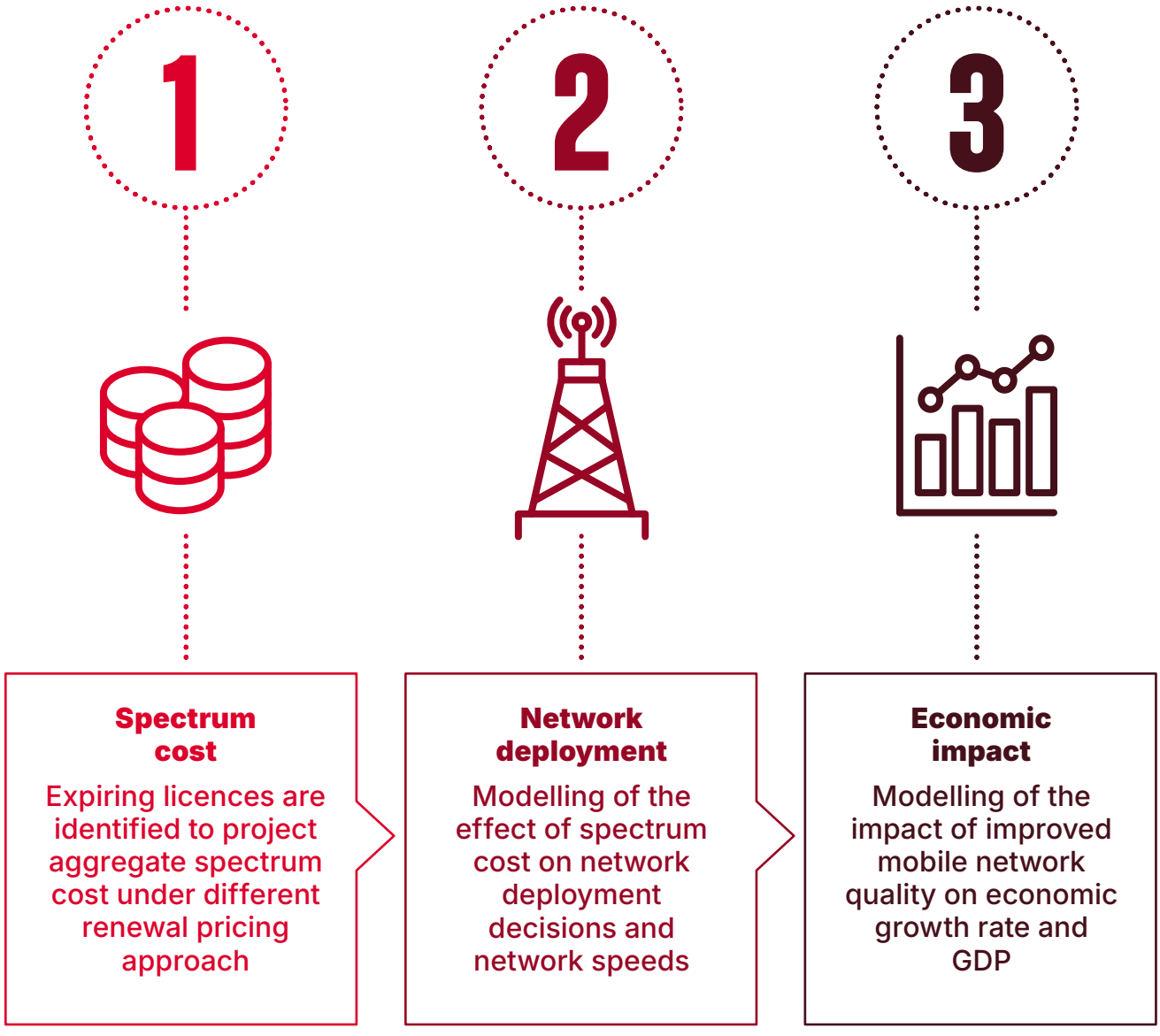
APPENDIX



Modelling the economic impact of renewals

The estimates of the impact of renewal pricing on network deployment and economic performance are based on robust evidence linked in three steps (see Figure 13).

Figure A1
Modelling approach in three steps



Source: GSMA Intelligence

There are four illustrative scenarios with defined pricing assumptions, aligning with the pricing approaches described earlier (see Table A1).

Table A1
Modelled spectrum pricing scenarios

Name	Description and rationale	Spectrum cost
Scenario 1: historical prices	Under this scenario, the real-terms renewal cost is the same as the original licence cost (adjusting for inflation and population growth since the initial assignment).	Very high
Scenario 2: adjustment in high-cost countries	This scenario examines the impact of only a partial adjustment to prices during renewals: – For countries with aggregate spectrum-cost-to-revenue ratios above the global average, we assume renewal at prices aligned with an international benchmark based on assignments from the last five years (adjusted for population and purchasing power parity). – For countries with aggregate spectrum-cost-to-revenue ratios below the global average, we assume renewal at historical prices (as in scenario 1).	High
Scenario 3: prices linked to revenue per MHz	Under this scenario, renewal prices are adjusted in line with fundamental drivers of commercial spectrum. Renewal prices will adjust in proportion to the decline in revenue per unit of spectrum that operators earn since the original assignment.	Medium
Scenario 4: automatic renewals	This scenario projects cost under conversion to indefinite licensing or renewal based on assured continued maximisation of value with no additional fees. Despite no renewal charges, spectrum cost in this scenario does not decrease to zero, as many licences assigned before 2026 will continue to be amortised until 2035 and later.	Low

Source: GSMA Intelligence assumptions and calculations

All scenarios assume that licences will be renewed for the same period as the original assignment. We also focus on renewals only and do not make any assumptions on the cost of additional spectrum that will likely be made available over the next decade, such as the 600 MHz and the upper 6 GHz bands.



Scenario definition

We build spectrum cost scenarios based on licence-level data from the GSMA Intelligence Spectrum Navigator database. We assume different renewal pricing approaches as defined in the scenario assumptions in Chapter 2. To calculate the amortised cost of licences and benchmarks for unit prices, we rely on adjustment for the weighted average cost of capital (WACC).

Adjustment for the WACC reflects the time value of money when operators are required to pay upfront for a licence with a given duration. The WACC adjustment amortises the cost of a licence over its duration, taking into account the cost of capital required to make an upfront payment (or a given schedule of instalments).

The WACC-adjusted annualised payment is calculated using a formula converting the present value of a lump-sum payment into an equivalent annuity with payments over the duration of the licence.

Equation 1

Adjustment of upfront cost based on the cost of capital

$$\text{WACC-adjusted annualised licence cost} = \frac{\text{Upfront cost}}{\dfrac{1 - \left(\dfrac{1}{1 + \text{WACC rate}}\right)^{\textit{Duration in years}}}{\text{WACC rate}}}$$

Hence, the present value (discounted value) of the annualised cost is equal to the present value of the lump sum.

We rely on the spectrum-cost-to-revenue ratio as a measure of the total cost of spectrum from all active licences owned by an operator. For each operator, we calculate the spectrum-cost-to-revenue ratio as specified in Equation 2.

Equation 2

Formula of spectrum-cost-to-revenue ratio

$$\text{Spectrum cost to recurring revenue ratio} = \frac{\text{WACC-adjusted annual upfront cost of all active licences} + \text{Annual spectrum fees}}{\text{Annual recurring revenue}}$$

The WACC-adjusted annualised spectrum cost for each active licence is calculated as outlined above. The cost of licences that started or expired during a particular year is attributed in proportion to the number of days the licence remained active in a given year. For example, if a licence ended on the 100th day of the year, only 100/365 of the annualised cost of the licence was attributed to that year.

Annual recurring revenue historical data and projections have been sourced from the GSMA Intelligence database.[36] Recurring revenue is defined as revenue from mobile subscriptions, excluding other streams such as sales of devices.

36. https://data.gsmaintelligence.com/data

Impact modelling

The impact model is a parameterised calculator tool incorporating inputs on spectrum cost and baseline economic projections. The baseline forecasts regarding key economic and mobile-sector indicators are obtained from GSMA Intelligence and the IMF.[37] We then use parameterised equations to estimate impacts, initially to calculate how a difference in spectrum cost will impact improvements to network quality, and in turn how changes to these will impact economic growth. We rely on the following key pieces of evidence. To measure the impact of spectrum cost on 5G rollout and network speeds, we parameterise the relationship between spectrum cost and network speeds based on the empirical relationship between spectrum cost and speeds estimated by GSMA Intelligence.

To reflect the uncertainty on the magnitude of the effect we rely on a range of parameters, which varied depending on the econometric model and the measure of spectrum cost:

- A lower spectrum-cost-to-revenue ratio is associated with higher network speeds. We estimate a non-linear relationship, which evaluated at a 7% cost-to-revenue ratio shows that halving spectrum costs improves network speeds by 10%.
- Alternative estimates show a non-linear relationship, which evaluated at a 7% cost-to-revenue ratio shows that a 10 pp lower spectrum-cost-to-revenue ratio results in 8.4% higher network speeds.[38]
- Other estimates show that halving of spectrum cost (in per connection terms) boosts speeds by 24%.[39]

We apply these impact parameters to the estimated cost-to-revenue ratios under different scenarios. For each scenario we obtain a percentage difference in network speeds relative to scenario 1 (very high cost). Impacts on speeds could become explosive for lower values of cost-to-revenue ratio and the cost per connection due to these impacts being calculated as a percentage change in speeds for a percentage change in spectrum cost metric. In these instances, we cap the impacts by restricting them at a maximum level before the cost-to-revenue ratio drops to 0.5% or the annual cost per connection drops to $0.1.

Additionally, in instances of a large fall in spectrum cost, we cap these impacts at a 50% increase to network speeds.

In the last step, we estimate the economic impact of improved mobile speeds. There are a number of studies that demonstrate faster broadband speeds (for both fixed and mobile technologies) can drive improved macroeconomic outcomes.[40] For this study, we assume that a 1% increase in speeds delivers a 0.02% increase in economic output. Similarly, we estimate these impacts in relation to scenario 1, our reference scenario. The baseline GDP forecast is based on the IMF WEO database, which provides forecasts of GDP up to 2030. To extend these forecasts to 2035, we extrapolate the last available year's growth rate.

Markets included in the analysis are as follows: Albania, Armenia, Australia, Austria, Bangladesh, Belgium, Brazil, Canada, Chad, Chile, China, Colombia, Republic of the Congo, Costa Rica, Croatia, Czechia, Denmark, Dominican Republic, Ecuador, Egypt, Ethiopia, Fiji, Finland, France, Germany, Ghana, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Lithuania, Malaysia, Mexico, Moldova, Morocco, Mozambique, Netherlands, Nigeria, Norway, Oman, Pakistan, Peru, Poland, Portugal, Romania, Russia, Saudi Arabia, Senegal, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sudan, Sweden, Taiwan, Tanzania, Thailand, The Bahamas, Turkey, Ukraine, the UK, the US, Uruguay and Vietnam.

37. World Economic Outlook, IMF, 2025
38. Global Spectrum Pricing, GSMA, 2025
39. Global Spectrum Pricing, GSMA, 2025
40. See for example Does broadband speed really matter as a driver of economic growth? Investigating OECD countries, International Journal of Management and Network Economics 5 2, no. 4 (2012): 336-356, Rohman, Ibrahim Kholilul and Erik Bohlin; The economic impact of mobile broadband speed, Telecommunications Policy 46, no. 5 (2022): 102351, Edquist, Harald; and Quality of communications infrastructure, local structural transformation, and inequality, Journal of Economic Geography 24, no. 1 (2024): 117-144, Acosta, Camilo and Luis Baldomero-Quintana. A full list of papers is provided in. Socioeconomic benefits of high-speed broadband availability and service adoption: A survey, Telecommunications Policy 48, no. 7 (2024), Wolfgang Briglauer, Jan Krämer and Nicole Palan.

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