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# Review of the ACMA's revised approach to ESL pricing

Prepared by NERA and Aetha Consulting  
on behalf of Telstra

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# 1. Executive summary

This report has been prepared jointly by Aetha Consulting (Aetha) and NERA Economic Consulting (NERA) to evaluate the Australian Communications and Media Authority's (ACMA's) revised approach to benchmarking international spectrum prices for the purpose of setting renewal prices for Expiring Spectrum Licences (ESLs).

The ACMA's previous approach was bespoke. Benchmark prices were adjusted based on an index of mobile services revenue per MHz per population (MSR Index) and subjected to cohort analysis. The ACMA's updated methodology is greatly influenced by a review it commissioned from DotEcon. Many of DotEcon's recommendations are well-founded, and overall, it has encouraged the ACMA to adopt a more orthodox benchmarking methodology. However, it has also prompted the ACMA to adopt a combination of changes that compound to produce a substantial overestimate of the market value of spectrum, especially in the two lower band groups ('Sub-1GHz' and 'Lower 1-3GHz').

Through our review, we have identified four major shortcomings:

1. The methodology fails to account adequately for the well-established decline in spectrum prices observed globally over the past decade;
2. The benchmark dataset contains missing awards and material errors;
3. The ACMA does not explicitly recognise or mitigate the asymmetric risk associated with setting renewal prices above a fair market value; and
4. It applies forward-looking inflation to its estimate of 2025 market value despite persistent long-run price deflation.

Taken together, these issues lead to proposed prices that we believe carry a substantial risk of being above actual fair market value, most notably in the 'Sub-1GHz' and 'Lower 1-3GHz' band groups.

## 1.1 Failure to account for the decline in spectrum prices

Both Aetha and NERA have extensive experience in global spectrum valuation – we have in aggregate supported regulators and operators preparing for more than 200 spectrum awards. We have also published independent analysis of trends in global spectrum prices over time. Based on this experience, our two teams are both firmly of the opinion that **spectrum prices generally rose during the 4G era until around 2015, before falling substantially**. This pattern is particularly pronounced for 'Sub-1GHz' and 'Lower 1-3GHz' spectrum.<sup>1</sup>

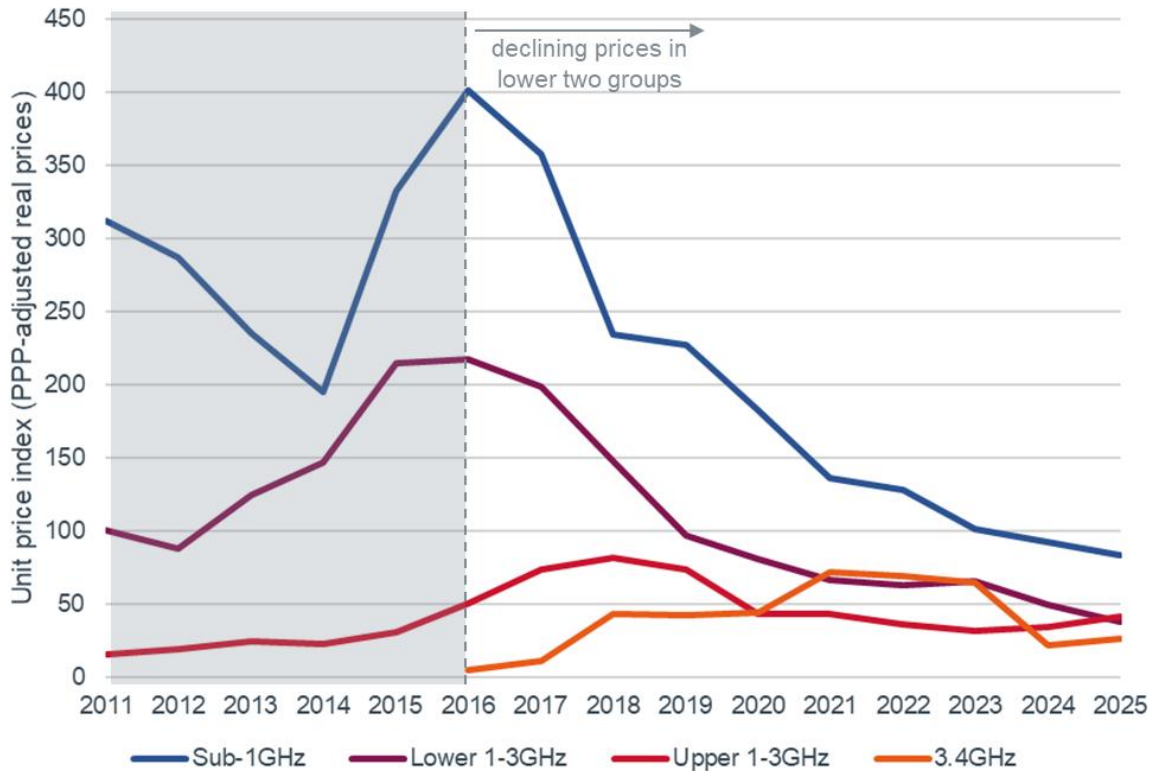
The absence of any mechanism to account for the decade-long decline in spectrum prices is our principal concern with the ACMA methodology and is, in our opinion, the primary cause of a significant overvaluation in the ACMA's preliminary price estimates.

As illustrated in Figure 1, the price trends we describe are clearly visible within the ACMA's own dataset, which shows a price peak around 2015-2016 followed by sustained declines across nearly a decade.

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<sup>1</sup> NERA and Aetha Consulting, September 2024, Setting Prices for Expiring Spectrum Licences in Australia, submitted to the ACMA by Telstra, section 1.2.

**Figure 1: Real spectrum prices (unit price index), three-year moving average**  
 [Source: ACMA data]



Based on DotEcon's advice, the ACMA has adopted two critical changes to its benchmarking approach. It has:

- Removed the MSR Index; and
- Expressed all benchmarks in real rather than nominal terms.

We understand DotEcon's reservations regarding the MSR Index, but with it removed, an alternative mechanism is required to adjust historic benchmarks for trends in spectrum prices over time. This issue is compounded by the decision to express benchmarks in real terms, which inflates historic prices by CPI despite evidence prices have fallen in both real and nominal terms for nearly a decade.

DotEcon and the ACMA have approached this issue by:

- Testing for evidence that spectrum prices have fallen historically, and
- Where they find such evidence, excluding data points from before 2018 and relying only on more recent benchmarks.

We agree with the ACMA's finding that there is strong evidence of a decline in spectrum prices in both the 'Sub-1GHz' and 'Lower 1-3GHz' band groups. However, the DotEcon and ACMA analysis understates the significance of these trends because the statistical approach used (primarily the Mann-Whitney U test) is not the most appropriate for detecting time trends, and the choice of cutoff years is arbitrary and has the effect of obscuring the full extent of price declines. For example, DotEcon fails to find statistically significant evidence of a downward trend in prices in the 'Sub-1GHz' band group – which is evident from more rigorous analysis – or indeed just 'eyeballing' the data.

## Improvements to time trend analysis

In this paper, we present a more robust statistical approach to testing for historical trends in spectrum prices. We use:

- The **Mann Kendall test** (rather than the Mann-Whitney U test) to test for trends in the data, because it is specifically designed to detect monotonic trends in time-ordered data; and
- The **Sen slope estimator** (rather than linear regression) to estimate the slope of the price trend, as it is less sensitive to outliers than linear regression analysis.

We adopt a start date of 2015 for our analysis, as this aligns with our prior published work showing that spectrum prices peaked at around this year AND when we interrogate the ACMA's own data sample, we identify the same peak (as illustrated in Figure 1). We also perform sensitivity analysis to this assumption but find that the results are insensitive to the choice of start date.

Using this approach, we find:

- Very strong evidence of price declines in both 'Sub-1GHz' and 'Lower 1-3GHz' (statistically significant at a greater than 99% confidence level).
- Average annual real declines in prices of ~17% in these two band groups.
- Weaker evidence of declining price trends in the 'Upper 1-3GHz' and '3.4GHz' band groups, but not at levels of statistical significance that may be considered robust.

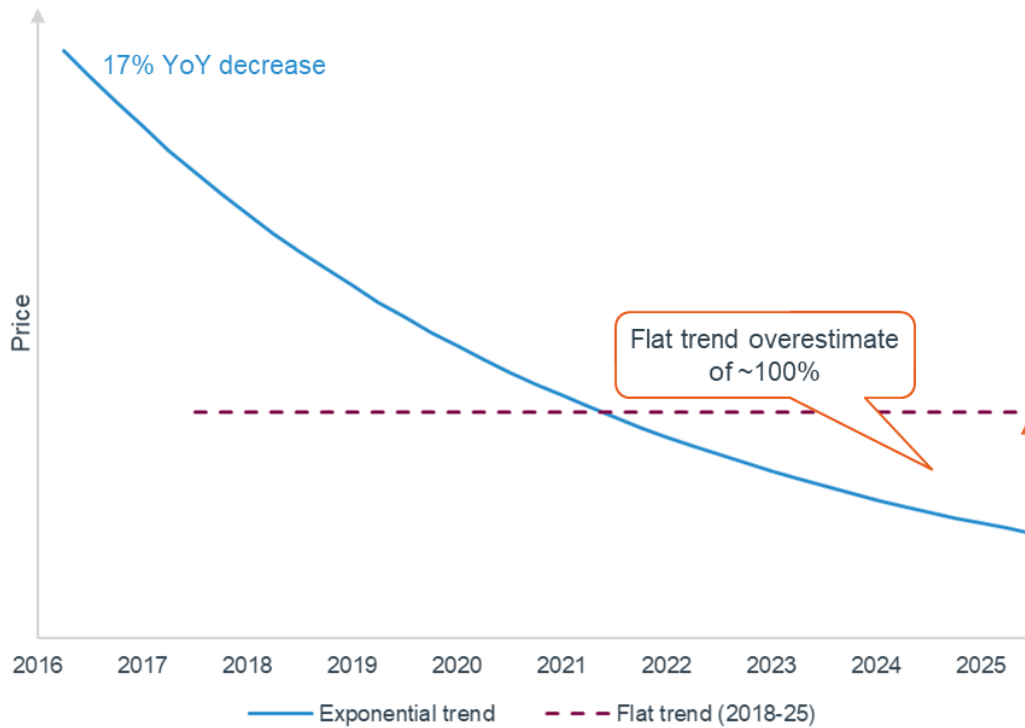
We strongly recommend that the ACMA replicates these tests using their final data sample.

## ACMA's solution where it finds downward pricing trends is inadequate

The ACMA correctly identifies statistically significant declines in the lower two band groups. However, its solution of simply cutting off the first half of the dataset is inadequate and results in a substantial overstatement of today's market value:

- The 2018 cutoff is arbitrary and unrelated to underlying price dynamics.
- The truncation reduces sample size, weakening the reliability of the results.
- The methodology results in an average benchmark being approximately four years old. With a ~17% annual price decline, a simple average from 2018-25 leads to an approximately **100% overstatement of 2025 prices**. Put differently, the ACMA's result is close to an estimate of market value in 2021/22 rather than 2025. This effect is illustrated in Figure 2 below.

**Figure 2: Illustration of the potential overestimate of market value in 'Sub-1GHz' and 'Lower 1-3GHz' band groups from cutting off at 2018 and assuming flat trend**



Using the ACMA's dataset and applying the Sen slope estimator trend, Figure 3 shows the geometric mean ("geomean") of adjusted benchmarks from 2015-2025 for the lower two band groups. This is compared to the ACMA's stage 4 prices and indicates that the ACMA methodology overestimates prices by around ~100%.

**Figure 3: Single-year price estimates for the lower two band groups adjusting for trend**

	Geomean of adjusted data	Median of adjusted data	IQR of adjusted data	ACMA stage 4 price	ACMA overestimate vs Geomean
Sub-1GHz	0.0343	0.0414	0.0217-0.0637	0.0755	120%
Lower 1-3GHz	0.0155	0.0159	0.0097-0.0270	0.0307	98%

For the other two band groups – 'Upper 1-3GHz' and '3.4GHz' – we consider the ACMA's methodology of benchmarking across the whole sample with no adjustments for time trends is currently acceptable. However, given that there is some evidence, albeit not statistically significant, of historic price declines, the ACMA should consider that its estimates of market value carry a **greater risk of overstatement than understatement**. Further, given that the 3.4GHz band was released relatively recently, trends may still be emerging. The ACMA should check for this as and when it updates its benchmarking prior to each renewal.

## 1.2 Missing data points and errors in ACMA's benchmark dataset

The ACMA's dataset is substantially improved over prior consultations, but still incomplete and contains significant errors:

- **50 missing benchmarks** that align with the ACMA's stated inclusion criteria.
- **7 significant pricing errors**, including misapplied licence fee discounts, incorrect population bases, and misapplied payment structures.
- **All US benchmarks should be corrected**, as they use gross rather than net bid values, and/or assume unrealistically short licence terms (10–15 years) despite US operators treating licences as perpetual assets renewed at token fees.

We have re-run our statistical analysis incorporating the above amendments to the dataset. Our estimates of the geomean using our adjusted dataset for the lower two band groups are shown in Figure 4. We again compare this to the ACMA's stage 4 prices and observe that the extent of the ACMA's overestimate increases in the Sub-1GHz band group, but reduces in the Lower 1-3GHz band group.

**Figure 4: Single-year 2025 price estimates for lower two band groups adjusting for trend and amendments to dataset**

	Geomean of adjusted data	Median of adjusted data	IQR of adjusted data	ACMA stage 4 price	ACMA overestimate vs Geomean
Sub-1GHz	0.0315	0.0344	0.0203-0.0606	0.0755	139%
Lower 1-3GHz	0.0180	0.0177	0.0110-0.0388	0.0307	71%

Using the updated dataset also impacts the benchmarks for the 'Upper 1-3GHz' and '3.4GHz' band groups. Applying the geomean for these band groups our estimates are:

- **Upper 1-3GHz: AUD0.019/MHz/pop** using real prices (vs the ACMA's stage 4 price of AUD0.017/MHz/pop) but with a risk of overstatement.
- **3.4GHz: AUD0.014/MHz/pop** using real prices (vs the ACMA's stage 4 price of AUD0.022/MHz/pop) but with a risk of overstatement.

In aggregate, these errors inflate estimated market value. Accordingly, we recommend that the ACMA addresses them. Source material supporting these omissions and errors has been collated and can be provided on request.

## 1.3 Failure to consider asymmetric risk

The ACMA's benchmarking is intended to estimate full market value for each spectrum band group and set renewal prices at this level. Such an approach exposes the Australian economy to significant risk. Benchmarking produces an estimate of market value, but it is **only a best guess based on a noisy sample**. This estimate may be too high or too low. The next step is for the regulator to determine where, within the range of observed benchmarks, to set prices, trading off the risk of setting prices too high or too low.

As we have set out in a previous submission to the ACMA, the risks associated with over-pricing spectrum are much greater than the risks associated with under-pricing spectrum relative to true market value.<sup>2</sup> This is a concept referred to as “asymmetric risk”. If spectrum is inadvertently priced above market value, operators will look to economise on its use, potentially declining to renew all their holdings. This would result in a valuable resource being underutilised, which is harmful to industry, consumers and ultimately the economy. In contrast, if spectrum is priced below market value, there is no meaningful economic downside, only a modest transfer of economic surplus from government to industry, much of which may be competed away downstream to the benefit of consumers.

Our concern is that the ACMA has not meaningfully considered asymmetric risk. The ACMA’s approach is to interrogate the geometric mean and median of the full sample and compare them to the inter-quartile range (IQR) associated with two cohort samples, based on countries with similar population density and GDP per capita to Australia respectively. The specific price selected varies for each band, but in all cases the proposed price is either equal to or very close to the geometric mean of the full sample. In effect, in choosing a mid-point, the ACMA is adopting price levels that have a roughly 50% likelihood of being above market value (subject to the methodology corrections we set out above). This in turn implies a significant risk that some spectrum may not be renewed.

Meanwhile, the ACMA’s sensitivity analysis appears perfunctory. In its revised methodology, the ACMA has embraced real over nominal prices and PPP rather than spot rates, which has pushed up its estimate of market value. Sensitivity analysis on these two methodological changes points to a risk of overstatement that the ACMA is currently disregarding.

We do not think that the ACMA’s revised approach gives appropriate consideration of asymmetric risk. Effectively, the ACMA expresses indifference between the risk of the spectrum going unsold and the possibility that revenue is not maximised, even though the economic consequences of the former are far more severe than the latter.

How could the ACMA better manage this risk? It could be more cautious in selecting its estimate of market value. For example, rather than simply adopting its central estimate, it could adopt the midpoint of its central estimate and the bottom of the IQR range for the full sample. The resulting price is still an estimate of market value, but it is a more cautious one that weighs the risk of overstating market value more strongly than understating value.

For the avoidance of doubt, picking a lower value than the central estimate in an IQR is not the same as offering a price discount to operators. A discount means deliberately pricing below market value. In contrast, our proposed methodology involves a more cautious approach to selecting a price based on market value from within a broad range of relevant benchmarks. This requires the Government to surrender some revenue relative to pricing at the central estimate. However, overall, the revenues that Government extracts from the mobile industry continue to rise compared to, for example when these spectrum licences were originally awarded – when unit prices were much higher, because a mobile operator in 2025 required so much more spectrum to deliver a good service.

## 1.4 Application of forward-looking inflation is inappropriate

As the ACMA intends to update its benchmarking ~2.5 years before each renewal date, it proposes to apply ~2.5 years of inflation to its estimates of market value to account for the period between the final benchmarking update and the renewal date. Its rationale is that “*it is uncertain if they [spectrum pricing trends] will persist*”. Put differently, the ACMA adopts a forecast of flat prices in real terms (‘no trend’)

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<sup>2</sup> NERA and Aetha, ‘Setting Prices for Expiring Spectrum Licences in Australia’, October 2024, Sections 3 and 6.1, submitted by Telstra to the ACMA.

going forwards. In our opinion, this approach is aggressive and likely to result in an overstatement of market value at the time of renewal, even if the original base estimate is correct.

Given the ACMA's aim of estimating full market prices, any forecast trend it applies for the period between the benchmarking and the point of renewal should be neutral – i.e. it should at least be no more likely to generate an overestimate as an underestimate (after setting the 2025 price cautiously owing to asymmetric risk). Given the decade-long trend of real prices declining by ~17% per year in the lower band groups, it appears more likely that a 'no trend' forecast will result in an overstatement than an underestimate. Likewise for the higher band groups, given weak evidence that prices have declined by ~7% per year, an assumption of flat real prices appears aggressive.

We agree that it is uncertain if the downward trends in spectrum prices will persist. However, the ACMA's proposed solution is effectively to assume that a trend that has persisted for the last decade will suddenly cease from 2025. This is not neutral.

We recommend that the ACMA adopts one of two solutions:

- **Apply a modest negative forward trend** – a midpoint between historic decline and flat real values would balance risk and avoid extreme overestimation; or
- **Hold prices steady in nominal terms** – if the ACMA embraces our recommendation above to take a more cautious approach to estimated 2025 market value (and updates to these values in future updates), then a neutral approach may instead be to set the price based on the current estimate with no forward inflationary adjustment.

## 1.5 Conclusion and recommendations

We find that the ACMA's revised methodology produces prices that:

- Materially overstate market value for the 'Sub-1GHz' and 'Lower 1-3GHz' band groups; and
- Reflect a plausible estimate of market value for 'Upper 1-3GHz' and '3.4GHz' band groups, but with a greater risk of overstatement than understatement.

Figure 5 shows the market value estimates published by the ACMA as well as our estimates which, based on our recommendations in this paper, account for:

- the time trend in the lower two band groups
- the dataset corrections
- asymmetric risk, by taking the midpoint of the geometric mean and lower quartile.

**Figure 5: 2025 market value estimates by band group (single-year 2025 AUD/MHz/pop)**

	Aetha-NERA methodology, dataset		ACMA	ACMA overestimate vs Aetha-NERA
	Before asymmetric risk adjustment	After asymmetric risk adjustment		
Sub-1GHz	0.032	0.026	0.075	191%
Lower 1-3GHz	0.018	0.014	0.031	112%
Upper 1-3GHz	0.019	0.015	0.017	8%
3.4GHz	0.014	0.011	0.022	94%

As an independent cross-check on our findings, the ACMA should compare its proposal against the fee levels that peer regulators have adopted when renewing mobile spectrum licences. These are significantly lower. A comparison to the UK is particularly relevant because Ofcom is also mandated to set annual fees based on 'full market value' and uses a benchmarking approach to derive these fees. The ACMA's proposed fees are 138% higher than Ofcom for Sub-1GHz spectrum; and 34% higher than Ofcom for Lower 1-3GHz spectrum. These margins far exceed any plausible country-specific adjustment, indicating that the ACMA's estimates are too high.

We recommend that the ACMA makes the following adjustments to its approach:

1. Take account of the dataset errors and omissions identified in this report;
2. Replicate our statistical methods to identify and quantify time trends for spectrum prices, and adjust benchmarks within the lower band groups to account for the statistically significant downward price trend across 2015-2025;
3. Exercise caution when determining where in the broad range of market price estimates to set the 2025 value for each band, considering the asymmetric risk of setting fees too high; and
4. For future prices at the point of renewal, apply a negative forward trend – or at minimum, refrain from applying inflation.

If these (or similar) changes are not implemented, we believe there is a high likelihood that renewal prices will be set above market value. This would be a bad outcome for the Australian economy. Notably, there is a real risk that the existing licensees may opt not to renew all their existing licences, resulting in this important public resource being underutilised.

## 2. Introduction

This report has been prepared jointly by Aetha Consulting (Aetha) and NERA Economic Consulting (NERA) to evaluate the Australian Communications and Media Authority's (ACMA's) revised approach to benchmarking international spectrum prices for the purpose of setting renewal prices for Expiring Spectrum Licences (ESLs).<sup>3</sup>

The ACMA laid out its original views on pricing during Stage 3 of the ESL consultation in April 2025.<sup>4</sup> This original approach was bespoke. Notably, benchmark prices were adjusted based on an index of mobile services revenue per MHz per population (MSR Index) and subjected to cohort analysis.

Following feedback, the ACMA engaged DotEcon to conduct a peer review of its methodology.<sup>5</sup> The ACMA's updated methodology is greatly influenced by this review. Many of DotEcon's recommendations are well-founded, and overall, it encouraged the ACMA to adopt a more orthodox benchmarking methodology. However, it has also led the ACMA to adopt a combination of changes that compound to produce substantially higher prices than those in the ACMA's original recommendations.

This report details the findings of our evaluation and is structured as follows:

- Section 3 focuses on our primary concern, the ACMA's failure to account for the significant decline in spectrum prices for lower frequencies over the last decade. We present a more robust approach for a) testing for historical trends in spectrum prices, and b) accounting for these trends when determining spectrum prices. We recommend the ACMA replicates this approach in its analysis.
- Section 4 details missing data points and errors in the ACMA's benchmark data sample, which we recommend are addressed by the ACMA.
- Section 5 presents revised statistical analysis, having amended the ACMA's dataset to account for the missing data points and errors identified in Section 4.
- Section 6 highlights that the ACMA fails to consider, in its approach, the asymmetric risk of inadvertently setting prices too high and explores actions it could take to mitigate this risk.
- Section 7 explains why the ACMA's application of inflation when projecting prices to the time of renewal is unwarranted.
- Section 8 demonstrates that the ACMA's revised prices are unduly high in comparison to those set by other regulators in similar circumstances.
- Section 9 sets out our overall conclusions and recommendations.

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<sup>3</sup> The ACMA, 'Expiring spectrum licences, stage 4 - Updated preliminary views of pricing', December 2025.

<sup>4</sup> The ACMA, 'Expiring spectrum licences, stage 3 - Preliminary views paper 4: Pricing for ESLs', April 2025.

<sup>5</sup> DotEcon, 'Review of the ACMA expiring spectrum licence pricing', September 2025.

### 3. Failure to account for the decline in spectrum prices

In this section, we focus on our primary concern, the failure to account for the significant decline in spectrum prices for lower frequencies over the last decade.

Our analysis is in four parts:

- Section 3.1 provides necessary background on trends in spectrum prices across different bands over the past 15 years, the ACMA's benchmarking period.
- Section 3.2 explores the statistical analysis that the ACMA and DotEcon undertook on price trends and identifies shortcomings.
- Section 3.3 presents a more robust statistical approach to testing for historical trends in spectrum prices, which we recommend the ACMA replicates in its analysis.
- Section 3.4 presents our recommended solution to account for time trends in spectrum prices:
  - For the two lower frequency band groups, we argue that it is impossible to arrive at a fair market value via benchmarking without adjusting for the downward price trend. We show, beyond reasonable doubt, that the cutting off the pre-2018 data and assuming a flat trend produces a substantial overestimate of today's market value.
  - For the two higher frequency band groups, our analysis indicates that the ACMA approach of using the full dataset and assuming a flat price trend does not cause material errors but does carry a risk of overstatement.

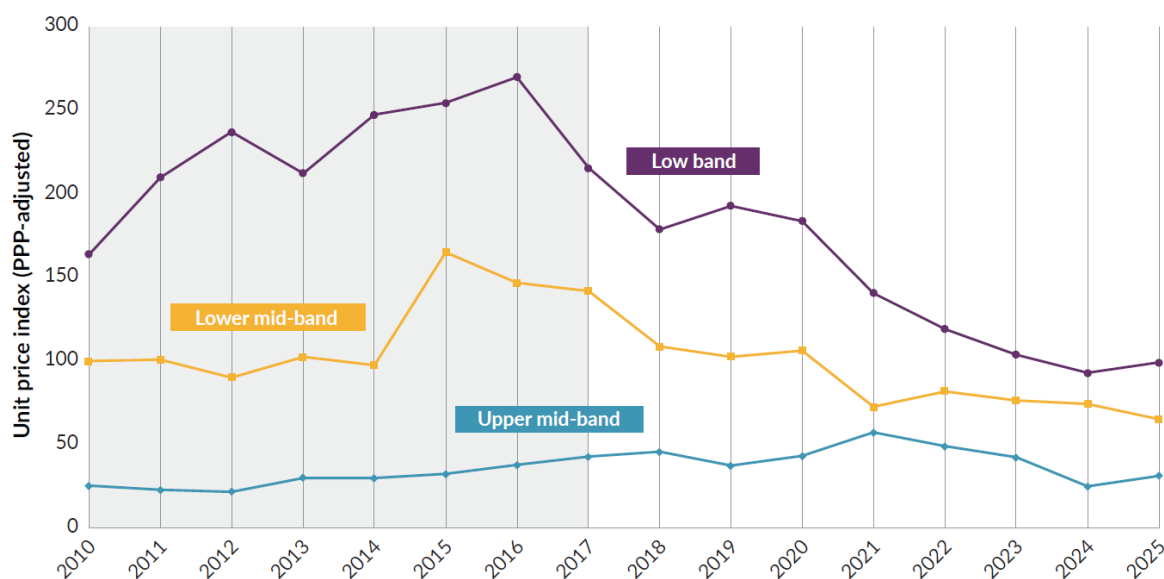
#### 3.1 Spectrum price trends from 2010 to 2025

Both Aetha and NERA have extensive experience in global spectrum valuation – we have in aggregate supported regulators and operators preparing for more than 200 spectrum awards by band. Based on this experience at the 'coal face' of spectrum pricing, we are firmly of the opinion that spectrum prices generally rose during the 4G era until around 2015, before falling substantially across the 5G era. The rise and subsequent fall are particularly evident for the lower frequency bands, specifically the 'Low band' (sub-1GHz bands) and the 'Lower mid-band' (1800MHz, 2100MHz, PCS, AWS).

In Figure 6, we present the latest price trends to end-2025, as reported in the NERA Spectrum Report 2026.<sup>6</sup> The graph shows the three-year moving averages of nominal spectrum prices across three band groups, which map directly to the ACMA's own band groups ('Upper mid-band' incorporates 3.4GHz). The data are based on a survey of prices from 65 major economies, a similar sample to that used by the ACMA. NERA uses a three-year moving average to improve sample size and smooth trends over time.

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<sup>6</sup> NERA, 'The NERA Spectrum Report 2026', January 2026, available at: [bit.ly/49t34xs](https://bit.ly/49t34xs).

**Figure 6: Three-year moving average of nominal spectrum prices<sup>7</sup> [Source: NERA]**


From this graph, we observe the following:

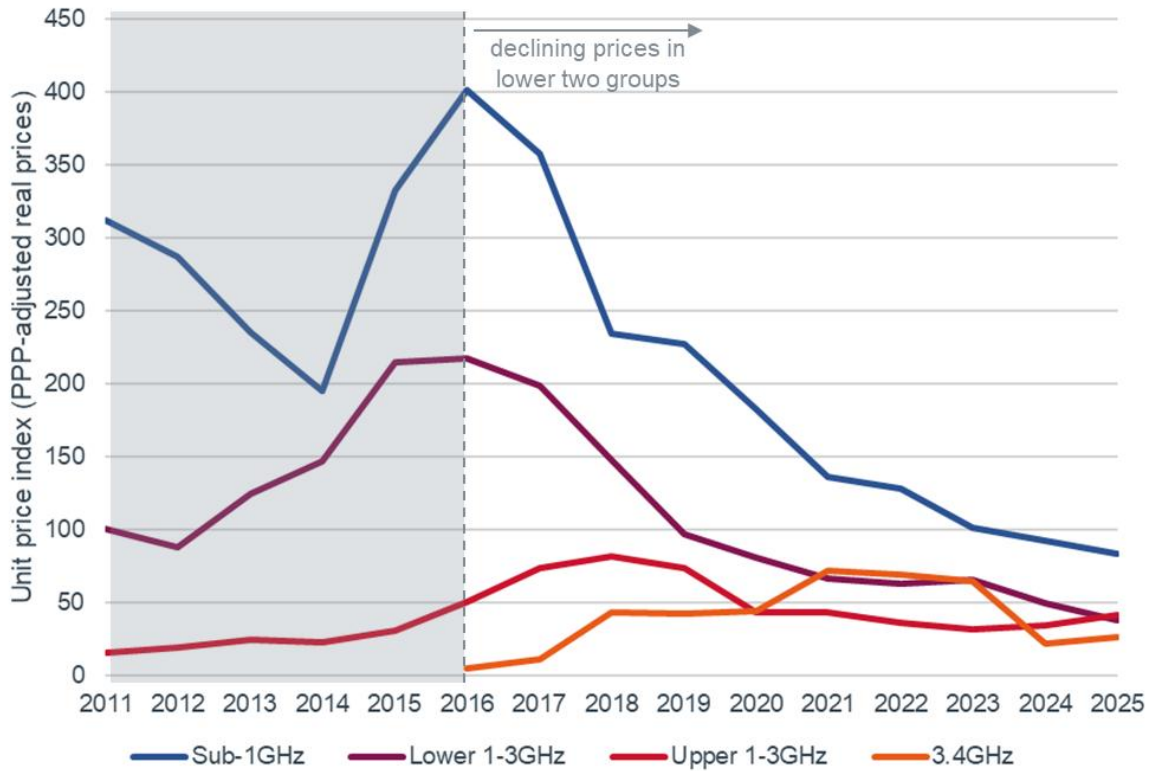
- In the 'Low band' (sub-1GHz bands) there is a period of generally increasing prices from 2010 to 2016, with the three-year moving average increasing in every year except one (2013). The moving average in 2016 is materially higher than in 2010. From 2016 to 2025, there is a period of significant decline in prices resulting in the moving average price in 2025 being substantially lower than both the peak in 2016 and the price in 2010. There is a small uptick in the moving average in the final year. We would caution against drawing any conclusions from this given a) it is the first increase in six years, and b) in the same year, there is an equally sized reduction in the moving average of 'Lower mid-band' spectrum.
- For the 'Lower mid-band' (1800MHz, 2100MHz, PCS, AWS), average prices appear to have been relatively stable from 2010 to 2014 followed by a material increase in the three-year moving average in 2015. Thereafter, the moving average price decreases every year from 2015 to 2025, except two (2020 and 2022). The moving average price in 2025 is materially lower than the peak price in 2015 and somewhat lower than the price in 2010.
- In the 'Upper mid-band' (2300MHz, 2600MHz, 3400MHz), prices have remained relatively stable, with a modest increase in most years from 2012 through to 2021 and a modest decrease thereafter. Prices at the start and end of the 2010-2025 period are similar.

For comparison, we used the ACMA's own dataset to construct a three-year moving average. The methodology is essentially the same as NERA's except that the ACMA uses real (rather than nominal) prices, so historic averages are higher. We show prices as an index ('Lower 1-3GHz', 2011 price = 100), as used by NERA.<sup>8</sup> The ACMA also separates '3.4GHz' from the other 'Upper 1-3GHz' bands. Figure 7 shows the results.

<sup>7</sup> Prices are adjusted for wealth differences using purchasing power parity (PPP).

<sup>8</sup> Specifically, in the ACMA dataset, the following steps are applied: (a) Prices are converted to AUD using PPP exchange rates; process are adjusted in real terms (i.e. today's money) by applying Australia CPI; (b) Prices are converted to a single-year price; and (c) prices are divided by MHz and population to get an AUD/MHz/pop price.

**Figure 7: Real spectrum prices (unit price index), three-year moving average**  
 [Source: ACMA data]

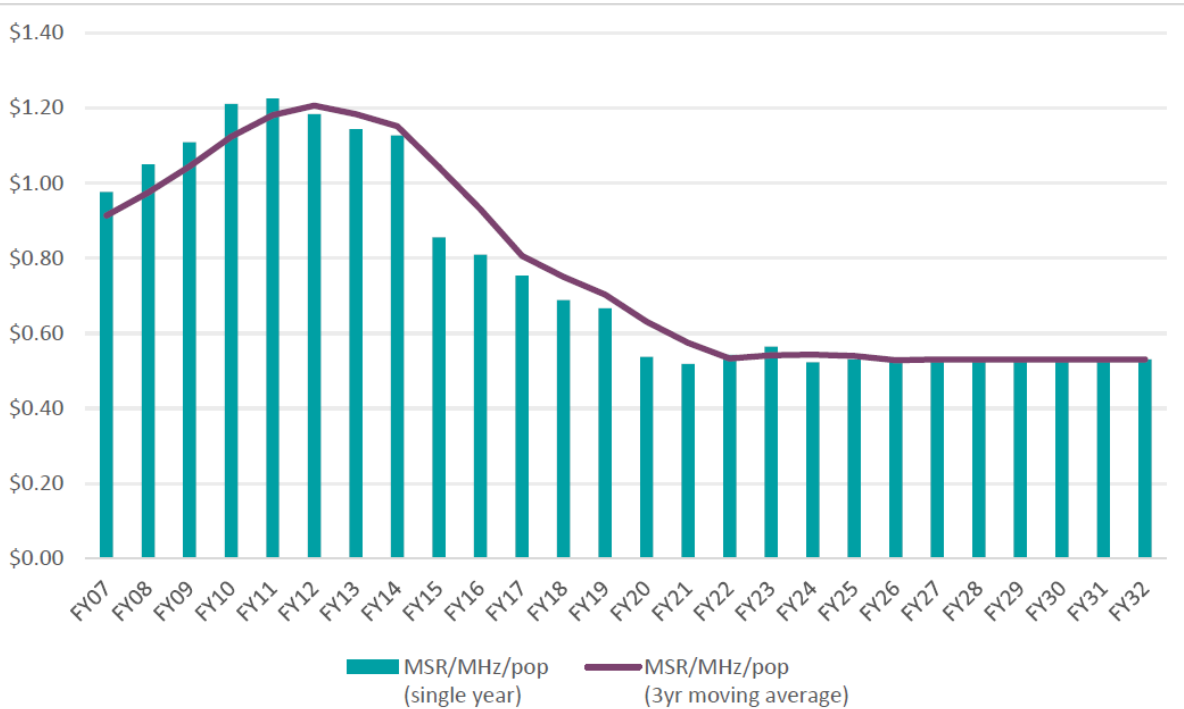


We observe that the ACMA’s dataset shows strikingly similar trends to the NERA report. Both datasets identify the same peaks in prices for the ‘Sub-1GHz’ and ‘Lower 1-3GHz’ band groups in around mid-2016 (i.e. early 2015 when accounting for the lag) with prices sharply decreasing thereafter. The price drop is more pronounced in the ACMA sample for these bands owing to the use of real rather than nominal prices. For the ‘Upper 1-3GHz’ and ‘3.4GHz’ band groups, there is some variation in prices, but these prices have been much more stable over the full period.

Overall, our initial review of the data suggests that there has not been one consistent price trend across all band groups over the past 15 years. In the lower band groups (‘Sub-1GHz’ and ‘Lower 1-3GHz’) prices are characterised by a period of increase from 2010 to around 2015 followed by a period of decrease. The upper band groups (‘Upper 1-3GHz’ and ‘3.4GHz’) have seen some variation but to a lesser degree than the other groups.

In its previous methodology, the ACMA adjusted benchmarks using the MSR per MHz per population Index (MSR Index). Whilst the statistical foundation of the Index was reasonably challenged by DotEcon, leading to the ACMA removing it from its methodology, it was an effective proxy for these declining prices, as illustrated in Figure 8 below.

**Figure 8: MSR/MHz/pop values – single-year and three-year moving average**  
 [Source: ACMA data]



The removal of the MSR Index is compounded by the ACMA's decision to revert to real-term benchmarking – again on DotEcon's advice – which inflates historic prices by CPI despite evidence prices have fallen in both real and nominal terms for nearly a decade.

DotEcon and the ACMA have approached this issue by a) testing for historical declines in spectrum prices in each of the band groups, and then b) where they find statistically significant declines, cutting off the datasets to include only benchmarks from 2018. We discuss each of these steps in the following subsection. We believe that the second step in particular has substantial shortcomings.

### 3.2 Shortcomings in the ACMA's approach to addressing spectrum pricing trends

In this section, we provide a critique of the statistical analysis and tests performed by the ACMA and DotEcon and explain why the ACMA's proposed solution of truncating the dataset for lower frequency band groups is inadequate.

#### ACMA and DotEcon statistical analysis

The ACMA and DotEcon both use the Mann-Whitney U test to test for downward price trends in each of the band groups. Strictly speaking, however, the Mann-Whitney U test does not test for a trend in the data but rather whether there is a lower median in prices from 2018 onwards compared with pre-2018 prices.

DotEcon finds statistically significant evidence for a lower median from 2018 onwards only in the 'Lower 1-3GHz' band group, whilst the ACMA finds evidence of this in both the 'Sub-1GHz' and 'Lower 1-3GHz' band groups.

Both the ACMA and DotEcon apply a 5% significance level, meaning that if pre-2018 and 2018 onwards prices were in fact the same, there is less than a 5% probability of incorrectly concluding that they differ.

DotEcon also uses linear regression of log real prices to investigate the price trends. It finds evidence at the 5% significance level for a decreasing trend for the 2013-2025 period in the 'Lower 1-3GHz' band group. It also finds weaker evidence, at the 10% significance level, of a decreasing trend in the 'Sub-1GHz' and 'Upper 1-3GHz' band groups. Figure 9 below shows the outputs of DotEcon's statistical analysis.

The p-values shown in Figure 9 are a measure of how likely the data sample (or any more extreme sample) would be if the null hypothesis were true. For the Mann-Whitney U test, the null hypothesis is that the medians of both groups (pre-2018 and 2018 onwards) are the same and for the linear regression it is that real prices are flat. A lower p-value provides stronger evidence that the null hypothesis should be rejected in favour of the alternative hypothesis, i.e. that the latter group's median is lower or that there is a linearly decreasing trend. Generally, a p-value of 0.05 or lower (5% significance level) is considered as providing sufficient evidence to reject the null hypothesis. However, given that in this context the null hypothesis would lead to higher estimates of 2025 market value (as it assumes that prices have been flat in real terms), and the asymmetric risk associated with this (refer to Section 6 for a detailed discussion), the ACMA may wish to consider less stringent significance levels in its analysis.

**Figure 9: DotEcon's statistical analysis of trends in real spectrum prices**  
 [Source: DotEcon, September 2025]

	Average annual trend in real price over 2013-2025	p-value of one-sided test against null of no trend	MW test p-value, pre-2018 compared with 2018 onwards
Sub-1GHz	-6.6%	0.059	0.144
Lower 1-3GHz	-11.1%	0.004	0.009
Upper 1-3GHz	-7.6%	0.095	0.183
3.4GHz	-1.5%	0.427	0.995

Although DotEcon and the ACMA do identify evidence of downward price trends, the statistical approaches adopted underestimate their significance. Specifically, in our view, their analysis has the following shortcomings:

- They fail to adopt the most appropriate statistical tests for the available dataset; and
- Their choice of start date for the benchmarking samples is arbitrary and they fail to conduct sensitivity analysis to their choices.

The Mann-Whitney U test is a non-parametric test for differences in the median between two data samples. DotEcon uses the test to assess the differences in prices between band groups to determine if *"the groupings chosen by the ACMA are appropriate"*<sup>9</sup>. The test is appropriate in this instance because there is a categorical distinction between price benchmarks from different band groups.

DotEcon and the ACMA also use the Mann-Whitney U test to provide evidence of a price decline in the datasets. However, strictly-speaking, it simply tests for whether the median of prices from 2018 onwards

<sup>9</sup> DotEcon, 'Review of the ACMA expiring spectrum licence pricing', September 2025, p.26.

are lower than pre-2018, rather than specifically testing for a trend. For this task, there is a better option: the Mann-Kendall test. The main downside of the Mann-Whitney U test is that it does not account for the exact timing of each award but simply groups the data into 'pre-2018' and '2018-onwards' buckets. Furthermore, the choice of 2018 as a cutoff year is arbitrary. By omitting some of the timing data, it ignores information that is useful for assessing whether there is a trend. A Mann-Kendall test for a monotonic increase or decrease in a dataset is preferable for this application. We adopt this approach in Section 3.3.

DotEcon also uses linear regression (ordinary least squares) of log prices to quantify the rate of price decrease. This analysis takes into account the date of the awards so is more appropriate to analyse a time trend. However, even when using log prices, linear regression is influenced by outliers and implicitly makes assumptions about the dataset – namely that the residuals are independent, have a constant variance and are normally distributed – which may not be correct. The Sen slope estimator, which is commonly used in conjunction with the Mann-Kendall test, is preferable here as it is more robust to outliers in a noisy sample (like this one) and does not make as many assumptions about the underlying distribution of the data. Again, we adopt this approach in Section 3.3.

Finally, the ACMA and DotEcon consider too long a timeframe when testing for decreasing price trends. The ACMA seems to include all data points (2009-2025) for its tests and DotEcon tests for trends from 2013 to 2025. Based on our high-level analysis of price trends in Section 3.1, it is apparent that there is no single unidirectional trend across this period, but rather a period of spectrum price increase and a period of decrease, with an inflexion point in around 2015. Starting these tests in years before 2015 risks conflating the increasing trend observed before 2015 with the decreasing trend after 2015 observed in Section 3.1.

### The ACMA's solution to address trends

Having found statistically significant trends using the Mann-Whitney U test in the 'Sub-1GHz' and 'Lower 1-3GHz' band groups, the ACMA's proposed solution is to restrict the sample for these band groups to awards from 2018 onwards.

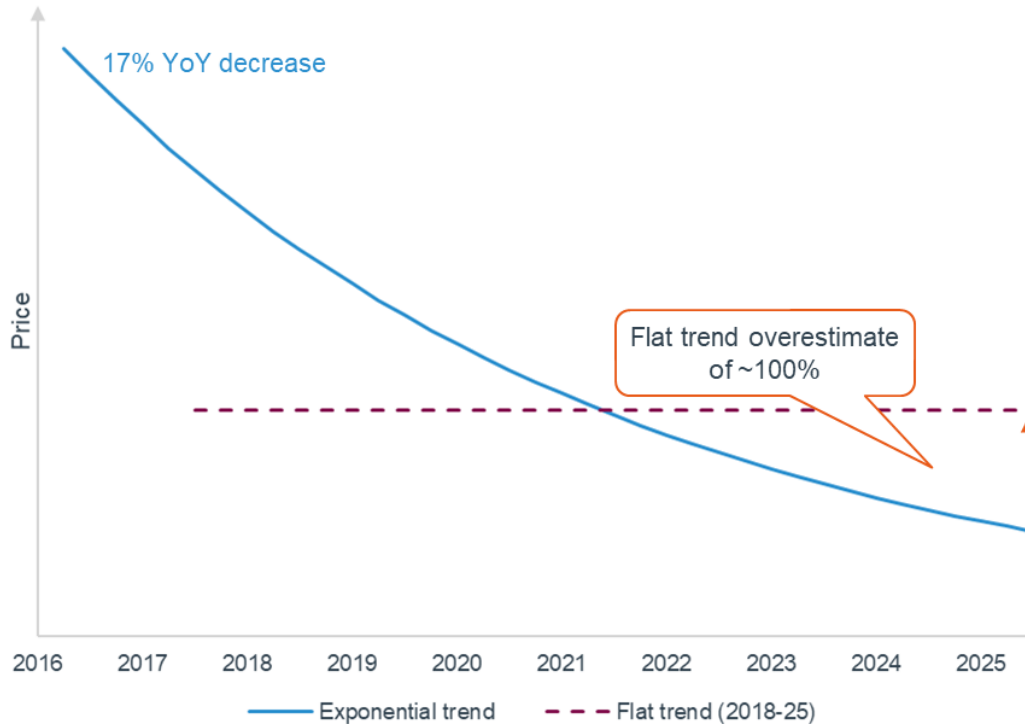
We believe that this is an inadequate solution that results in a substantial overstatement of today's market value. This for the following reasons:

- The 2018 cutoff is arbitrary and unrelated to underlying price dynamics.** The ACMA says it is chosen because it is *"the median point of the sample and is aligned with the global commencement of awards for spectrum identified for 5G services"*.<sup>10</sup> However, the fact that 2018 is the median point is largely irrelevant when considering a time trend in prices and aligning with spectrum for 5G services being awarded represents only one of many factors that may influence price trends (and in fact, the first 5G spectrum award [in Germany] was in 2015). Moreover, simply from 'eyeballing' Figure 6, it is clear that 2018 does not represent an inflexion point for spectrum prices, as average prices declined significantly before this date and they have declined significantly after this date.
- The truncation reduces sample size.** This weakens the reliability of the results.
- The methodology results in an average benchmark being approximately four years old.** The ACMA is modelling average prices across a period in which prices declined. Consequently, the result is close to an estimate of market value in 2021/22 rather than 2025. In Figure 10, we illustrate this effect by comparing an exponentially decreasing trend to a flat trend (for 2018-2025). The chart shows that a 17% annual decrease in prices could result in the flat trend assumption overestimating

<sup>10</sup> The ACMA, 'Expiring spectrum licences, stage 4 - Updated preliminary views of pricing', December 2025, p.23.

market value by approximately 100% (as we will show later, ~17% is the observed average annual decline for both lower band groups).

**Figure 10: Illustration of the potential overestimate of market value in 'Sub-1GHz' and 'Lower 1-3GHz' band groups from cutting off at 2018 and assuming flat trend**



### 3.3 Improvements to the time trend analysis

In this section, we apply the statistical tests introduced above to the ACMA's own dataset to quantify price trends and determine whether they are statistically significant. We adopt a start date of 2015 for our analysis, supported by evidence from both NERA and the ACMA's datasets that average prices paid for global spectrum peaked in approximately this year.

For this dataset, we believe the most appropriate test to detect whether there is a decreasing trend is the **Mann-Kendall test**. It is a non-parametric test, meaning it does not rely on assumptions about the underlying distribution of the data. It is used to test for monotonically increasing or decreasing trends in an ordered dataset. In our case, it compares all pairs of prices (ordered in time) assigning a 1, -1 or 0 when the more recent price is greater than, less than or equal to the older price respectively. The test statistic is the sum of all these values.

A significant advantage of the Mann-Kendall test is that it considers the timing of each award. We perform a one-sided Mann-Kendall test to look for a monotonically decreasing trend. This is preferable to the Mann-Whitney U test, where the data must be split into distinct groups, which requires selection of an arbitrary cutoff date.

We believe the most appropriate test for quantifying the trend is the **Sen slope estimator** (also known as Theil-Sen slope estimator), which is commonly used in conjunction with the Mann-Kendall test. It estimates a linear trend for the dataset by taking the median of the gradients between all pairs of data points. Importantly, the Sen slope estimator is more robust to outliers compared with linear regression making it a better choice for the benchmarking data where many factors may affect the price. We have calculated the Sen slope estimator for the log real prices in each band group.

In addition to the Mann-Kendall test results and the Sen slope estimator, we provide linear regression (ordinary least squares) of log prices and Mann-Whitney U test p-value results for comparison with the existing DotEcon and ACMA analysis.

In summary, we have conducted the following analysis, using the ACMA's dataset (i.e. without the additions and changes we propose in Section 4), for each of the four band groups.

- **Mann-Kendall test** to assess whether there is a statistically significant decreasing trend in spectrum prices from 2015 to 2025;
- **Mann-Whitney U test** to assess whether the prices in 2015 Q1 to 2020 Q2 have a higher median than the prices in 2020 Q3 to 2025 Q4 (splitting the data at the median date point);
- **Sen slope estimator** to calculate the linear trend in log prices from 2015 to 2025 (p-value is the same as for Mann-Kendall test); and
- **Linear regression of log prices** from 2015 to 2025 using ordinary least squares.

Figure 11 shows the full results of each statistical test for all band groups.

**Figure 11: Statistical tests on real spectrum prices 2015-2025 [Source: ACMA data]**

	Sub-1GHz	Lower 1-3GHz	Upper 1-3GHz	3.4GHz
<b>Sample size</b>	49	40	21	47
<b>Mann-Kendall test one-sided p-value</b>	<0.0001	0.0003	0.1319	0.1565
<b>Mann-Whitney U test one-sided p-value</b>	0.0005	0.0018	0.0527	0.2503
<b>Sen slope estimator implied annual trend</b>	-16.8% ( <i>p</i> < 0.0001)	-17.0% ( <i>p</i> = 0.0003)	-7.2% ( <i>p</i> = 0.1319)	-6.5% ( <i>p</i> = 0.1565)
<b>Linear regression (annual trend and one-sided p-value)</b>	-15.4% ( <i>p</i> = 0.0002)	-19.8% ( <i>p</i> = 0.0001)	-7.8% ( <i>p</i> = 0.1812)	-4.4% ( <i>p</i> = 0.5616)

For each test, we show the p-value of the one-sided hypothesis test looking for a decreasing trend compared to a null hypothesis of a flat trend (note that a p-value for the Sen slope estimator has the same meaning as a p-value for Mann-Kendall test). The p-value gives the probability of the dataset being observed if the alternative hypothesis is false and there is in fact a flat trend. For example, a p-value of 0.05 means a 5% probability of observing the data if there is no trend (i.e. prices have been flat in real terms).

We highlight in green instances where the tests produce a value of  $p < 0.05$ , which means the result is statistically significant at the 5% level. This applies to all tests for the two lower band groups. In fact, all are significant well below a 1% level, which is exceptionally strong evidence. Accordingly, we recommend changes to the ACMA benchmarking methodology to address this. For the two upper band groups, we observe evidence of a downward slope, but the results are only significant at a ~15% level which is not robust. However, the data still suggest there may be a downward trend rather than a flat trend, so it would be inappropriate to ignore this. We propose below that this be addressed when determining final renewal prices (and weighing asymmetric risk) rather than in the benchmark methodology.

Figure 12 shows the ACMA benchmarking dataset with the Sen slope estimator trends for each band group using log scales. This may be contrasted with DotEcon's linear regressions from its report, as shown in Figure 9.<sup>11</sup>

The Mann-Kendall test provides strong evidence that a decreasing trend in spectrum prices in the 2015-2025 period exists for the 'Sub-1GHz' and 'Lower 1-3GHz' band groups. The Mann-Whitney U test also identifies strong evidence of a lower medians for more recent awards.

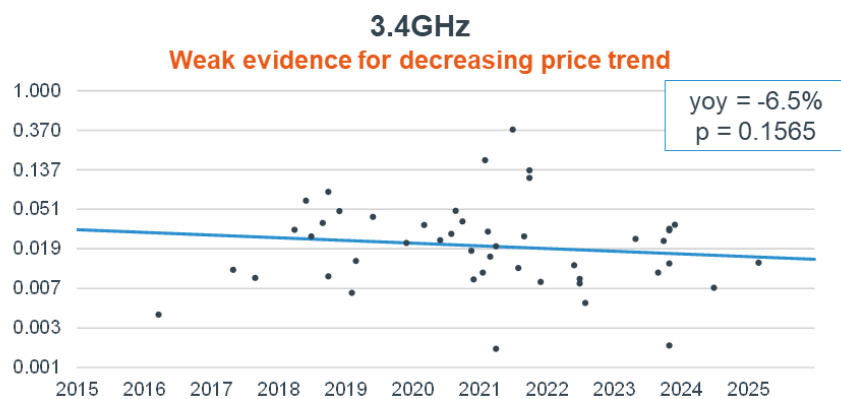
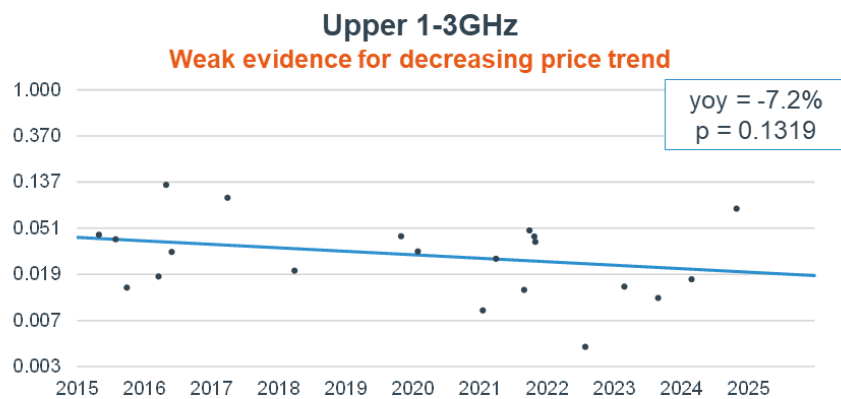
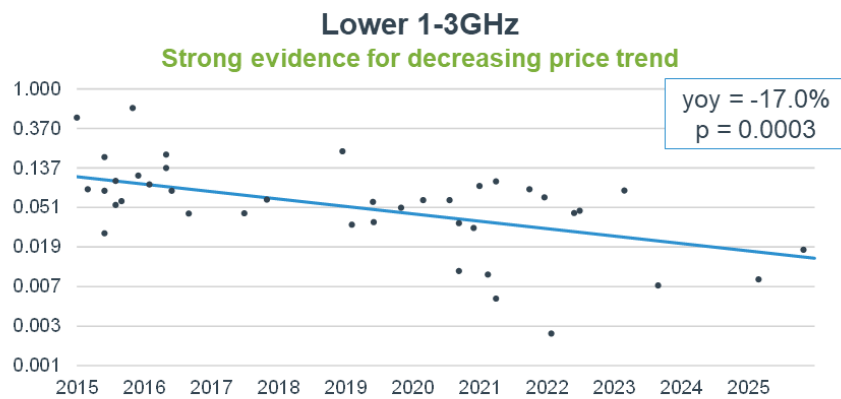
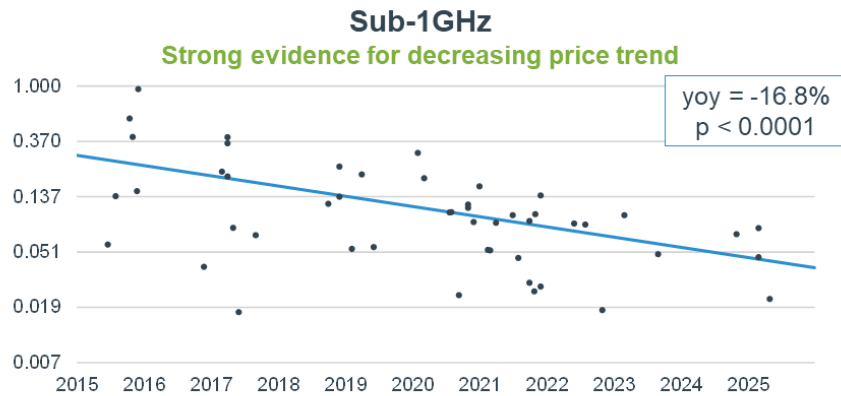
In the 'Upper 1-3GHz' and '3.4GHz' band groups, both the Mann-Kendall test and the Mann-Whitney U test find evidence of a decreasing trend, but this finding is not statistically significant using a 5% significance threshold (although there is only a ~15% chance that the data sample is observed if there is in fact a flat trend). Additionally, given that the 3.4GHz band was released relatively recently, trends may still be emerging. We recommend that the ACMA checks for this as and when it updates its benchmarking prior to each renewal.

We use the Sen slope estimator to quantify the trend for each band. The Sen slope estimator predicts annual decreases of 16.8% and 17.0% for the 'Sub-1GHz' and 'Lower 1-3GHz' band groups respectively, compared with 15.4% and 19.8% respectively using linear regression. The annual decreases predicted are similar across these two tests, but – for the reasons discussed above – we believe the Sen slope estimator is more appropriate for the data sample. The Sen slope estimator also predicts annual decreases of 7.2% and 6.5% respectively for the 'Upper 1-3GHz' and '3.4GHz' band groups, but the results are not statistically significant at the 5% level.

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<sup>11</sup> DotEcon, 'Review of the ACMA expiring spectrum licence pricing', September 2025, pp.21, 48.

**Figure 12: Single-year 2025 AUD/MHz/pop real prices with Sen slope on log scale [Source: ACMA data]**



Our conclusions differ from DotEcon's results, as reported in Figure 9. We find much stronger evidence of declining price trends and more pronounced average annual reductions. This is true even when comparing the Mann-Whitney U tests and the linear regression of log prices, and applying the same methodology as DotEcon. We expect this is primarily owing to our different sample period of 2015-2025, compared to DotEcon's 2013-2025. However, differences may also result from our use of the ACMA benchmarking dataset which appears to differ from the DotEcon benchmarking dataset.

Overall, our results using the 2015-2025 timeframe and the ACMA dataset fit with the results found by the ACMA of a statistically significant decreases in the 'Sub-1GHz' and 'Lower 1-3GHz' band groups. Whilst there is evidence of downward trends in the other groups, it is not statistically significant at the 95% confidence level.

As a sensitivity analysis to our choice of 2015-2025 as the timeframe for assessing whether there is a decreasing trend, we have performed the same analysis for a range of other cutoff years. Figure 13 shows the results for cutoff years from 2013 to 2018. For example, a cutoff year of 2014 means we look for trends in the period 2014-2025. The annual trend implied by the Sen slope estimator is very similar across the 2014-2016 period in the 'Sub-1GHz' and 'Lower 1-3GHz' band groups and all these results are statistically significant at the 5% significance level. Even a cutoff year of 2013 or 2017 shows a statistically significant trend in these band groups with one marginal exception. In conclusion, the trend in prices over 2015-2025 is reasonably insensitive to the choice of initial year when using the Mann-Kendall test; we maintain our recommendation to use a 2015 start date.

**Figure 13: Additional statistical tests [Source: ACMA data]**

Cutoff year	2013	2014	2015	2016	2017	2018
<b>Sub-1GHz</b>						
Sample size	58	52	49	43	42	35
MK-test p-value	0.0001	0.0000	0.0000	0.0006	0.0001	0.0003
MW-test halfway p-value	0.0015	0.0016	0.0005	0.0026	0.0014	0.0143
Sen YoY change	-10.9%	-15.9%	-16.8%	-16.0%	-17.4%	-17.4%
LR YoY change	-10.2%	-14.3%	-15.4%	-12.6%	-14.6%	-16.7%
LR p-value	0.0012	0.0001	0.0002	0.0090	0.0027	0.0051
<b>Lower 1-3GHz</b>						
Sample size	47	42	40	30	25	23
MK-test p-value	0.0002	0.0000	0.0003	0.0054	0.0841	0.0933
MW-test halfway p-value	0.0006	0.0008	0.0018	0.1009	0.2485	0.0474
Sen YoY change	-13.7%	-17.7%	-17.0%	-17.1%	-12.6%	-18.5%
LR YoY change	-16.5%	-20.0%	-19.8%	-19.9%	-19.3%	-21.6%
LR p-value	0.0000	0.0000	0.0001	0.0029	0.0490	0.0654
<b>Upper 1-3GHz</b>						
Sample size	26	23	21	18	15	14
MK-test p-value	0.6378	0.5000	0.1319	0.1444	0.2142	0.4564
MW-test halfway p-value	0.4490	0.2118	0.0527	0.0469	0.2778	0.1285
Sen YoY change	1.4%	-0.1%	-7.2%	-10.4%	-12.8%	-3.1%
LR YoY change	2.7%	0.6%	-7.8%	-10.5%	-11.4%	-2.2%
LR p-value	0.6244	0.9257	0.1812	0.1580	0.2896	0.8685
<b>3.4GHz</b>						
Sample size	47	47	47	47	46	44
MK-test p-value	0.1565	0.1565	0.1565	0.1565	0.0751	0.0232
MW-test halfway p-value	0.3430	0.3463	0.2503	0.1423	0.0529	0.0089
Sen YoY change	-6.5%	-6.5%	-6.5%	-6.5%	-10.2%	-14.7%
LR YoY change	-4.4%	-4.4%	-4.4%	-4.4%	-9.4%	-14.2%
LR p-value	0.5616	0.5616	0.5616	0.5616	0.2233	0.0828

### 3.4 Recommended solution: apply a downward price trend to benchmarks for lower frequency bands

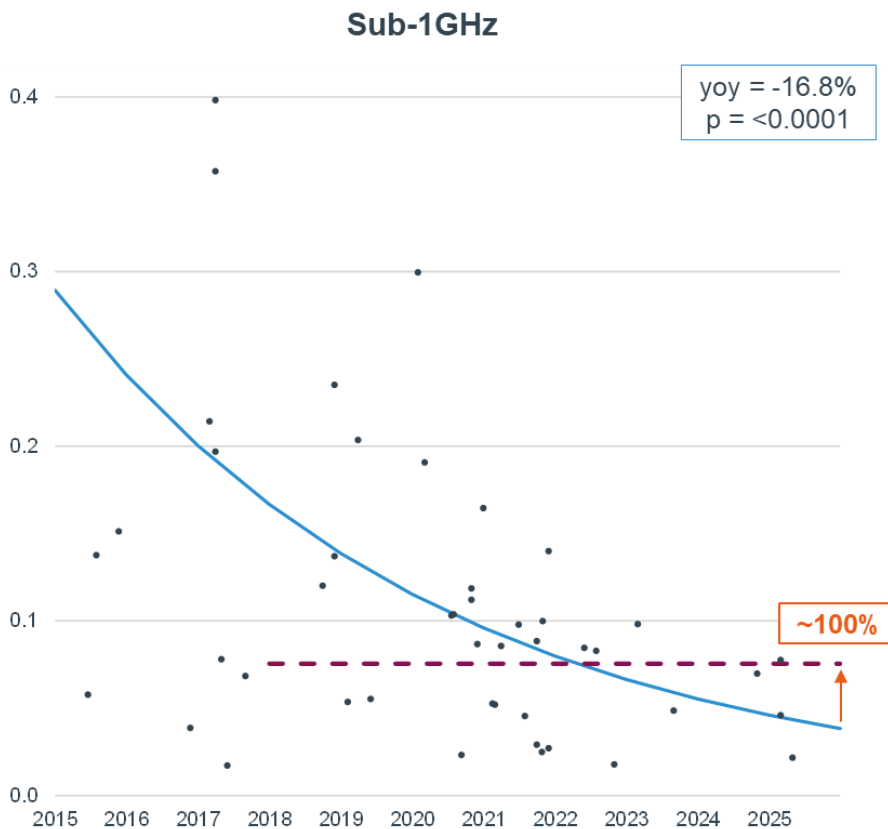
In this section we provide our recommended solution for each of the band groups.

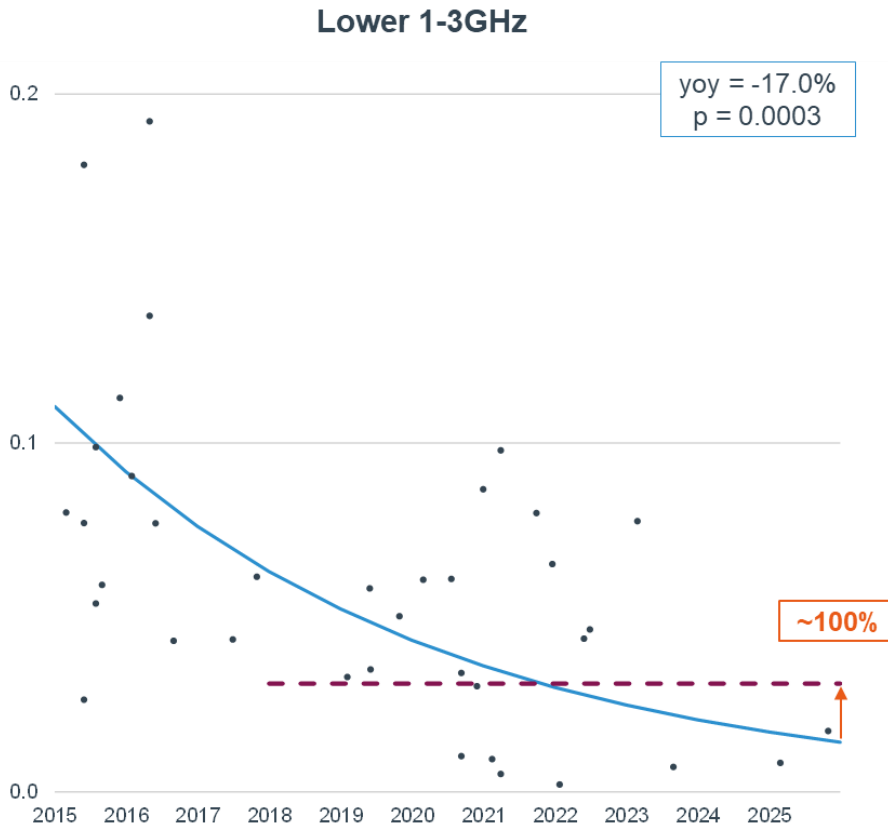
#### 'Sub-1GHz' and 'Lower 1-3GHz' band groups recommendation

Given the statistically significant trends found for the lower two band groups, we recommend the following approach. For the 'Sub-1GHz' and 'Lower 1-3GHz' band groups, prices from before 2015 should be excluded from the benchmarking dataset and the price should be calculated from the benchmarking data after adjusting for the trend found by the Sen slope estimator.

Figure 14 shows the exponential trend for real prices implied by the Sen slope estimator, represented by the blue line. This is compared to the flat trend assumption (geometric mean) of the data for 2018-2025 represented by the purple dashed line. The difference between the two, in 2025, is the potential overestimate of market prices associated with the ACMA's proposed approach. Note that in each of the charts in Figure 14 a small number of data points are not shown due to being above the y-axis cut-off.

**Figure 14: Single-year 2025 AUD/MHz/pop real benchmark prices, flat trend and exponential Sen slope trend [Source: ACMA data]**





We calculate central estimates based on the benchmarking data and using the trend found by the Sen slope estimator for the lower two band groups. First, we adjust all the benchmarks using the Sen slope estimator trend. Using that data, we calculate the geometric mean (geomean), median and inter-quartile range (IQR) of the data and compare it with the ACMA's single-year 2025 price estimates. Figure 15 shows the estimates using this methodology, noting that these do not account for asymmetric risk which is discussed in Section 2.

**Figure 15: Single-year 2025 AUD/MHz/pop price estimates for the lower two band groups adjusting for trend**

	Geomean of adjusted data	Median of adjusted data	IQR of adjusted data	ACMA stage 4 price	ACMA overestimate vs Geomean
Sub-1GHz	0.0343	0.0414	0.0217-0.0637	0.0755	120%
Lower 1-3GHz	0.0155	0.0159	0.0097-0.0270	0.0307	98%

Figure 16 shows the 2025 geomeans using the dataset adjusted for the Sen slope estimator trend for a variety of cutoff years. The bold values highlight our recommended methodology of using the time trend adjustment on the 2015-2025 data. All price values are single-year 2025 AUD/MHz/pop. We observe that estimates using this methodology are robust to the choice of cutoff year.

**Figure 16: Single-year 2025 AUD/MHz/pop price estimates sensitivity analysis for lower two band groups [Source: ACMA data]**

Cutoff year	2013	2014	2015	2016	2017	2018
<b>Sub-1GHz</b>						
Sample size	58	52	49	43	42	35
Geomean of adjusted data	0.046	0.036	<b>0.034</b>	0.035	0.034	0.035
<b>Lower 1-3GHz</b>						
Sample size	47	42	40	30	25	23
Geomean of adjusted data	0.019	0.015	<b>0.015</b>	0.015	0.018	0.014

Overall, we find that the ACMA methodology overestimates value for the lower two band groups by around ~100% (before considering asymmetric risk). Our recommendation of adjusting for the time trend in the lower two band groups is consistent with the ACMA's statistical analysis but corrects the current overestimates. This is especially important when considering the asymmetric risk of overestimating versus underestimating market prices, as we discuss in Section 6.

### 'Upper 1-3GHz' and '3.4GHz' band groups recommendation

For the '**Upper 1-3GHz**' and '**3.4GHz**' band groups we find some evidence of decreasing trends in spectrum prices over the 2015 to 2025 period; however, it is weaker than the trends found for the two lower band groups (not statistically significant at the 5% level).

One way forward would be to adjust historic prices using the same method suggested for the lower two band groups. However, we find this has a much less pronounced impact on the final prices meaning there is not the same risk of overestimating the price using the current methodology.

The other option is to maintain the ACMA's existing approach: include all the data points in the dataset and use the ACMA's existing single-price methodology (geometric mean or median). An advantage of this option is that it uses a larger sample size by not cutting off any of the data points, which increases the reliability of the results.

On balance, given the evidence for a decreasing trend is weak in these two band groups, we think that the ACMA's existing approach is acceptable. However, in this case, we question whether it is appropriate to adjust historic prices for inflation. If there is no adjustment for historic price trends, then there is no mechanism to offset any bias associated with CPI. The statistical evidence is that it is more likely than not that prices have declined rather than increased over this period, so to inflate historic benchmarks by CPI is counter intuitive.

In conclusion, we find that the statistical evidence for making a downward adjustment to historic prices for the higher bands is not robust. However, it is apparent that **there is a greater risk of an overestimate than an underestimate**, given weaker statistical evidence of price declines over the time period analysed. For the two higher bands, the risk of overstatement may be diminished by expressing historic benchmarks in nominal terms (no CPI adjustment). Risk of overstatement can be further reduced by adopting a cautious approach to selecting the market price in the next step, taking into consideration sensitivity analysis and asymmetric risk.

## 4. Missing data points and errors in the ACMA's benchmark data sample

The ACMA's new analysis is based on a significantly expanded and improved sample of benchmarks. In this respect, the process has clearly benefited from inputs from stakeholders and from DotEcon. Moreover, the ACMA has fully embraced DotEcon's recommendation to focus on a broad sample and rely on "*transparent statistical methods can be used to ensure final price estimates are robust to outliers and appropriate for the Australian context without simply dropping observations at the outset.*"<sup>12</sup> Given this approach, it is important that the sample that the ACMA ultimately uses is as accurate as possible and is not missing any valid awards or misstating prices.

NERA maintains its own database of spectrum awards, known as the Gigabase. Telstra asked us to review the ACMA sample and identify if there are any omissions or significant errors in the ACMA dataset. We identified the following:

1. **Uncertainty over sample definition** – the ACMA could be clearer in articulating specific rules for determining what benchmarks are in and out of the sample. We suggest some clear rules that broadly align with the ACMA approach. We have endeavoured to apply the ACMA's preference for a large, inclusive sample.
2. **50 missing benchmarks** – spectrum price events that appear to meet the ACMA criteria for inclusion but are missing from the dataset.
3. **7 significant errors** – seven awards where prices appear to be substantially misstated in the ACMA dataset, either significantly too high or too low.
4. **Systematic misstatement of US prices** – a number of issues with treatment of US awards, including use of gross bids instead of net bids and use of outdated or incorrect population totals for some awards, and incorrect licence duration for all US awards.

We address each of these issues in the following sections. Source material supporting these omissions and errors has been collated and can be provided on request.

### 4.1 Uncertainty over sample definition

In determining the sample of international awards for inclusion in its benchmark, the ACMA must evaluate a series of trade-offs between:

- *Narrowing the sample* – focusing on a limited group of awards with similar characteristics to Australian awards, considering factors such as economic wealth, population density and timing of award; and
- *Broadening the sample* – embracing a wider group of awards with more disparate characteristics and relying on statistical averaging to account for differences.

Each approach has pros and cons. Surveys of international pricing data produce noisy samples. A narrow sample may be tailored to produce an Australia-specific benchmark but it is less statistically robust as it is vulnerable to being skewed by outliers. A broader sample is more robust, being less

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<sup>12</sup> DotEcon, 'Review of the ACMA expiring spectrum licence pricing', September 2025, p.4.

vulnerable to outliers, but it produces a global benchmark for market price rather than a number that is specific to Australia.

The ACMA's original methodology mixed both approaches. As a starting point, it embraced a broad sample but through cohort analysis, the sample became narrow. In its report, DotEcon recommended focusing on a broad sample. Specifically, it says: "*No competitive auctions should be excluded from a benchmarking exercise without good reasons, which are restricted to obvious errors or unavailability of data, or very strong a priori reasons to believe an award is irrelevant.*"<sup>13</sup> The ACMA has largely embraced this approach in its revised methodology.

Notwithstanding the goal of inclusivity, some rules are still necessary to determine whether awards are included or excluded. The ACMA explicitly or implicitly embraces the following rules:

- The award must be an auction, i.e. there was scope for prices to be bid up above reserve. This means that direct awards or renewals at fixed prices are excluded.
- It must be possible to identify a price for each band. This means that prices must be published in a non-aggregated form. This results in some combinatorial auctions being excluded.
- There must be an acceptable source to verify the prices, ideally documentation from the relevant regulatory body.

DotEcon also recommend focusing on "*competitive awards*" and excluding awards where "*significant amounts of spectrum go unsold*". However, this recommendation requires subjective judgement. What if part of an award is competitive and another is uncompetitive? What if spectrum sells but there is no excess demand? In this regard, there is an obvious tension with the broader goal of inclusivity. It is ambiguous how to define these awards, and it is ambiguous to what extent including or excluding such awards may generate high- or low-price outliers. Given the emphasis on inclusivity, we propose a simpler test. Awards should be included if substantial quantity of spectrum is sold and the result can be benchmarked, and the award meets all other criteria.

We also noticed that the ACMA dataset, while containing a large selection of auction prices for high income countries is much less representative with respect to low- and middle-income countries. This may reflect the greater difficulty of identifying source information for such countries. There are pros and cons of including such countries in a benchmarking exercise for a relatively rich country, such as Australia. However, consistent with the ACMA's approach of developing a large, inclusive sample, we have proceeded on the basis that such countries should be included.

## 4.2 Missing awards in the ACMA dataset

It is important that the ACMA proceeds with a sample that includes all awards that meet the necessary criteria, accepting that some awards may be lost owing to lack of reliable reference sources or difficulties in interpreting published prices. NERA compared the ACMA dataset to its own database and identified 50 benchmarks that appear to meet the criteria discussed in Section 4.1 but are not in the current ACMA dataset (and for which we have appropriate source information on file). We request that the ACMA reviews this material and make the necessary updates to its dataset.

Many of these data points are from low- and middle-income countries, The current ACMA dataset was very weak in this respect, for example including data for Nigeria, Thailand, Vietnam but missing other countries, such as Georgia, Indonesia and South Africa. To the extent that we can provide appropriate source data, we have attempted to plug the gaps.

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<sup>13</sup> DotEcon report to ACMA, p3.

In Figure 17, we itemise the awards and the relevant data points to calculate prices for proposed inclusion in the database.<sup>14</sup>

**Figure 17: Table of Missing Awards to Propose for Inclusion**

Country	Band	Allocation Date	License Start Year	License Duration	Award Currency	Upfront fee (Award Currency)	MHz-POPs	Upfront Fee per MHz-POP	Annual Fee?	Deferred Payments?
Brazil	2100 MHz (FDD)	2010-02-01	2010	15	BRL	1,453,000,000	3,927,069,840	0.370	No	No
Brazil	2600 MHz (FDD)	2012-06-01	2012	15	BRL	2,565,370,000	23,997,324,840	0.107	No	No
Brazil	700 MHz (FDD)	2014-09-01	2015	15	BRL	5,822,453,605	12,207,579,000	0.477	No	Yes
Brazil	3500 MHz	2021-10-01	2021	20	BRL	3,268,063,720	80,592,463,832	0.041	Yes	No
Brazil	2300 MHz	2021-10-01	2021	20	BRL	2,393,285,964	16,789,145,429	0.143	Yes	No
Brazil	700 MHz (TDD)	2021-10-01	2021	20	BRL	1,427,872,492	4,175,964,427	0.342	Yes	No
Colombia	700 MHz (FDD)	2019-12-01	2020	20	COP	2,107,202,939,243	4,014,992,480	524.834	No	No
Colombia	2600 MHz (FDD)	2019-12-01	2020	20	COP	1,279,381,317,875	3,011,244,360	424.868	No	No
Colombia	2600 MHz (FDD)	2023-12-01	2024	20	COP	117,158,291,904	522,339,663	224.295	No	Yes
Hong Kong	2600 MHz (FDD)	2013-03-01	2013	15	HKD	1,540,000,000	358,945,000	4.290	No	No
Hong Kong	2100 MHz (FDD)	2015-03-01	2015	15	HKD	2,421,200,000	358,731,960	6.749	No	No
Hungary	3500 MHz	2016-04-01	2016	18	HUF	896,600,010	785,121,840	1.142	No	No
Iceland	2100 MHz (FDD)	2017-05-01	2017	5	ISK	16,500,000	10,302,000	1.602	Yes	No
Iceland	2600 MHz (FDD)	2017-05-01	2017	15	ISK	38,300,000	48,076,000	0.797	Yes	No
Latvia	3500 MHz	2017-11-01	2019	10	EUR	500,000	194,224,800	0.003	No	No
Mexico	2600 MHz	2018-08-01	2018	20	MXN	2,100,000,000	14,881,663,320	0.141	Yes	No
Mexico	800 MHz	2021-10-01	2021	20	MXN	1,080,852,000	606,917,611	1.781	Yes	No
Mexico	2600 MHz (FDD)	2021-10-01	2021	20	MXN	270,000,000	1,051,652,645	0.257	Yes	No
Romania	3500 MHz	2015-10-01	2016	10	EUR	3,677,485	1,585,249,280	0.002	Yes	No
Slovakia	3500 MHz	2015-07-01	2015	10	EUR	2,433,706	325,428,060	0.007	No	No
Taiwan	1800 MHz	2013-10-01	2013	17	TWD	72,603,859,886	2,799,640,080	25.933	No	Yes
Taiwan	1800 MHz & 2100 MHz	2017-11-01	2017	13	TWD	27,955,950,035	3,076,453,120	9.087	No	Yes
Taiwan	3500 MHz	2020-01-01	2020	20	TWD	126,553,823,718	6,431,795,280	19.676	No	Yes
Colombia	AWS	2013-06-01	2013	10	COP	501,113,302,800	4,161,413,700	120.419	No	No
Colombia	2600 MHz	2013-06-01	2013	10	COP	269,417,520,000	4,623,793,000	58.268	No	No
Croatia	800 MHz	2013-11-01	2013	11	HRK	280,796,999	85,113,780	3.299	Yes	No
Croatia	1800 MHz	2015-11-01	2015	9	HRK	141,400,000	65,576,222	2.156	Yes	No
Croatia	2100 MHz (FDD)	2019-02-01	2019	6	HRK	87,632,331	121,957,590	0.719	Yes	Yes
Georgia	700 MHz & 800 MHz	2024-10-01	2024	15	GEL	57,700,000	111,608,948	0.517	No	No
Georgia	2600 MHz (FDD)	2024-10-01	2024	15	GEL	23,100,000	223,217,895	0.103	No	No
Georgia	3500 MHz (5G)	2024-10-01	2024	15	GEL	19,400,000	372,029,826	0.052	No	No
Dominican Republic	3500 MHz (5G)	2021-10-01	2021	20	USD	82,651,000	1,556,502,220	0.053	No	No
Indonesia	2300 MHz	2017-10-01	2017	10	IDR	9,189,836,098,587	7,934,965,560	1,158.144	Yes	No
Indonesia	2100 MHz (FDD)	2017-10-01	2017	10	IDR	6,872,220,530,495	5,289,977,040	1,299.102	Yes	No
Moldova	850 MHz	2025-01-01	2025	5	EUR	560,700	24,287,803	0.023	No	No
Peru	700 MHz (FDD)	2016-05-01	2016	20	USD	911,220,000	2,801,950,110	0.325	No	No
Peru	3500 MHz (5G)	2025-08-01	2025	20	USD	506,336,045	13,891,115,205	0.036	No	No
Thailand	1800 MHz	2018-08-01	2018	15	THB	11,362,291,590	711,278,020	15.974	No	Yes
Thailand	700 MHz (FDD)	2019-06-01	2020	15	THB	12,522,585,077	713,077,630	17.561	No	Yes
Thailand	1400 MHz & 2100 MHz	2025-06-01	2025	15	THB	19,600,000,000	3,594,463,486	5.453	No	No
Thailand	2300 MHz	2025-06-01	2025	15	THB	3,114,285,714	718,892,697	4.332	No	No
Tanzania	3500 MHz (5G)	2022-10-01	2022	15	USD	55,100,001	10,479,639,680	0.005	Yes	No
Tanzania	2300 MHz & 2600 MHz	2022-10-01	2022	15	USD	106,847,798	11,789,594,640	0.009	Yes	No
Tanzania	700 MHz (FDD)	2022-10-01	2022	15	USD	25,548,469	1,309,954,960	0.020	Yes	No
Vietnam	2600 MHz (TDD)	2024-12-01	2024	15	USD	296,000,000	9,964,045,315	0.030	No	No
Vietnam	3500 MHz (5G)	2024-12-01	2024	15	USD	101,400,000	9,964,045,315	0.010	No	No
South Africa	700 MHz & 800 MHz	2022-03-01	2022	20	ZAR	8,337,529,192	4,791,510,800	1.740	No	No
South Africa	2600 MHz	2022-03-01	2022	20	ZAR	3,731,860,321	8,385,143,900	0.445	No	No
South Africa	3500 MHz (5G)	2022-03-01	2022	20	ZAR	2,408,500,000	5,150,874,110	0.468	No	No
Vietnam	3500 MHz (5G)	2024-07-01	2024	15	USD	112,500,000	9,964,045,315	0.011	No	No

A brief description of these awards is as follows:

- **Brazil.** The 2100MHz (2010), 2.6GHz (2012), 700MHz FDD (2014) and 5G auction for the 700MHz, 2.3 and 3.5GHz bands (2021) should be added. All of these auctions were competitive and sold meaningful quantities of spectrum.

<sup>14</sup> Unless otherwise noted, all benchmarks are sourced from the Gigabase, NERA's database of spectrum awards. The benchmarks are derived directly from national regulators and other public domain sources, such as operator press releases and industry news stories. We make significant efforts to ensure the accuracy of our data, but collation from disparate primary sources is challenging and errors or definitional issues can occur. We use sources that we believe are reliable, but it is not always possible to verify them with certainty, and in cases of ambiguity we may apply expert judgment to assess the status of certain spectrum holdings, attribution of prices, or categorization of awards. If you spot any issues, please advise us.

- **Colombia.** The AWS and 2.6GHz award in 2013 should be added. The 700MHz and 2.6GHz award (2019) and 2.6GHz award<sup>15</sup> (2023) should also be added. We note that 2.6GHz was sold in the same auction as 3.5GHz, and this latter award is already in the ACMA dataset.
- **Hungary.** The ACMA benchmarks the value of the 2020 3.5GHz Hungarian award but does not include the earlier 2016 award in which 80MHz of 3.5GHz spectrum was sold. 2016 is at the start of the 5G period, and MNOs may have had an expectation of being able to use this spectrum for 5G in the near future. Moreover, including early C-band awards will help to broaden the sample and improve the robustness of trend inference.
- **Iceland.** The ACMA includes 700MHz and 800MHz benchmarks from Iceland's 2017 award but omits the 2100MHz and 2.6GHz bands that were also sold as part of this award.
- **Hong Kong.** The 2.6GHz (2013) and 2100MHz (2015) awards should be added. The ACMA includes 12 other benchmarks from Hong Kong.
- **Latvia.** The ACMA benchmarks the value of the 3.5GHz band sold in Latvia's 2018 and 2023 auctions, but fails to include the 2017 award. It would be consistent to also include the 3.5GHz award in 2017.
- **Mexico.** The 2600MHz auction in 2018, which sold all spectrum, is missing. The 800MHz and 2.6GHz awards in 2021 are also missing; this award included some spectrum available as regional lots, not all of which sold, so it is appropriate only to benchmark the spectrum sold (consistent with approach for US awards).
- **Romania.** The ACMA includes several benchmarks from Romania but does not include the 2015 3.5GHz award. Including early C-band awards will help to broaden the sample and improve the robustness of trend inference.
- **Slovakia.** The ACMA includes the 2022 3.5GHz Slovakian award but does not include the 2015 3.5GHz award. Including early C-band awards will help to broaden the sample and improve the robustness of trend inference.
- **Taiwan.** The Taiwanese 1800MHz band (2013), 2100MHz band (2017) and 3.5GHz band (2020) were competitive awards, in which all spectrum was sold. The 1800MHz band award in 2017 was also competitive and sold meaningful quantities of spectrum.
- **Croatia.** The ACMA should include the 2013 800MHz award, as this was a competitive auction. We note that the first 800MHz award held just before this 2013 auction was not an auction and therefore should not be included. The ACMA should also include the 2015 1800MHz and the 2019 2100MHz awards.
- **Dominican Republic.** The 2021 3.5GHz award from the Dominican Republic was a competitive auction where meaningful quantities of spectrum were sold.
- **Georgia.** The 700MHz, 800MHz, 2.6GHz and 3.5GHz benchmarks from Georgia's 2024 auction should be included, as they were competitive awards in which all spectrum was sold.
- **Indonesia.** The 2100MHz, AWS and 2.3GHz awards in Indonesia's 2017 auction sold all available spectrum, so should be included.

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<sup>15</sup> We propose that the ACMA benchmark the price for the one block of 2.6 GHz spectrum that was sold nationwide in this award.

- **Moldova.** The ACMA includes the 700MHz, 1.5GHz and 3.5GHz band benchmarks from the 2025 Moldovan auction but omits the 850MHz award that was also sold as part of the award. All spectrum was sold for this omitted band.
- **Peru.** The 700MHz (2016) and 3.5GHz (2025) awards were competitive awards, in which all spectrum was sold.
- **Thailand.** The ACMA should include Thailand's 1800MHz (2018) and 700MHz (2019) awards, as they were competitive and had sold all available spectrum. The 2025 auction for the 1400MHz, 2100MHz and 2.3GHz bands also sold all spectrum, so should be included.
- **Tanzania.** The 700 MHz, 2.3GHz, 2.6GHz and 3.5GHz awards from the Tanzania's 2022 auction should be included by the ACMA. All of the available spectrum was sold.
- **Vietnam.** The ACMA includes the 2.6GHz benchmark from the early-2024 Vietnamese auction but does not include the 2.6GHz (TDD) award that was sold later that same year, with meaningful amounts of spectrum sold. The two 3.5GHz auctions in 2025 should also be added, as they were competitive auctions with meaningful amounts of spectrum sold.
- **South Africa.** The ACMA should include the 2022 5G auction<sup>16</sup> in South Africa, which awarded spectrum in the 700MHz & 800MHz, 2.6GHz and 3.5GHz bands. This was a competitive auction in which, except for one block in the 800MHz band, all spectrum was sold.

### 4.3 Significant errors in the ACMA dataset

We reviewed the benchmarks in the ACMA dataset and identified 7 awards where the ACMA price differed significantly from its own data – 5 where the ACMA appears to have overstated prices and 2 where the ACMA has understated the price. In Figure 18, we list these awards.

**Figure 18: Table of Awards with Significant Errors**

Country	Band	Allocation Date	License Start Year	License Duration	Award Currency	Upfront fee (Award Currency)	MHz-POPs	Upfront Fee per MHz-POP	Annual Fee?	Deferred Payments?
Portugal	700 MHz (FDD)	2021-10-01	2021	20	EUR	96,000,000	518,091,550	0.185	Yes	No
Hungary	2100 MHz (FDD)	2020-03-01	2020	15	HUF	12,840,000,000	292,504,470	43.897	Yes	No
United States	2600 MHz (TDD)	2022-08-01	2022	40	USD	419,133,261	5,478,255,241	0.077	No	No
Colombia	3500 MHz	2023-12-01	2024	20	COP	1,053,227,244,162	16,714,869,232	63.011	No	Yes
Portugal	3500 MHz	2021-10-01	2021	20	EUR	313,836,000	3,108,549,300	0.101	Yes	No
United States	3500 MHz	2020-08-01	2020	40	USD	4,543,232,339	23,205,805,840	0.196	No	No
United States	3450 MHz	2021-11-01	2021	40	USD	22,418,284,236	33,114,119,615	0.677	No	No

A brief description of our proposed corrections is as follows:

1. **Portugal.** For the 700MHz auction (2021), it appears that the ACMA has not accounted for the 80% discount to the annual licence fees applied by the regulator for the 700MHz and 3.6GHz bands. This overstates the total Net Present Value of the annual licence fees over the licence duration and overstates the final price.
2. **Hungary.** For the 2100MHz (2020) award, it appears as though the ACMA has not accounted for annual fees. While we are aligned with the ACMA on the upfront auction fee, successful bidders also had to pay meaningful annual licence fees.

<sup>16</sup> All calculations for this auction are based on the results of the main stage of the auction, and not the initial "Opt-In" phase auction.

3. **United States.** For the 2.5GHz award (2022), it appears that the ACMA has applied nationwide population rather than the subset of populations associated with the available spectrum. This results in an overstatement of the available population and therefore an understatement of the final benchmark price.
4. **Colombia.** For the 3.5GHz auction (2023), we note that the winning bids were to be paid in annual instalments over the duration of the licence. Therefore, total revenue should be calculated as the sum of the payments in net present value term.
5. **Portugal.** For the 3.6GHz auction (2021), the ACMA has incorrectly calculated the total revenue of the 3.6GHz portion of the auction.<sup>17</sup> As with the 700MHz award, a discount of the annual fee of 80% was also applied to this band, which appears not to be applied by ACMA. The ACMA calculated the 3.5GHz portion of the auction as 1.55bn EUR. However, the total revenue generated for the entire multiband auction was approximately 567m EUR.
6. **United States.** For the FCC 3.7GHz auction (2020-21), [labelled above as 3.5GHz (2020)], the ACMA lists the total revenue as gross bid values<sup>18</sup>, rather than net bid values, which is inconsistent with the net bid values used in the 2.6GHz auction.<sup>19</sup> Moreover, for the 3.5GHz (2020) and 3.45GHz (2021) auctions, the population figure used by the ACMA to calculate the final prices are consistent using FCC 2010 population estimates, which are based on the 2010 Census. As the auction started in 2020, we recommend that the ACMA should instead use the World Bank's 2020 population estimates for the United States, as that would better reflect the valuation of spectrum by bidders at the time. Both errors have the effect of overstating the price for this award. As discussed further below, these awards are also benchmarked with artificially low licence durations.

## 4.4 Treatment of US benchmarks

In its report, DotEcon recommends that licences be benchmarked solely on the basis of their initial term. It acknowledges that some licences come with “*a strong expectation of licence renewal*” which “*clearly increases the value of the licence.*” However, it also says that “*renewals would typically not be expected without having to pay further fees, which would often be set based on estimated market value for the spectrum at that time.*” On this basis, it says that it “*agree[s] with the ACMA's approach of using the initial licence term as the licence duration in these cases.*”

We consider this to be a reasonable approach whenever there is an expectation that renewal fees will be related to market value. However, we strongly disagree with this approach in the case of countries where there is a strong expectation that licences will be renewed and there is no expectation of meaningful renewal fees. This issue impacts two countries in the sample: the US and Canada.

In the case of the US, it is unambiguous that spectrum licences are de facto a perpetual asset renewed at token fee rates. As a matter of fact, the FCC began allocating spectrum for mobile licences in 1982 and had its first auction in 1994. The licences allocated in these early awards have now been in commercial use for over 30-40 years, repeatedly renewed to existing licensees at token fees.

This certainty over renewal and absence of meaningful renewal fees is an important reason why operators in the US have generally paid much higher fees for spectrum than in most other countries.

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<sup>17</sup> We note that we include only the National Lots block of the award, and not the Regional H and I Lots also allocated for this spectrum band. This is because it is difficult to ascertain the correct data on population for each region. We keep the National Lots as it is possible to verify the population figure from relevant data sources.

<sup>18</sup> Additionally, there is a typo in the ACMA's value for the gross bid values – the ACMA has listed this as 4.585bn USD, when in fact it is 4.858bn USD.

<sup>19</sup> We agree with the approach to use the net bid values for US spectrum auctions, as it reflects the actual price paid by bidders.

This market-friendly licensing regime (combined with a large population and regional licensing of spectrum) has supported a relatively liquid secondary market, as participants enjoy certainty that if they trade a licence, the new owner will be able to exploit the licence fully without fear of it terminating or having to pay a substantial renewal fee.

It is well understood in the industry that US mobile operators consider their spectrum licences to be perpetual assets. For example, in the context of financial securitisation of spectrum assets, Sprint published the following advice to investors:<sup>20</sup>

*“As long as the Company acts within the requirements and constraints of the regulatory authorities, the renewal and extension of these licenses is reasonably certain at minimal cost. Accordingly, we have concluded **that FCC licenses are indefinite-lived intangible assets.**”*  
[emphasis added]

Accordingly, to model US licences on the basis of their initial term (historically 10 years but now increased to 15 years) would be a gross error. This approach would result in an obvious overstatement of US benchmarks versus other countries.

The case of Canada is more ambiguous. During the 2010s through early 2020s, the initial term of early low-band and PCS awards expired, and ISED opted to renew them in place without charging any fees. Although there was a clear expectation of renewal, the Government's position on fees was ambiguous. It is certainly the case that the industry grew accustomed to zero-price renewals, and this may have impacted prices in auctions in this period. However, from 2024-25, the regulator undertook a review of fees, and this ultimately led to the imposition of new annual fees on all existing and future licences after the expiry of the initial term. These fees were derived from an analysis of market prices.

When we benchmark prices for countries outside North America, we often exclude US and Canada benchmarks owing to their unique regulatory status and frequent position as high price outliers. When we do include them, typically in the context of broader samples, we model US licences as having a duration of 40 years or more, to reflect the expectation of renewal at token fees. The net present value difference between a 40-year and perpetual asset is small, whereas the difference between a 10- and 40-year asset is substantial.<sup>21</sup> We do normally benchmark Canada based on the initial term, which for recent awards is 20 years.

In conclusion, we request that the ACMA models all US awards as if they have a licence term of no less than 40 years. The recommendation at footnote 11 in the DotEcon report that US licences be modelled based on their initial term (10-15 years) is clearly inappropriate, as it does not reflect the way these licences are valued in the real world. No changes for other countries are required.

As addressed in Section 4.3, two US awards were amongst our list of significant errors. Given the broader issue with licence terms, we provide in Figure 19 corrected benchmarks for all US awards in the ACMA sample.

<sup>20</sup> Sprint, Form 10-Q, 2019, available at: [https://s29.q4cdn.com/310188824/files/doc\\_financials/2019/q1/Q1-2019-Form-10Q.pdf](https://s29.q4cdn.com/310188824/files/doc_financials/2019/q1/Q1-2019-Form-10Q.pdf).

<sup>21</sup> Using a discount rate of 8.49%, the difference between the present value of a perpetuity and a 40-year annuity yielding equal annual cashflows is only 4%, whereas a 40-year annuity is worth 73% more than a 10-year annuity yielding equal cashflows.

**Figure 19: Corrected US benchmarks**

Country	Band	Allocation Date	License Start Year	License Duration	Award Currency	Upfront fee (Award Currency)	MHz-POPs	Upfront Fee per MHz-POP	Annual Fee?	Deferred Payments?
United States	600 MHz	2017-04-01	2019	40	USD	19,311,003,826	22,074,745,431	0.875	No	No
United States	PCS	2014-02-01	2014	40	USD	1,564,000,000	3,183,863,290	0.491	No	No
United States	AWS	2015-01-01	2015	40	USD	41,329,673,325	16,035,505,871	2.577	No	No
United States	2600 MHz (TDD)	2022-08-01	2022	40	USD	419,133,261	5,478,255,241	0.077	No	No
United States	3500 MHz	2020-08-01	2020	40	USD	4,543,232,339	23,205,805,840	0.196	No	No
United States	3700 MHz	2021-02-01	2021	40	USD	81,114,481,921	92,968,835,120	0.872	No	No
United States	3450 MHz	2021-11-01	2021	40	USD	22,418,284,236	33,114,119,615	0.677	No	No

For all US awards, we apply a consistent methodology that reflects the value of the spectrum at the time of the award. Specifically, for all awards, we:

- Calculate the upfront fee as the sum of net bids instead of gross bids. This corresponds to the actual price paid for the spectrum by bidders. Although the auction system records gross bids, small-bidder discounts are known before the auction, so bidders bid with the knowledge that they will pay their net bid amount. Benchmarking using gross bids therefore overstates US benchmark values. In their sample, the ACMA has been inconsistent between selection of net and gross bids.
- Model licences as having a licence term of 40 years. This contrasts with the ACMA's approach of modelling all licence durations using the initial term of 10-15 years, resulting in an overstatement of the value of US benchmarks after adjustments for licence durations.
- Model the bandwidth of spectrum in MHz based on the quantity of spectrum that was sold rather than the bandwidth that was available. Using total MHz available (e.g., 280MHz in the case of the 3.7GHz auction) results in an underestimate of the value of US benchmarks as it fails to account for unsold spectrum.
- Use actual population at the time of the award, rather than using outdated 2010 population figures. Although the FCC historically used 2010 population figures for reporting purposes (to align with the last available census) bidders in these auctions bid on the basis of the population actually available to cover at the time of the auction. Dividing prices by 2010 population figures would result in an overstatement of the value of US benchmarks. We use World Bank population estimates of the US population in each award year to ensure consistency with the approach used for benchmarking prices in other countries.

## 5. Updated statistical analysis using revised dataset

We have re-run the statistical analyses from Section 3 using the revised dataset described in Section 4 and find similar results. Again, we find evidence of declining prices for all frequency band groups, and the trends for the 'Sub-1GHz' and 'Lower 1-3GHz' band groups are statistically significant. Notably, there is very strong statistical evidence for a downward trend in both lower band groups, with significance at the 1% level.

Figure 20 summarises the results of the statistical analysis (compare to Figure 11 for the unadjusted dataset). Figure 21 shows the Sen slope estimator trends for each band group using log scales for the revised dataset (compare to Figure 12 for the unadjusted dataset).

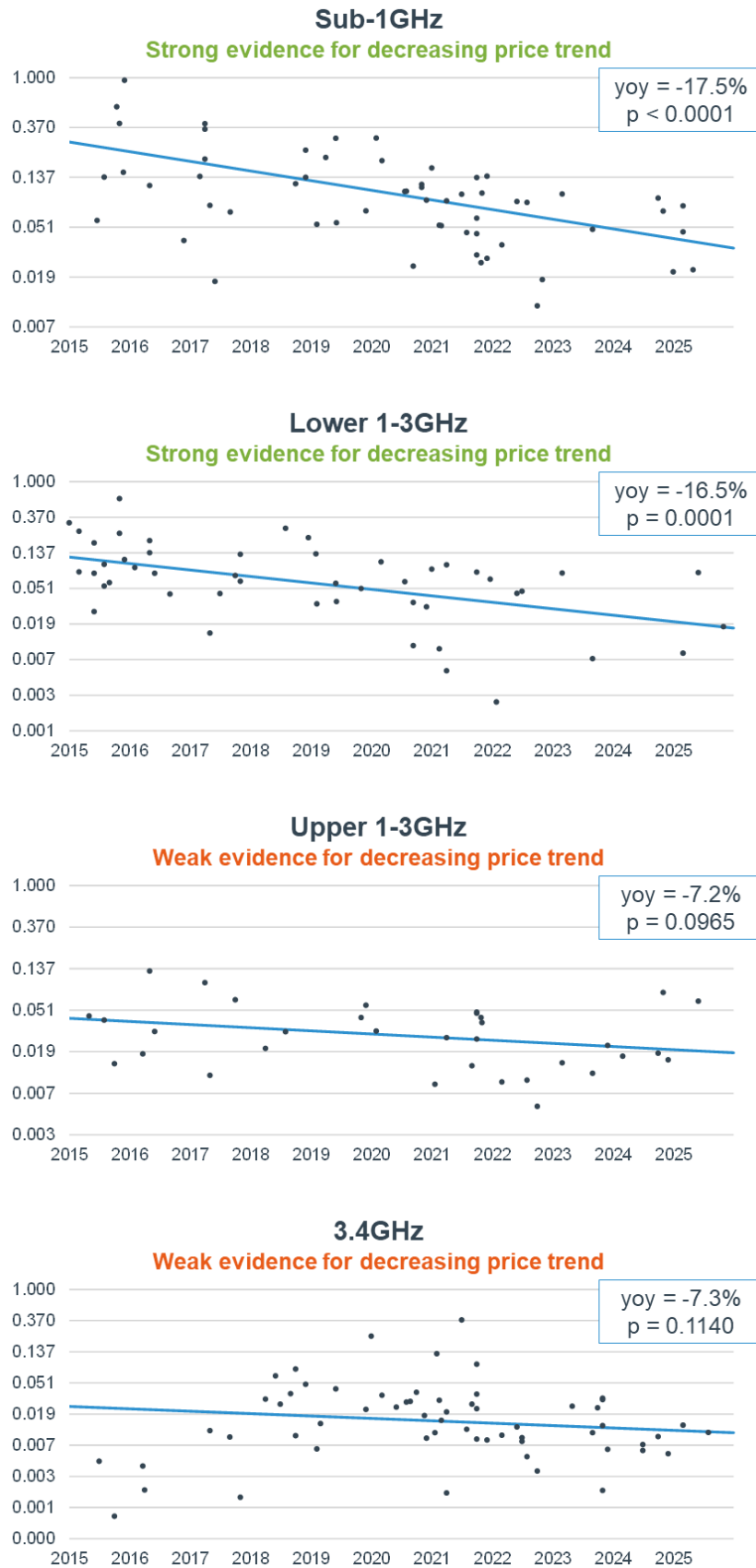
The results are very similar to those presented in Section 3 for the unadjusted ACMA dataset results. We again find strong evidence for a decreasing trend in the 2015-2025 period for the 'Sub-1GHz' and 'Lower 1-3GHz' band groups using the Mann-Kendall test. There is also again some evidence, albeit not statistically significant, for decreasing trends in the 'Upper 1-3GHz' and '3.4GHz' band groups over the same period.

For the band groups where there is a statistically significant trend detected by the Mann-Kendall test at the 5% level (highlighted in green), the annual decreases calculated by the Sen slope estimator are similar. The revised dataset has 17.5% and 16.5% annual decreases for the 'Sub-1GHz' and 'Lower 1-3GHz' band groups respectively compared with 16.8% and 17.0% for the unadjusted dataset.

**Figure 20: Statistical tests on real spectrum prices 2015-2025**  
 [Source: Aetha-NERA revised dataset]

	Sub-1GHz	Lower 1-3GHz	Upper 1-3GHz	3.4GHz
Sample size	58	48	33	60
Mann-Kendall test one-sided p-value	<0.0001	0.0001	0.0965	0.1190
Mann-Whitney U test one-sided p-value	0.0001	0.0004	0.0291	0.2911
Sen slope estimator implied annual trend	-17.5% ( $p < 0.0001$ )	-16.5% ( $p = 0.0001$ )	-7.2% ( $p = 0.0965$ )	-7.3% ( $p = 0.1190$ )
Linear regression (annual trend and one-sided p-value)	-16.0% ( $p < 0.0001$ )	-17.9% ( $p = 0.0001$ )	-6.2% ( $p = 0.1505$ )	+2.8% ( $p = 0.6602$ )

**Figure 21: Single-year 2025 AUD/MHz/pop real prices with Sen slope on log scale [Source: Revised dataset]**



As in Section 3, we calculate central estimates based on the updated benchmarking data adjusting for the trend found by the Sen slope estimator for the lower two band groups. Figure 22 below shows the estimates using this methodology, noting that these do not account for asymmetric risk which is discussed in Section 6.

**Figure 22: Single-year price estimates for the lower two band groups adjusting for trend and amended dataset**

	Geomean of adjusted data	Median of adjusted data	IQR of adjusted data	ACMA stage 4 price	ACMA overestimate vs Geomean
Sub-1GHz	0.0315	0.0344	0.0203-0.0606	0.0755	139%
Lower 1-3GHz	0.0180	0.0177	0.0110-0.0388	0.0307	71%

We observe that using our updated dataset the extent of the ACMA's overestimate increases in the 'Sub-1GHz' band group, but reduces in the 'Lower 1-3GHz' band group.

Using the updated dataset also impacts the benchmarks for the 'Upper 1-3GHz' and '3.4GHz' band groups. Applying the geomean of real prices for these band groups our estimates are:

- **Upper 1-3GHz: AUD0.019/MHz/pop** (vs the ACMA's stage 4 price of AUD0.017/MHz/pop) but with a risk of overstatement
- **3.4GHz: AUD0.014/MHz/pop** (vs the ACMA's stage 4 price of AUD0.022/MHz/pop) but with a risk of overstatement.

## 6. Failure to consider asymmetric risk

In this section, we explore what actions the ACMA could take to mitigate the asymmetric risk that it inadvertently sets price above actual market value, leading to a situation where operators decide not to renew all spectrum and the economy is damaged. At current proposed prices, we fear this risk is very high, owing to methodological errors. However, even with the lower estimates of market prices that we anticipate when the ACMA updates its analysis, asymmetric risk remains a concern. It may be managed by the ACMA taking a more cautious approach to estimating market value within the range of possible values identified through benchmarking. Specifically, we recommend, for each band, adopting the mid-point of the ACMA's central estimate and the lower inter-quartile range (IQR) for the full sample.

For avoidance of doubt, we are not proposing that the ACMA offers a discount to MNOs relative to market value. The ACMA has made clear that it proposes to set prices based on market value. We are simply proposing that the ACMA adopts a cautious approach in selecting the renewal price from within the uncertain range in which the fair market value likely lies.

This section is in two parts:

- In Section 6.1, we define asymmetric risk, explain why it matters and propose an approach to manage it; and
- In Section 6.2, we make the case that sensitivity analysis on the results reinforces the case for a cautious approach in setting market prices.

### 6.1 Managing asymmetric risk

A regulator setting prices for renewing spectrum often has considerable discretion regarding the level of those prices. In principle, prices might be set anywhere between a basic level that recoups administrative costs and an estimate of the full market value for the spectrum. It is generally recognised that market value represents an upper bound for prudent fee setting. If prices were set above market value, then operators might decline to renew all the available spectrum resulting in some valuable frequencies going unused. This would be wasteful and damaging to the economy.

The ACMA has developed a benchmarking model that seeks to estimate full market value for each spectrum band category. Furthermore, it proposes to set prices based on the full amount of this estimate. Accordingly, its approach can be categorised as a 'full market value' model. Put simply, the ACMA is proposing to set prices in a way that it hopes will maximise revenues extracted from the industry without incentivising the industry to return any spectrum.

It is important that the ACMA recognises that this approach exposes the Australian economy to risk. The methodology employed produces an estimate of market value, but it is only an estimate. This estimate could be too high or it could be too low. The ACMA estimates market value using international spectrum prices, which provide a useful, but noisy and imprecise, benchmark for Australian market value. Accordingly, the ACMA should recognise that any average benchmark it identifies comes with a wide error margin.

The risks associated with over pricing spectrum are much greater than the risks associated with under pricing spectrum relative to full market value. This is a concept referred to in the industry as 'asymmetric risk'. Telstra introduced this concept in previous submissions, including a report prepared by Aetha and NERA and submitted to the ACMA in October 2024.<sup>22</sup> Section 3 of that report made the case for setting

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<sup>22</sup> NERA and Aetha, 'Setting Prices for Expiring Spectrum Licences in Australia', October 2024, Sections 3 and 6.1.

prices cautiously relative to full market value, and Section 6.1 explored the economic downside of inadvertently setting spectrum prices too high.

In short, if spectrum is inadvertently priced above market value, operators will look to economise on its use, potentially declining to renew all their holdings. This is bad for Australia:

- Spectrum, a natural Australian resource, will be underused. There is no other use of ESL spectrum that comes close to matching the value that mobile can generate.
- To the extent that MNOs avoid spectrum, funds may be diverted to building more infrastructure, as an alternative solution to increasing capacity. This means unnecessary spend on technology that must be imported.
- To the extent that MNOs overpay for spectrum, industry profitability will be further weakened, their cost of capital will rise, and their ability to invest in networks will be eroded.
- Regional Australia may be disproportionately harmed because financially constrained operators may tend to concentrate investment in cities where population and wealth is concentrated, and higher investment costs can more readily be recovered.

In contrast, if spectrum is priced below market value (whether inadvertently or deliberately), the economic downside, if any, is negligible. There may be a modest transfer of economic value from the state to operators, as price levels are reduced, but any benefit to MNOs may then be competed away to the benefit of consumers. Meanwhile, operators should continue to make efficient use of all available spectrum.

The Australian mobile industry has been here before: in 2013 there was ministerial intervention in the award of 700MHz which resulted in a significant hike in the reserve price. The higher prices were an attempt to increase government revenue, overriding the ACMA's decision. The new price was above market value. As a result, only Optus and Telstra participated in the award, and both acquired spectrum below the cap. Consequently, 30MHz out of a total of 90MHz went unsold. This spectrum subsequently lay unused for four years, depriving Australian consumers of the quality-of-service benefits from deployment. And the Government did not secure its target revenues because so much spectrum was unsold.

Ultimately, the final 30MHz of 700MHz spectrum did sell at a higher price in an award in April 2017. In this regard, Australia was fortunate because spectrum prices increased after 2013. The current era is different; spectrum prices have been falling for the last decade and may continue to decline. If the ACMA locks in excessive prices now, then spectrum not renewed could lie fallow for a decade or more. This is not an abstract risk. Such a scenario has, for example, played out in Mexico, where very high annual fees motivated the country's third operator, Telefonica, to hand spectrum back to the regulator, close its network and reinvented itself as an MVNO.

We recognise that some other submissions to prior consultations may have obscured the importance of weighing asymmetric risk. For example, the Coleago response painted substantial renewal prices as generally bad, irrespective of how they are set relative to market value. To our mind, they exaggerate the burden associated with substantive prices while distracting from the more serious risk that prices are set above market value. Meanwhile, Professor Holden has countered that MNOs should treat one-off renewal prices as a sunk cost, implying their subsequent investment decisions should be unaffected. We believe his position is overstated and does not give adequate regard to the extent to which higher spectrum prices weaken the MNOs' finances (in an era of already low profitability), raise the cost of capital and generate behavioural pressure on MNOs to retrench rather than invest.

In our opinion, in the context of a market value model (as embraced by the ACMA), the best way to manage asymmetric risk is to take a cautious approach when selecting final renewal prices from within

the plausible range of market value. The ACMA's current approach is to interrogate the geometric mean and median of the full sample and compare them to the IQR associated with two cohort samples, based on countries with similar population density and GDP per capita to Australia respectively. The specific price selected varies for each band, but in all cases the proposed price is either equal to or very close to the geometric mean of the full sample. In our opinion, this is aggressive. In choosing a mid-point, the ACMA is embracing price levels that have a roughly 50% likelihood of being above market value (after applying the methodology corrections we set out in Section 3).

To manage asymmetric risk, we propose that the ACMA should instead pick a price level that carries a much lower risk of overstatement. For example, rather than simply adopting its central estimate, it could adopt the midpoint of its central estimate and the bottom of the IQR range for the full sample. This would reduce the risk of pricing above market value to rather less than 25%.

In conclusion, the ACMA's current approach expresses indifference between the risk of the spectrum going unsold and the possibility of the government missing out on additional revenues, even though the economic consequences of the former are far more severe than the latter. We think this profile is a poor fit with the ACMA's objectives of promoting investment and supporting consumers, and runs contrary to Australia's general economic interest. A more cautious approach to setting renewal prices using benchmark evidence is merited.

Figure 23 shows the geometric mean (geomean), inter-quartile range (IQR) and the midpoint of the lower quartile (LQ), using the Aetha-NERA methodology and updated dataset. The 'Geomean and LQ midpoint' is our cautious estimate of market value for each band group.

For the lower two band groups we take the updated benchmarking dataset (as discussed in Section 4), adjust the benchmarks for the timing trend found using the Sen slope estimator (2015-2025) and account for asymmetric risk by taking the midpoint of the geometric mean (geomean) and LQ of the 2015-2025 data. For the upper two band groups we do not apply a time trend adjustment but using the updated dataset we take the midpoint of the geomean and LQ for the whole period. We compare these values to the ACMA's stage 4 estimates of market value.

**Figure 23: Aetha-NERA 2025 market value estimates by band group (single-year 2025 AUD/MHz/pop)**

	Geomean	IQR	Geomean and LQ midpoint	ACMA stage 4 price	ACMA overestimate vs Aetha-NERA
Sub-1GHz	0.0315	0.0203-0.0606	0.0259	0.0755	191%
Lower 1-3GHz	0.0180	0.0110-0.0388	0.0145	0.0307	112%
Upper 1-3GHz	0.0191	0.0117-0.0412	0.0154	0.0167	8%
3.4GHz	0.0143	0.0081-0.0292	0.0112	0.0217	94%

We find the ACMA overestimates the market value in all band groups with the 'Sub-1GHz' having the greatest overestimate of 191% and the 'Upper 1-3GHz' band group the smallest at 8%. We note that this produces a value for Lower 1-3GHz that is slightly below Upper 1-3GHz. In practice, we would not recommend setting the price for Upper 1-3GHz above Lower 1-3 GHz, given we would expect the latter to have somewhat greater value. Here, the ACMA might consider a greater discount for asymmetric risk for upper bands than lower ones, reflecting the fact that we make no adjustment for downward price trends to the two higher bands. We discuss this further under sensitivity analysis.

## 6.2 Sensitivity analysis

In its report, the ACMA identifies the importance of sensitivity analysis. However, the actual analysis performed appears perfunctory. In its revised methodology, the ACMA has embraced real over nominal prices and PPP rather than spot rates, which have pushed up its estimate of market value. Sensitivity analysis on these two methodological changes points to a risk of overstatement that the ACMA is currently disregarding.

In its new methodology, the ACMA has opted only to model real rather than nominal prices, notwithstanding evidence that spectrum prices have gone down while general prices have gone up. If our proposal to account for price trends for the two lower bands is adopted, this change nets out. However, it remains a concern for the two higher bands, where no trend is applied even though there is strong evidence that real (and nominal) prices have trended down. Sensitivity analysis points to a risk of overstatement if a simple mean or median is adopted. Indeed, after applying our methodology and enlarged sample, the average price for the 'Lower 1-3GHz' band group is below the 'Upper 1-3GHz' band group price. We attribute this to overstatement of the 'Upper 1-3GHz' price. It should be addressed in the final step, when taking account of sensitivities.

Previously, the ACMA engaged in an extensive cohort analysis process and identified a value range based on the intersection of its PPP and spot rate analysis. In line with DotEcon's recommendations, most of these steps have been removed. The ACMA does still look at benchmarks based on spot rather than PPP prices, and they are lower, but it effectively concludes that they are not low enough for it to take account of them.

Both these sensitivities point to a risk of overstatement of market value. As with asymmetric risk more generally, this can be managed by adopting a more cautious approach to estimating market value.

## 7. Application of forward-looking inflation is inappropriate

The ACMA's benchmarking methodology produces a price for the final year of analysis, currently 2025. However, for the ESL process, it is required to set prices for the year of renewal, from 2028 to 2032 depending on the band. To adjust for this difference, the ACMA proposes to apply CPI inflation to its latest estimate to arrive at a price on the renewal date. Specifically, the ACMA proposes to update the benchmarking dataset closer to the renewal date *"to include awards that occur up to 6 months before the renewal application period for each ESL band"*. There is a *"2-year window prior to licence expiry in which to apply for renewal"*<sup>23</sup> meaning benchmarking updates will cease ~2.5 years before the renewal date for each band. This means that the ACMA will apply ~2.5 years of inflation to the prices produced by the final benchmarking exercise for each band.

Consider, for example, the 850MHz and 1800MHz bands. The timeframes for renewal lead the ACMA to state that *"the prices contained within our preferred views are effectively final prices for licences expiring in June 2028 (850MHz and 1800MHz bands)"*.<sup>24</sup> Therefore, for these two bands, an inflation adjustment of 7.4% is included in the final proposed price, which is around 2.5 years of the Reserve Bank of Australia's inflation forecast.

The ACMA's rationale for this approach is that *"it is uncertain if they [spectrum pricing trends] will persist"*<sup>25</sup>, and given this uncertainty it forecasts 'no trend' in real terms going forwards with the aim of *"improving the accuracy of future price estimates"*<sup>26</sup>. We believe this position is aggressive and likely to result in result in an overstatement of market value, even if the original base estimate is correct.

Even if the ACMA takes into account the asymmetric risk in identifying a market price, any forecast trend it applies for the period between the benchmarking and the point of renewal should be neutral – i.e. it should be equally likely that the adjustment is an overestimate as an underestimate. Given the decade-long trend of real prices declining by ~17% per year in the lower band groups, it appears more likely that a flat forecast will result in an overstatement than an underestimate.

We agree that there is **uncertainty** regarding whether the downward trends in spectrum prices will persist. However, the ACMA's proposed solution is effectively to assume that a trend that has persisted for the last decade will cease abruptly from 2025. This does not appear neutral. A more reasonable view must be that spectrum prices are more likely to decline (in real terms) than not.

Figure 24 illustrates this issue graphically. It shows the historic trend in prices for the 'Lower 1-3GHz' band group (used for 1800MHz prices) as determined in Section 3 for 2015-2025 (blue line), and extrapolates this to 2028 (dashed blue line), when 1800MHz renewal prices will be due. We also show the proposed ACMA forecast of flat real pricing (dashed grey line). The assumed sudden change in trend is stark.

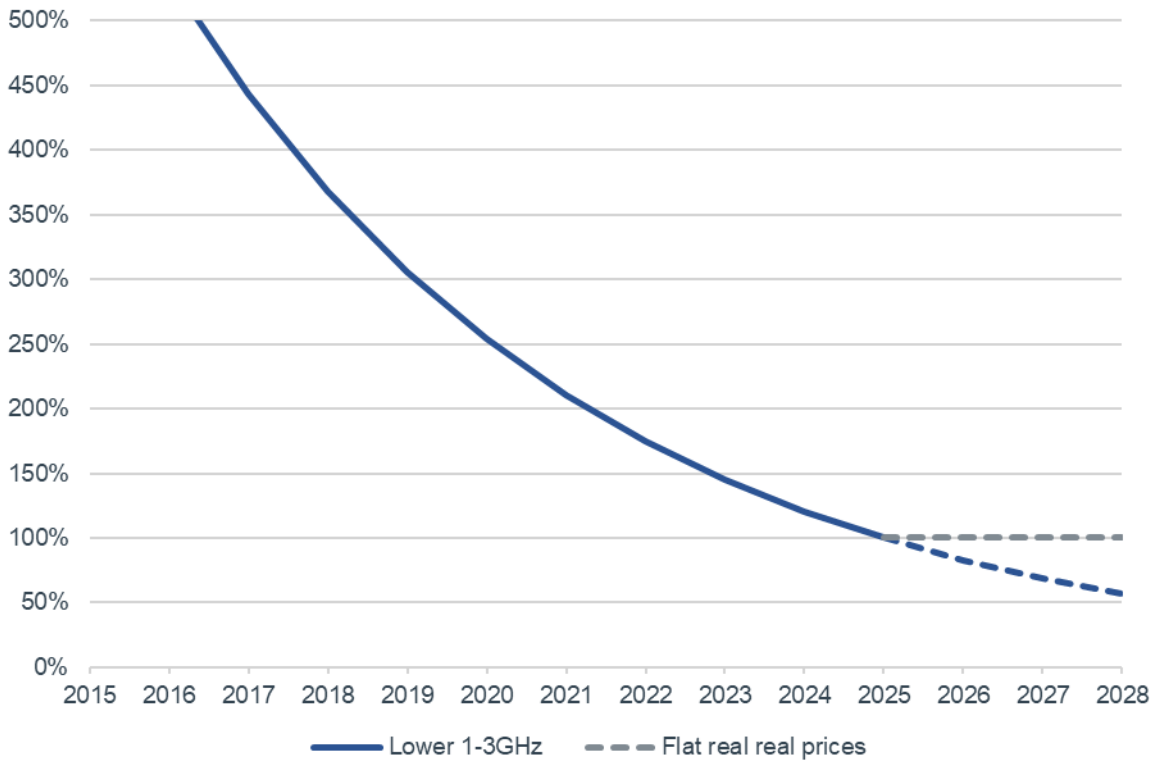
<sup>23</sup> The ACMA, 'Expiring spectrum licences, stage 4 - Updated preliminary views of pricing', December 2025, pp. 39-40.

<sup>24</sup> The ACMA, 'Expiring spectrum licences, stage 4 - Updated preliminary views of pricing', December 2025, p. 4.

<sup>25</sup> The ACMA, 'Expiring spectrum licences, stage 4 - Updated preliminary views of pricing', December 2025, p. 14.

<sup>26</sup> The ACMA, 'Expiring spectrum licences, stage 4 - Updated preliminary views of pricing', December 2025, p. 39.

**Figure 24: Lower 1-3GHz - future forecasting price options (2025 = 100%)**



We suggest that the ACMA adopts one of two solutions:

1. **Adopt a modest negative trend.** One option could be to split the difference between extrapolating the existing trend and a flat real trend. This approach might be considered neutral in that it may balance the risk of underestimate and overestimate.
2. **Make no forward inflationary adjustment and instead address the issue by being more cautious when estimating market value.** In Section 6, we made the case for being more cautious when setting prices to manage the asymmetric risk of setting prices too high and damaging the economy. A significant advantage of being cautious is that there is much less risk that continued price erosion results in excessive spectrum prices at the time of renewal. If prices have already been set cautiously, then holding prices steady in nominal terms might be considered a neutral assumption.

Solution 1 is most appropriate if the ACMA continues to follow its current approach of attempting to price at full market value based on benchmark averages. Solution 2 is more relevant if the ACMA opts to set prices cautiously relative to benchmarks to manage asymmetric risk.

## 8. Cross-check of ACMA prices against those set by peer regulators

One tool available to the ACMA to assess the risk that its estimate of market value is too high is to compare its output against other regulators who have set renewal prices based on market value. In this section, we highlight two peer regulators, Ofcom in the United Kingdom and ISED in Canada, that have recently set renewal fees for spectrum informed by international benchmarks. Both opted to set prices that are significantly lower than those proposed by the ACMA. The comparison to Ofcom is particularly relevant, given that UK annual fees were reset in 2025 based on a 'full market value' benchmarking methodology.

Ofcom is mandated to set annual fees for renewing spectrum licences whose initial term has expired based on 'full market value'. Like the ACMA, it uses international benchmarking to estimate these prices. Ofcom has dismissed arguments from operators that it should set prices significantly lower than its central estimate of market value, as it says it was mandated by the Government to price at "full market value". However, it does recognise that there is 'asymmetric risk' associated with over-pricing versus under-pricing. Its approach to managing risk is by adopting what it describes as a cautious approach in interpreting benchmark evidence and determining values for assumptions in its methodology. In 2025, it conducted a review of annual fees for 900MHz and 1800MHz.<sup>27</sup> This resulted in a significant reduction in both fees, consistent with international evidence that prices for these types of spectrum had declined significantly since the last review in 2018. Ofcom previously benchmarked 3.5GHz in 2019.<sup>28</sup>

ISED introduced a new annual fee regime in 2025, informed by international benchmarking. Unusually, rather than set different prices by band category, it opted to set a flat fee across all sub-10GHz bands. This likely results in an understatement of sub-1GHz fees relative to other bands, and an overstatement of 3.4 GHz fees.<sup>29</sup>

In Figure 25, we compare the ACMA's proposed prices (expressed in single-year AUD/MHz/pop) to those set by Ofcom and Canada. We observe that the ACMA's prices for 'Sub-1GHz' are 138% higher than Ofcom's and 189% higher than ISED's, and prices for 'Lower 1-3GHz' are 34% higher than Ofcom's and 17% higher than ISED's. This should be a red flag for the ACMA that it has substantially overestimated the prices for these bands, especially for the 'Sub-1GHz' band group.

<sup>27</sup> Ofcom, 'Review of Annual Licence Fees - Decision to revise Annual Licence Fees for 900, 1800 and 2100MHz spectrum', 18 July 2025.

<sup>28</sup> Ofcom, 'Annual Licence Fees for UK Broadband's 3.4 GHz and 3.6 GHz spectrum', June 2019.

<sup>29</sup> ISED, CPC-2-1-32 — Spectrum Licence Fees for certain Spectrum Licences used to provide Commercial Mobile Services below 10 GHz, Issue 1, July 2025.

**Figure 25: Proposed ACMA renewal prices compared to Ofcom and ISED (single-year AUD/MHz/pop prices)**

	ACMA	Ofcom	ISED	ACMA premium over Ofcom	ACMA premium over ISED
Sub-1GHz	0.0755	0.0318	0.0261	138%	189%
Lower 1-3GHz	0.0307	0.0229	0.0261	34%	17%
Upper 1-3GHz	0.0167	Not available	0.0261		-36%
3.4GHz	0.0217	0.0222	0.0261	-2%	-17%

NOTES: UK and Canadian fees are derived from OFCOM and ISED documents references in footnotes below. Fees have been converted to Australian dollars at World Bank PPP exchange rates and are expressed on a single-year AUD/MHz/pop basis. All fees except UK 3.4GHz were set in 2025, so no inflation adjustment is required. UK 3.4GHz fees were set in 2019, so are converted to AUD at 2019 PPP exchange rate and inflated to arrive at a 2025 real value.

Of the two comparisons, we suggest that the ACMA places most weight on comparison with Ofcom, as (a) the UK regime is also based on full market value; (b) Ofcom identifies broadly the same band categories as the ACMA; and (c) the UK prices are based on a detailed benchmarking study. In contrast, ISED's study is higher level and adopts a flat fee structure across bands that is somewhat divorced from market values.

Although the ACMA's and Ofcom's 3.4GHz prices appear similar, we note that we have applied inflation to the UK 2019 price, whereas broader internal benchmarking suggests the 3.4GHz band value has declined in real and nominal terms from 2019-25. Therefore, this supports our view that the ACMA's estimate of 3.4GHz value carries a risk of overstatement.

## 9. Conclusions and recommendations

Based on the evidence presented in the report, we find that the ACMA's revised methodology produces prices that:

- Materially overstate market value for the 'Sub-1GHz' and 'Lower 1-3GHz' band groups; and
- Reflect a plausible estimate of market value for 'Upper 1-3GHz' and '3.4GHz' band groups, but with a greater risk of overstatement than understatement.

Figure 26 shows the market value estimates published by the ACMA as well as our estimates which, based on our recommendations in this paper, account for:

- the time trend in the lower two band groups (Sections 3 and 5)
- the dataset corrections (Section 4)
- asymmetric risk, by taking the midpoint of the geometric mean and lower quartile (Section 6).

**Figure 26: 2025 market value estimates by band group (single -year 2025 AUD/MHz/pop)**

	ACMA	Aetha-NERA methodology, dataset and asymmetric risk adjustment	ACMA overestimate vs Aetha-NERA
Sub-1GHz	0.075	0.026	191%
Lower 1-3GHz	0.031	0.014	112%
Upper 1-3GHz	0.017	0.015	8%
3.4GHz	0.022	0.011	94%

Consequently, we recommend that the ACMA makes the following adjustments to its approach:

- Take account of the dataset errors and omissions identified in Section 4;
- Replicate our statistical methods to identify and quantify time trends for spectrum prices, and adjust benchmarks within the lower band groups to account for the statistically significant downward price trend across 2015-2025;
- Exercise caution when determining where in the broad range of market value estimates to set the 2025 value for each band, considering the asymmetric risk of setting renewal prices too high; and
- For future prices at the point of renewal, apply a negative forward trend – or at minimum, refrain from applying inflation.

If these (or similar) changes are not implemented, we believe there is a high likelihood that renewal prices will be set above market value. This would be a bad outcome for the Australian economy. Notably, there is a real risk that the existing licensees may opt not to renew all their existing licences, resulting in this important public resource being underutilised.



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