Chorus opex productivity target for PQP2

Response to NZCC draft decision

16 May 2024

Project Team

[redacted]

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1. Introduction and summary

1. On 18 April 2024 the NZCC released its draft decision regarding Chorus's expenditure allowances for the second regulatory period (**PQP2**) from 2025-2028.
2. We have been asked to provide our views on the NZCC's expectations and assumptions relating to Chorus's operating expenditure (**opex**) productivity and the interdependencies between the chosen productivity factor and the other assumptions in the base-step-trend (**BST**) model.
3. The NZCC's draft decisions on opex productivity appear to be motivated by two main concerns:
   A. Chorus's opex may not have been efficient in the base year (2022); and
   B. concerns regarding the appropriateness of using EDB elasticities to scale Chorus's allowed opex with connections.
4. To address these concerns, the NZCC applied productivity factors of 1% and 3% to certain components of Chorus's opex, resulting in an average productivity factor of 2.1%. This had the effect of reducing Chorus's allowed opex over PQP2 by $63 million or 9.0%.
5. In our view, this decision imposes an excessive burden on Chorus to improve productivity, particularly given the productivity expectations embedded in other aspects of Chorus' proposal, and the NZCC's draft decision. We summarise our reasoning as follows:
   A. Productivity gains can come in the form of catch-up (inefficient firms becoming efficient), scale economies (lower average costs as output grows), and frontier shift (efficient firms becoming more efficient). The BST model has three mechanisms which implicitly or explicitly embed productivity targets (**"productivity mechanisms"**):
      i. step changes/adjustments to the base year are well-suited to adjusting for specific catch-up targets;
      ii. elasticities in the trend term can be used to set targets for scale economies; and
      iii. productivity factors can deal with the remaining frontier shift, plus any further productivity targets that were not adequately captured by the first two mechanisms.
   B. The NZCC's concerns about the base year being inefficient imply a view that some catch-up productivity is needed. These concerns should be mitigated by the $22 million worth of step changes relating to IT and solar cost savings. This is a substantial saving (a 3.1% reduction to the total opex allowance) and should somewhat offset expectations of gains in other categories.
   C. Regarding the NZCC's concerns about EDB elasticities being inappropriate for Chorus:
      i. This implies a view that Chorus should achieve even greater scale economies than what is required of EDBs. From the NZCC's perspective, there should only be issues with applying EDB elasticities to Chorus if they are demonstrably too high (i.e. if they allow Chorus too much opex for a given increase in connections). If it instead thought the EDB elasticities were too low, it would only compound this issue by applying a further productivity factor.

ii. These concerns should be mitigated by the fact that Chorus has taken a highly conservative approach to applying the EDB elasticities. Part of Chorus' justification for using connections as the sole driver was that it would also partially pick up the impact of network length on opex (i.e. connections and line length are correlated). However, the EDB elasticity Chorus applied comes from the NZCC's two-output model, which separately estimates the impact of connections growth and line length on opex. Because connections and line length are correlated, this results in a lower elasticity for connections than if a one-output connections-only model was estimated (where connections growth is relied on to pick up growth in customer numbers and network length). The NZCC's econometric models for EDBs produce a standalone connections elasticity of 0.78 for network opex, which is materially higher than the partial connections elasticity of 0.45 used by Chorus.

D. Given the material catch-up and scale economies targets already implicit in Chorus' application of the BST model, a productivity factor should not be needed to account for either of these concerns. In fact, the average 2.1% productivity factor likely overcorrects for both. It reduces the opex allowance by vastly more ($63 million) than even the most extreme elasticity setting of zero would ($10 million).[1] And the NZCC's implementation of this productivity factor in addition to the IT and solar step changes fails to recognise that it may be most efficient for Chorus to achieve its catch-up gains in those particular categories, leading to a double-counting issue if it proceeds with those projects but must still find similar gains elsewhere. This is exacerbated by the fact that our review of the BST model found that the 3% non-network productivity factor is still applied to IT opex (which is not carved out as its own cost category) despite NZCC reporting to have exempted it.

E. The remaining objective of the productivity factor is therefore to set a frontier shift target. However, the average productivity factor of 2.1% is significantly higher than frontier shift targets that have been set by other Australian and New Zealand regimes (which more typically range from 0-0.5%).

i. In this regard, the NZCC appears to have placed an inappropriate amount of weight on a piece of bottom-up entry analysis by Ofcom in the UK when arriving at the 1% and 3% figures. Ofcom's analysis was undertaken in a different context that is not directly applicable here, and without the same level of scrutiny and engagement that would apply in a regulatory allowance-setting context. The NZCC also appears to have misinterpreted some important aspects of the analysis, including the lack of delineation between network and non-network opex.

F. The NZCC appears to therefore be embedding an expectation of catch-up in its productivity trend factors, but this is likely double counting catch-up given the material step change already applied and assumes that Chorus can maintain its historic rate of catch-up productivity gains from the build phase (where its cost per connection fell by approximately 1.9% per year) even though it is moving into the operate phase.

[1] The reduction of $10 million is in comparison to a hypothetical counterfactual scenario where there are no productivity targets (i.e. no step changes, elasticities = 1, and productivity factors = 0%).

6. In this report we:

   A. set out a conceptual framework of productivity gains in the context of Chorus's lifecycle (section 2);

   B. explain the difference between Chorus's proposal and the NZCC's draft decision, including how these differences flow through to the opex allowance (section 3);

   C. provide specific critiques of the NZCC's draft decision (section 4); and

   D. provide commentary on the overall productivity target that has been set for Chorus (section 5).

2. Background on productivity and BST modelling

7. In this section we set out:

   A. the three broad types of productivity gain (section 2.1); and

   B. the three productivity mechanisms we have identified and how they are implemented in the BST model (section 2.2).

2.1. Types of productivity gain

8. Both the NZCC and IV suggested Chorus's opex may not have been efficient in the base year, 2022.[2] This would imply that there are productivity gains to be achieved in PQP2.

9. At its simplest, productivity is about producing more outputs with fewer inputs, but this can occur in different forms. We identify three ways in which a firm can achieve productivity gains, which we set out in Table 2.1 below.

Table 2.1: Types of productivity gain

Type of productivity gain	Description	Example	How does this increase productivity?
Catch-up productivity	An inefficient firm becoming more efficient	A firm that wasn't implementing industry best practice reduces costs by adopting industry best practices.	The firm now needs fewer inputs to produce the same amount of outputs
Scale economies	A firm's average costs decreasing as it increases output	The firm has fixed costs that do not directly scale with output	The firm can increase its outputs at a faster rate than it increases its inputs
Frontier shift	An efficient firm becoming more efficient	A technology advancement improves upon prior industry best practice	The firm can now produce more outputs using the same amount of inputs

2.2. Productivity mechanisms in the BST model

10. It is important that a productivity target is clear about expectations of each type of productivity, otherwise there are risks of double-counting or setting unrealistic targets.

11. It can therefore be best to address each with a different mechanism. We set out these mechanisms, and the types of productivity gain they are effective at targeting, in Table 2.2 below.

[2] E.g. see NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, paras 7.23.1-7.23.2 and 7.26-7.27; and Synergies Economic Consulting, Independent verification report – Chorus' PQP2 expenditure proposal (CY2025-2028), October 2023, p.216.

Table 2.2: Productivity mechanisms and the corresponding types of productivity gain they can capture

Mechanism	Description	Effective at targeting
Step changes	One-off adjustments made to the base year	Catch-up productivity
Elasticities	A scale factor to the output trend that determines how much allowed opex should grow for a given increase in outputs (i.e. connections). A higher elasticity increases the opex allowance, all else equal. If the elasticities of the outputs sum to less than 1, then the model incorporates an assumption of *increasing* returns to scale (e.g. a 1% increase in output results in a less than 1% increase in opex)	Scale economies
Productivity factors	An offsetting reduction to the output trend based on an overall expectation of annual improvement in opex efficiency.	Frontier shift productivity

12. Mathematically, these mechanisms are incorporated into Chorus's BST model as follows:[3]

$$OutputTrend = [(1 + \%ConnectionChange \times Elasticity) \times (1 - \%ProductivityFactor)] - 1$$

$$OutputTrendIndex = (1 + OutputTrend_{current\ year}) \times OutputTrendIndex_{previous\ year}$$

$$RealOpexAllowance = [(BaseYear + OffSetAdjustments) \times OutputTrendIndex] + StepChanges$$

$$NominalOpexAllowance = RealOpexAllowance\ inflated\ using\ CPI/LCI$$

13. The output trends are calculated separately for each cost category which is later aggregated to produce an overall opex allowance. This means that the elasticity and productivity factor can (and do) vary between cost categories. There are six cost categories used in the BST model:[4]

Table 2.3: Cost categories in the BST model

Network or non-network?	Cost category	2022 contribution to total unallocated opex
Network opex	Copper maintenance	14.0%
	Fibre maintenance	7.4%
	Other network	22.2%
Non-network opex	Advertising	4.5%
	Insurance	2.2%
	Other non-network	49.8%

Source: Chorus, BST model documentation v1.0, November 2023, p.28.

14. There are three important takeaways from the equations above.

3 The colouring is for clarity so that the same parameter can be tracked across multiple equations. The equations were provided to us by Chorus.

4 As defined by Chorus at Table 11.5 of Chorus, Our Fibre Assets, November 2023.

15. First, the productivity factor can significantly offset the extent to which the output trend (and therefore the opex allowance) is able to scale with connections. In conjunction with the initial multiplicative effect of the elasticity, even a relatively small productivity factor can produce a negative output trend which essentially forces the opex allowance to shrink as connections grow. This is illustrated in Table 2.4 below.

Table 2.4: Hypothetical illustration of the effect of varying elasticity and productivity factor on the output trend, assuming 4% connection growth

Assuming %ConnectionChange = 4%, what will the OutputTrend be when we vary the elasticity and productivity factor?		**Productivity factor**			
		0%	**0.25%**	**1%**	**3%**
Elasticity	**1**	4%	3.74%	2.96%	0.88%
	0.75	3%	2.74%	1.97%	-0.09%
	0.5	2%	1.75%	0.98%	-1.06%
	0.25	1%	0.75%	-0.01%	-2.03%
	0	0%	-0.25%	-1.00%	-3.00%

Note: These calculations were done by simply plugging example numbers into the equation:

$$OutputTrend = [(1 + \%ConnectionChange \times Elasticity) \times (1 - \%ProductivityFactor)] - 1$$

16. Second, the output trends compound across years within a regulatory period. Each year's output trend is multiplied with the previous years' output trends to produce a cumulative output trend index. This means that, in effect, a 3% productivity factor reduces the allowance significantly more in the final year of the period than it does in the first year of the period. Intuitively this is because the productivity factor reflects an expectation of year-on-year productivity improvement rather than applying a flat reduction, but the downside is that any errors in this expectation are compounded in future years rather than corrected for. We illustrate this effect in Table 2.5 below.

Table 2.5: Hypothetical illustration of the cumulative effect of varying productivity factor on the output trend index, assuming 4% connection growth and 0.5 elasticity

Assuming %ConnectionChange = 4% and Elasticity = 0.5, what will the OutputTrendIndex be over each year of the regulatory period when we vary the productivity factor?		**Productivity factor**				
		0%	**0.25%**	**1%**	**3%**	**Difference between 0% and 3%**
Year in regulatory period	**Year 1**	1.0200	1.0175	1.0098	0.9894	3.1pp
	Year 2	1.0404	1.0352	1.0197	0.9789	6.1pp
	Year 3	1.0612	1.0533	1.0297	0.9685	9.3pp
	Year 4	1.0824	1.0716	1.0398	0.9583	12.4pp

Note: These calculations were done by simply plugging example numbers into the equations:

$$OutputTrend = [(1 + \%ConnectionChange \times Elasticity) \times (1 - \%ProductivityFactor)] - 1$$

$$OutputTrendIndex = (1 + OutputTrend_{current\ year}) \times OutputTrendIndex_{previous\ year}$$

17. Third, the output trend index is applied to the base year of each cost category *before* step changes are accounted for. This means that the elasticities and productivity factor for each cost category are applied to pre-step-change opex, rather than post-step-change opex, which magnifies the effect of the output trend index when the step change is negative.[5] We illustrate this effect in Table 2.6 below (which also roughly illustrates the effect of varying the output trend indexes as calculated in Table 2.5).

Table 2.6: Hypothetical illustration of the effect of applying output trends to pre-step-change opex rather than post-step-change opex

Assuming BaseYear + Offset Adjustments = $180 million and StepChanges = -$20 million, what will the RealOpexAllowance be when we vary the output trend index and whether it is applied to step changes?		Output trend index applied to…	
		Pre-step-change opex (actual BST model)	**Post-step-change opex (hypothetical alternative)**
Output trend index	**1.10**	$178 million	$176 million
	1.05	$169 million	$168 million
	1	$160 million	$160 million
	0.95	$151 million	$152 million
	0.90	$142 million	$144 million

Note: These calculations were done by simply plugging example numbers into the equations:

$RealOpexAllowance = [(BaseYear + OffSetAdjustments) \times OutputTrendIndex] + StepChanges$ (actual)

$RealOpexAllowance = [(BaseYear + OffSetAdjustments\ ) + StepChanges] \times OutputTrendIndex$ (hypothetical)

18. It is therefore crucial that a productivity factor takes into account the productivity target that is already implicit in step changes and elasticities, as well as the large cumulative impact it can have on allowances later in the period.

19. Otherwise there is a risk of double counting (e.g. if a productivity factor embeds expectations of both catch-up and frontier shift, but there have separately been step changes that account for catch-up, as we discuss later in section 4.1).

20. Different regulatory regimes deal with this in different ways. For example, we note that the NZCC's regulatory regime for EDBs assumes that they are incentivised to reveal their efficient costs through the IRIS regime which means productivity factors are not used to correct for base year efficiency.[6] We also note that the AER effectively does not set productivity targets through elasticities since it always scales the elasticities to sum to 1 (which assumes constant returns to scale), meaning its productivity factors also embed expectations of scale economies.[7]

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[5] I.e. when the step change is negative, applying output trends to the pre-step-change opex further increases the allowance when the output trend index is positive but further reduces the allowance when the output trend index is negative. The opposite effect occurs when the step change is positive.

[6] NZCC, DPP3 final decision – reasons paper, November 2019, para 5.40.

[7] NERA, Review of the AER's proposed output weighting - 2020-2025 regulatory proposal, December 2018, section 2.3; and AER, Expenditure forecast assessment guideline for electricity distribution, August 2022, pp.25-26.

3. Effect of NZCC PQP2 draft decision

21. In this section we set out:

   A. the productivity mechanisms that were proposed by Chorus for PQP2 and how the NZCC's draft decision differed (section 3.1); and

   B. the cumulative productivity target embedded in each of the Chorus proposal and the NZCC draft decision, including each productivity mechanism's contribution to the overall target (section 3.2).

3.1. Differences between Chorus proposal and NZCC draft decision

22. Chorus proposed an opex allowance of $740 million over PQP2, which amounts to ~$157 per forecast connection in 2025 and ~$153 per forecast connection in 2028.

23. However, the NZCC's draft decision is to allow Chorus to spend $608 million in opex over the course of PQP2 (although our replication exercise approximates it as $607 million)[8]. This is 18% lower than Chorus' proposal and we estimate it as ~$135 per forecast connection in 2025 and ~$121 per forecast connection in 2028.

24. This difference is partly explainable by the different productivity mechanism settings. We set out in Table 3.1 below the relevant features of each of Chorus's and the NZCC's proposals, with the differences highlighted in purple.

Table 3.1: Key features of Chorus's proposal and the NZCC draft decision with respect to productivity mechanisms (differences highlighted in purple)

Mechanism	Opex cost category	Chorus proposal	NZCC draft decision	Explanation
Step changes relating to IT and solar capex projects	Other non-network	$12.7m saving due to IT capex	$20.4m saving due to IT capex	Chorus proposed to adjust the base year to account for the opex savings that would be achieved through IT and solar projects. NZCC modelled the IT opex saving itself using a higher 'minimum benefit ratio' and found that an additional $7.7m could be saved.
	Other network	$1.2m saving due to solar capex	$1.2m saving due to solar capex	
Elasticities	Copper maintenance	0.45	0.45	Chorus proposed to adopt the connections component of the network and non-network elasticities applied to EDBs in DPP3. The NZCC expressed
	Fibre maintenance	0.45	0.45	

8 We understand this is due to small differences in the allocation of opex to FFLAS vs non-FFLAS services and therefore we are comfortable that our replication is a reasonable approximation of the productivity targets set by the NZCC.

	Other network	0.45	0.45	concerns about this approach but ultimately accepted it for network opex. For advertising opex, it declined to apply an elasticity on the basis that it should be a constant expense in real terms regardless of the size of the network.
	Insurance	0	0	
	Advertising	0.65	0	
	Other non-network	0	0	
Productivity factor	Copper maintenance	0%	0%	Chorus submitted that sufficient productivity targets were already embedded in the other mechanisms. NZCC disagreed and adopted benchmarks sourced from Ofcom, citing its concerns with EDB elasticities and saying that Chorus had not sufficiently justified a zero productivity factor.
	Fibre maintenance	0%	1%	
	Other network	0%	1%	
	Insurance	0%	0%	
	Advertising	0%	0%	
	Other non-network	0%	3%	

Source: Chorus, Our Fibre Assets, November 2023, p.214-217; and NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, pp.148-153.

29. We note that there were other differences between Chorus's proposal and the NZCC's decision, for example NZCC declining some other proposed step changes and altering the forecast number of connections. These also implicitly affect the overall productivity target, but we have focused on the mechanisms in Table 3.1 above which we consider to be most salient.

3.2. The relative significance of productivity mechanisms

30. In Table 3.2 below, we compare the PQP2 opex allowances proposed by both Chorus and the NZCC to a counterfactual where the three productivity mechanisms are removed completely. This is a purely hypothetical exercise intended to illustrate how each contributes to the overall productivity target. In this counterfactual, there are:

    A. no step changes to account for opex savings from IT and solar capex projects;

    B. elasticities of 1 for every cost category, implying constant returns to scale, (i.e. no expectation of scale economies in any cost category, which aligns with the approach to elasticities utilised by the AER as outlined at para 20); and

    C. productivity factors of 0% for every cost category.

Table 3.2: Comparison of opex allowances proposed by Chorus and NZCC in the factual, and counterfactual allowances with no productivity mechanisms

		Chorus proposal	NERA replication of NZCC draft decision
Factual: PQP2 opex allowance	A	$740 million $155.56/connection	$607 million $127.88/connection
Counterfactual: Opex allowance without productivity mechanisms	B	$764 million $160.58/connection	$697 million $146.96/connection
Cumulative productivity target ($ and as a % reduction on counterfactual allowance)	B – A	$24 million (3.1%) $5.02/connection	$91 million (13.0%) $19.08/connection
Counterfactual but with factual IT/solar step changes	C	$750 million $157.65/connection	$676 million $142.39/connection
Contribution of IT/solar step changes to productivity target	B – C	$14 million (1.8%) $2.94/connection	$22 million (3.1%) $4.57/connection
Counterfactual but with factual elasticities applied	D	$754 million $158.50/connection	$691 million $145.65/connection
Contribution of elasticities to productivity target	B – D	$10 million (1.3%) $2.09/connection	$6 million (0.9%) $1.32/connection
Counterfactual but with factual productivity factors applied	E	N/A (same as counterfactual)	$634 million $133.69/connection
Contribution of productivity factor to productivity target	B – E	—	$63 million (9.0%) $13.28/connection
Hypothetical alternative counterfactual but with elasticities of zero applied to all opex categories	F	—	$687 million $144.18/connection
Hypothetical contribution of zero elasticities to productivity target	B – F	—	$10 million (1.5%) $2.14/connection

Source: NERA analysis of scenario modelling provided by Chorus. Note: The factual scenario replicates the settings from Table 3.1 above, while the counterfactual scenario removes the effect of productivity mechanisms (no IT/solar step changes, elasticities of 1, and productivity factors of 0). Also note that in the NZCC's actual draft decision the opex allowance for PQP2 is approximately $1 million higher than we report for the NZCC factual scenario. We understand this is due to small differences in the allocation of opex to FFLAS vs non-FFLAS services and therefore we are comfortable that our replication is a reasonable approximation of the productivity targets set by the NZCC.

31. This shows that the NZCC set a significantly higher productivity target (13.0% of counterfactual opex) than Chorus set for itself (3.1% of counterfactual opex). Most of this is caused by the application of the 1% and 3% productivity factors, which contributes $63 million to the NZCC's

overall productivity target of $91 million. The $63 million represents a 9.0% reduction on counterfactual opex, which is much higher than either 1% or 3% because of the way the effect of the productivity factor accumulates over the period (discussed in section 2.2 above).

32. In contrast, the last two rows show that the maximum possible productivity target that could be set by elasticities (i.e. zero elasticity for every opex category is $10 million). This indicates that the productivity factors significantly overcorrect for the NZCC's concerns about using EDB elasticities, which we return to later in section 4.3.

33. Our model also shows that the remaining differences between Chorus's proposal and the NZCC's, i.e. apart from the productivity mechanisms we have identified, amount to $67 million (the difference between the two counterfactuals).

4. Review of NZCC's chosen parameters

34. In this section we provide more detailed analysis setting out that:

A. the NZCC double-counts the productivity gains achieved by the IT and solar step changes (section 4.1);

B. Chorus had already applied the EDB elasticities in a conservative way (section 4.2);

C. the NZCC's chosen productivity factors would overcorrect for any perceived limitations of the other mechanisms (section 4.3);

D. the productivity factors applied by the NZCC represent an unrealistic expectation that Chorus can maintain its historic rate of opex productivity gains (section 4.4); and

E. the NZCC has placed an inappropriate amount of weight on Ofcom's bottom-up entry analysis (section 4.5).

4.1. The IT and solar step changes already represent substantial catch-up and have not been carved out of the ongoing productivity assumption

35. In its draft decision, the NZCC expressed concerns about whether the base year was efficient, implying that there is scope for catch-up productivity. For example it commented that: [9]

> *"Chorus has not incorporated efficiency gains for fibre maintenance and there is no evidence to suggest that Chorus' 2022 other network opex and non-network opex are efficient"*

36. The IT and solar step changes are essentially pre-emptive adjustments offered by Chorus to account for catch-up productivity that it expects to achieve from its capex projects.

37. However, the NZCC appeared unsatisfied that the IT and solar gains were the only gains Chorus could achieve. It commented that *"there are efficiency gains to be made as Chorus improves its processes and business operations over time"*.[10]

38. Ultimately, the NZCC set productivity factors on top of these step changes. It said that it exempted the IT proportion of non-network opex from the 3% productivity factor since it is addressed through the $20.4m step change.[11]

39. However, this presumes that productivity must be achieved uniformly across all categories.

40. It may be most efficient for Chorus to prioritise the pursuit of opex productivity gains through IT and solar savings rather than seek to achieve savings across categories. As shown above in Table 3.2, the IT and solar opex step changes already represent a 1.8-3.1% reduction in the PQP2 opex allowance compared to counterfactual opex (depending on whether Chorus's or NZCC's proposal is used).

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9 NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, para 7.44.

10 NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, para 7.41.

11 NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, para 7.45.2.

41. In other words, the IT and solar step changes represent an opex saving that is comparable to the annual 1.9% reduction in cost per connection that Chorus achieved over 2018-2022 (which we discussed in our original report for Chorus that was provided to the IV).[12]

42. This is a substantial saving and should somewhat offset expectations of gains in other categories. I.e. if the NZCC believes that the application of a productivity factor worth $63 million over PQP2 is appropriate for Chorus, this should at least be *inclusive* of the $22 million step changes. However, the NZCC does not appear to have discounted the productivity factor to account for the presence of step changes.

43. And, as we noted in our report to Chorus provided to the IV, these step changes may include some frontier shift as well as catch-up (especially if they relate to sector-wide improvements in technology).[13] Therefore, any frontier shift target that is set <u>over and above</u> these step changes should consider whether there is frontier shift already embedded in the IT and solar projects, otherwise the target would double-count.

44. Moreover, we have reviewed Chorus's replication of the NZCC's BST model and our understanding is the IT opex subcategory was not exempted from the 3% productivity factor, which further exacerbates the double-counting issue.

    A. As we set out in section 2.2, there are six cost categories to which output trends (i.e. elasticities and productivity factors) are applied. The output trends vary between cost categories, but they do not vary at the more granular subcategory level.

    B. The IT subcategory is part of Chorus's 'Other non-network opex' cost category. The NZCC applies an elasticity of 0 and a productivity factor of 3% to this category. As we show in Table 2.4, this produces an output trend of -3% regardless of any change in connections (since connections are zeroed out by the elasticity).

    C. As we understand it, there is no provision in the underlying calculation of the BST model to exempt the IT subcategory from the output trend of its parent category (e.g. by carving it off into a separate cost category).

    D. And as we also set out in section 2.2, the output trends are applied before step changes are added, which means the output trends apply to the *pre*-step-change opex rather than the *post*-step-change opex.

    E. The net result is the 3% productivity factor is applied to the whole 'Other non-network opex' category, including IT opex, essentially requiring Chorus to make 3% in other non-network opex savings year-on-year. Then, the $20.4m step change is further deducted from the total PQP2 allowance, ensuring the 3% year-on-year savings cannot come from the IT capex project.

    F. The NZCC may have intended the IT step change itself to be exempted from output trends, but that is already a mechanistic outcome of how the BST model is implemented, and is true of all step changes.

45. In essence, the NZCC's draft decision overlooks the productivity gains that have already been accounted for by step changes and requires Chorus to find further gains to stay within its

[12] NERA, Regulatory Period 2 – Recommended options for applying a base-step-trend model, June 2023, p.31.

[13] NERA, Regulatory Period 2 – Recommended options for applying a base-step-trend model, June 2023, p.31.

allowance. If Chorus had anticipated that a productivity factor would be applied in addition to productivity-based step changes it proposed, it may not have proposed the step changes in the first place. This would have added $14 million back to its opex allowance (or $22 million following the NZCC's adjustment to the IT step change).

4.2. Chorus had already applied the EDB elasticities in a conservative way

46. Both the NZCC and the IV expressed concerns about the applicability of EDB elasticities to Chorus. The NZCC ultimately accepted Chorus's proposed network elasticity of 0.45 but said it accounted for its concerns through the use of the productivity factor (we discuss this below in section 4.3). It also declined to apply the 0.65 elasticity to advertising (viewing it as a constant expense in real terms) and reduced the amount of forecast connection growth to account for Chorus's fibre frontier network expansion, neither of which we discuss in detail in this report.[14]

47. Our critique here is that NZCC did not justify the direction of its concerns. In other words, from the NZCC's perspective there should only be issues with applying EDB elasticities to Chorus if they are demonstrably too high (i.e. if they allow Chorus too much opex for a given increase in connections). If it instead thought the EDB elasticities were too low, it would only compound this issue by applying a further productivity factor.

48. In fact, there is reason to believe Chorus's network elasticities should be higher than 0.45, as we now explain.

49. Elasticities can be applied to one output or to many outputs. When one output is used, the elasticity represents the full effect of that output on opex (**"standalone elasticity"**). When many outputs are used, each elasticity represents the partial effect of the output on opex, holding the other outputs constant (**"partial elasticities"**). This allows the partial elasticities to be applied separately and then summed together to capture the aggregate effect on opex.

50. The NZCC scales EDBs' opex allowances using a two-output model, where the two outputs are connections and line length. For the EDBs' 2020-2025 pricing period (**DPP3**), it used regression analysis to estimate the partial elasticities for connection and line length growth set out in Table 4.1 below. Beneath these we present the equivalent standalone elasticities if the only relevant output was connection growth, which we calculated by re-running the NZCC's regression model with connection growth as the only explanatory variable.

14 NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, paras 7.38-7.39 and 7.52-7.53.

Table 4.1: Partial elasticities applied by NZCC to EDBs in DPP3 and the standalone elasticities from an equivalent one-output model

Opex category		Elasticity to connection growth (i.e. ICP growth)	Elasticity to line length growth	Combined effect on opex of a 1% change in connections and line length
Network opex	Partial	0.45	0.49	0.94%
Non-network opex	Partial	0.65	0.22	0.87%
Network opex	Standalone	0.78		0.78%
Non-network opex	Standalone	0.81		0.81%

Source: NZCC, DPP3 final decision – reasons paper, November 2019, paras A97 and A98 and NERA analysis of NZCC, Econometric model for opex – EDB DPP3 final determination, November 2019. Note that NZCC inconsistently reports which elasticity relates to which category throughout the reasons paper (e.g. at p.6, Table 5.6, Table A.5), but having reviewed the underlying econometric model, we can confirm that paras A97 and A98 contain the correct figures.

51. This table can be interpreted as follows:

   A. If an EDB's connections increase by 1%, its allowed network opex *under a one-output model* would increase by 0.78%.

   B. However, *under a two-output model*, the same connection growth would only increase allowed network opex by 0.45% because it would be accompanied by a further increase based on line length growth:

      i. If this line length growth was also 1%, the EDB's allowed network opex will increase by a further 0.49%. Together, this would produce a combined increase of 0.94% to the network opex allowance, as shown in the right-hand column of Table 4.1.

      ii. Alternatively, if the accompanying line length growth was only 0.5%, the combined increase would be less at 0.695%, which is still higher than 0.45%.

52. Chorus does not have reliable line length data, so it proposed to use a one-output model based on connection growth alone (which it explained can proxy line length). However, rather than estimating the standalone connection growth elasticities (0.78 and 0.81), it adopted the partial connection growth elasticities that were applied to EDBs (0.45 and 0.65).[15]

53. Chorus has therefore taken a highly conservative approach by using the partial elasticity from a two-output model for its one-output model. The partial elasticity of 0.45 is likely to significantly understate how much network opex should scale with connections alone because it deliberately omits the portion of network opex growth that can be better explained by line length growth, assuming that the second partial elasticity will be applied to capture this portion. I.e. for EDBs, a 1% increase in connections would almost always lead to a more-than-0.45% increase in allowed network opex unless the accompanying line length growth was

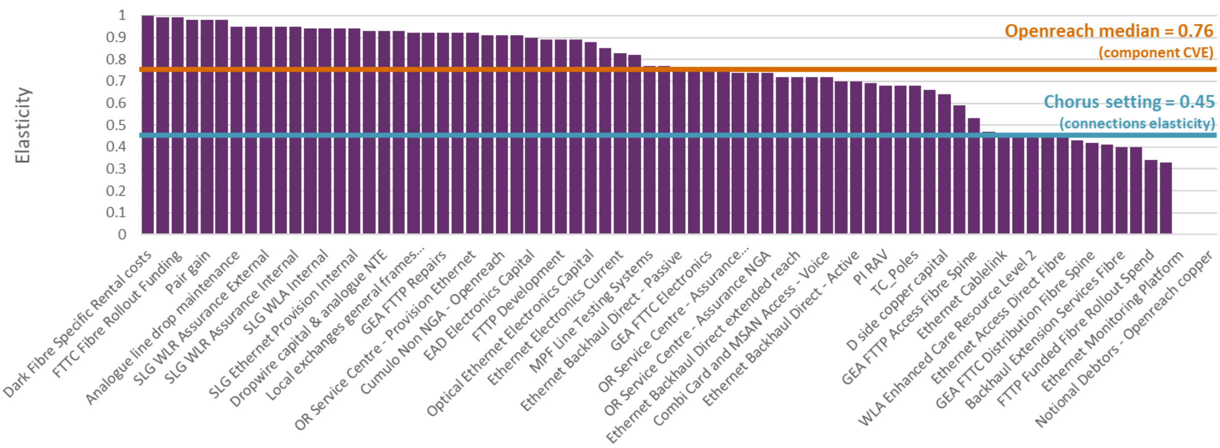
[15] Although the non-network elasticity of 0.81/0.65 becomes moot if no elasticity is applied to advertising. Chorus, Our Fibre Assets, November 2023, p.215 and Table 11.5.

actually 0% (which is unlikely to be true because, as noted above, connection growth is a proxy for line length).

54. If Chorus had used standalone one-output elasticities instead of partial two-output elasticities, its proposed opex allowance would have been $745 million over PQP2 instead of $740 million. Equally, if the same adjustment was made to the NZCC's draft decision, its proposed opex allowance would have been $610 million over PQP2 instead of $607 million. This difference of $3-5 million, arising from a significant difference in elasticities, should be sufficient to account for any concerns about the applicability of EDB elasticities without any need for a further productivity factor.

55. To demonstrate that 0.45 is comfortably appropriate for a fibre operator, we can compare with Ofcom, which applies cost volume elasticities (CVEs) to Openreach. This is different from a connections elasticity, since the CVEs are applied to cost *components* rather than to the final service, so it is not a directly comparable approach.[16] Regardless, we note that the vast majority of the Openreach CVEs are above the Chorus setting of 0.45, with the Openreach CVEs having a median value of 0.76 (see Figure 4.1). This difference still exists if we only consider the cost components that are related to Openreach's fibre to the premises (FTTP) services, which have a median CVE of 0.74 (see Figure 4.2).

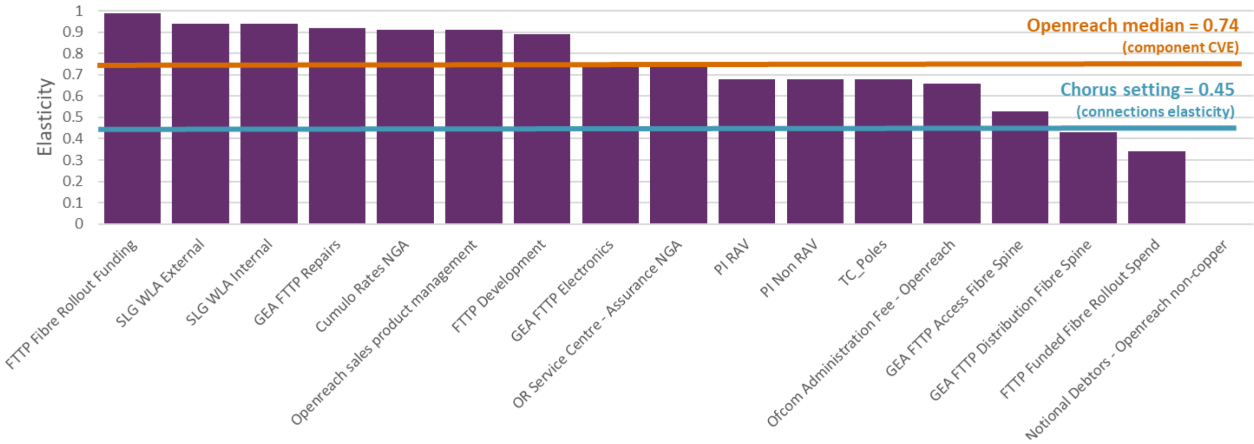
Figure 4.1: Elasticities for each of Openreach's cost components under Ofcom's cost volume elasticity (CVE) model



Source: Ofcom, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021, Cost forecast model. Ofcom applies separate pay and non-pay CVEs to each component (e.g. see A14.114), so where the two are different, we have presented the lower CVE to be conservative.

[16] Specifically, Ofcom estimates costs by first forecasting growth in "services", which likely bears similarities to connections depending on the service. Growth in services is then converted to growth in component volumes based on the amount of each component a given service uses. The growth in component volumes is then used with CVE to forecast changes in cost.

Figure 4.2: Elasticities for only Openreach's cost components that relate to fibre to the premises (FTTP) services



Source: Ofcom, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021, Cost forecast model. Note: The FTTP services are GEA FTTP rentals external (SL315), GEA 40/10 other rentals external (SL314), GEA other rentals (all other speeds except 40/10) internal (SL305), and GEA 40/10 other rentals internal (SL304). All cost components that had a positive usage factor in any of those services were included. And as above, Ofcom applies separate pay and non-pay CVEs to each component (e.g. see A14.114), so where the two are different, we have presented the lower CVE to be conservative.

4.3. The NZCC's chosen productivity factors would overcorrect for any perceived limitations of the other mechanisms

56. As set out in section 3.2, the effect of the productivity factor dwarfs the effect of the other mechanisms on the magnitude of the opex allowance. It is set to a level that is punitive for Chorus and cannot be justified as correcting for flaws in the other mechanisms.

57. The NZCC cited its concerns about EDB elasticities when justifying the productivity factor, but as shown in Table 3.2, the materiality of the EDB elasticities to the overall productivity target (approx. contribution of $6 million) is vastly below the materiality of the productivity factor that was set (approx. contribution of $63 million).

58. And as shown in Table 3.2, even elasticities of zero would only contribute $10 million to the overall productivity target (i.e. an additional $4 million compared to elasticities of 0.45). Although setting elasticities to zero would be an extreme approach, this would have a much smaller impact on the opex allowance than the productivity factors the NZCC has applied.

59. As discussed below at para 81, the IV suggested that a productivity factor of 0.25% would be appropriate if the IT and solar step changes were not achieved. According to our modelling, the IT and solar step changes in the NZCC's model contribute $22 million to the productivity target, whereas a 0.25% productivity factor would contribute $13 million. So, while a 0.25% productivity factor would not quite offset the loss of the step changes, a 0.56% factor would be sufficient to achieve this. In comparison, the NZCC's average productivity factor which contributes a productivity target of $63 million appears disproportionate.

4.4. The productivity factors applied by the NZCC exceed reasonable estimates of frontier shift

60. Given the analysis of the previous sections suggests that substantial catch-up and scale economy targets are already embedded in the proposed application of the BST model, the productivity factor should only be used to set a "residual productivity target", i.e. a target beyond that which is already embedded in the step changes and elasticities. This should represent frontier shift.

61. The NZCC adopted a 1% productivity factor for 'fibre maintenance' and 'other network' opex and a 3% non-network productivity factor for 'other non-network' opex. In other words, it set a 1% factor for network opex (except copper maintenance) and a 3% factor for non-network opex (except insurance and advertising).[17]

62. The NZCC's draft decision relied on Ofcom estimates to set these benchmarks. It said these benchmarks are appropriate as reference points for Chorus because they are forward-looking and relate to a directly comparable network operator (Openreach), but it did not explain why it was deviating from the IV's recommendation of a zero productivity factor.[18] It also said that it exempted the IT proportion of non-network costs from the 3% factor, [19] but as we set out in section 4.1, this does not appear to have been applied in practice.

63. Using our estimates from Table 2.3, this means that under the NZCC's proposal:

    A. 29.6% of Chorus's opex would be subject to a 1% productivity factor (based on 2022 contribution to total unallocated opex);

    B. 49.8% of Chorus's opex would be subject to a 3% productivity factor; and

    C. the remaining 20.6% would not be subject to a productivity factor.

64. According to our modelling, this produces an identical outcome to if a 2.1% productivity factor was applied across all six cost categories. We therefore discuss 2.1% as being the average productivity factor (it is essentially a weighted average).

65. However, 2.1% would be an unrealistic frontier shift target. As we set out in our report to Chorus which was provided to the IV, frontier shift targets for regulated utilities in NZ and Australia have typically ranged between 0-0.5%. This does expand to 1.25% when considering the UK, but 2.1% remains well above this bound.[20]

66. The NZCC said that a zero productivity factor would have to be justified in the context of an efficient base year.[21] This is an unusual viewpoint – a firm can be efficient and still have a frontier shift target.

[17] NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, para 7.45.

[18] NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, paras 7.15.10 and 7.43.

[19] NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, para 7.45.2.

[20] NERA, Regulatory Period 2 – Recommended options for applying a base-step-trend model, June 2023, p.32.

[21] As well as the appropriateness of EDB elasticities. NZCC, PQP2 expenditure allowances for Chorus draft decision – reasons paper, April 2024, para 7.23.6.

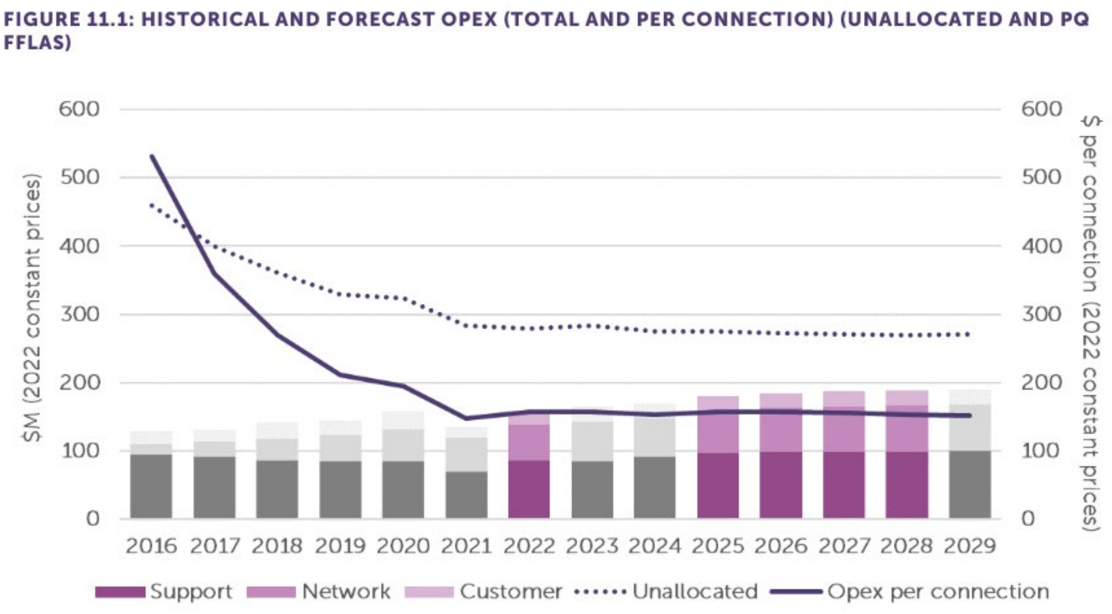
67. The issue seems to be that the NZCC is also attempting to deal with catch-up productivity through the productivity factor, without considering how it has already been accounted for by the other mechanisms.

68. In this regard we note that, as mentioned in section 4.1 above, Chorus's average cost per connection fell 1.9%/year from 2018-2022 (while it was building the network). We explained in our report to Chorus that that this included historic catch-up productivity that may not be replicable on a forward-looking basis due to the build-to-operate transition.[22]

69. While the 1.9% annual decline in cost per connection is not directly comparable to a productivity factor, we note that the average productivity factor applied by the NZCC is even higher at 2.1%. This suggests the productivity factor is likely imposing a requirement on Chorus to continue reducing opex at an even greater rate than historically in PQP2 while at the same time requiring a large step change and greater scale economies than are assumed for EDBs.

70. We also note that Chorus's historic and forecast data shows opex per connection significantly levelling off from 2021 onwards (see solid line in Figure 4.3 below), which raises doubts over whether such a significant amount of catch-up productivity would be achievable (beyond what has already been proposed in step changes).

Figure 4.3: Chorus projection of opex per connection, 2016-2029



Source: Chorus, Our Fibre Assets, November 2023, Figure 11.1.

22 NERA, Regulatory Period 2 – Recommended options for applying a base-step-trend model, June 2023, p.31.

4.5. The NZCC has inappropriately weighted Ofcom's bottom-up entry analysis

71. Ofcom's analysis was undertaken in a different context that is not directly applicable to Chorus, and was not subject to the same level of scrutiny and engagement that would apply in a regulatory allowance-setting context. The NZCC also appears to have misinterpreted some important aspects of the analysis.

72. The 1% and 3% come from a cost modelling exercise undertaken by Ofcom where it used a 'bottom-up' model to estimate the cost of deploying and operating a new large-scale fibre network. The bottom-up model relies on a number of assumptions, as opposed to a top-down model which relies on historic data.[23]

73. Crucially, Ofcom's bottom-up model does not relate to a specific fibre operator since it was used to determine a benchmark for market entry rather than set actual regulatory allowances. For example, Ofcom explains (emphasis added):[24]

> *We have taken a bottom-up approach to modelling a fibre network. We consider that a bottom-up approach provides better flexibility to assess the costs across different geographies and for different scales of deployment.* ***Furthermore, it would be difficult to conduct top-down modelling for estimating the costs of a large-scale fibre network since one does not exist yet in the UK****, i.e. total network cost information is unavailable.*

74. In fact, Ofcom separately undertook a top-down cost modelling exercise for the existing copper and fibre operator, Openreach, and set an opex efficiency target of 3.5% for its wholesale local access (WLA) services. Ofcom arrived at this target because: [25]

    A. Ofcom originally proposed an opex efficiency target of 3.5-6.5%;

    B. Openreach disagreed and said that its opex efficiency target should be in the range of 0.5% to 3.5%, noting that Ofcom's analysis was based on outdated data and Openreach's opex efficiency would be lower in future due to the impacts Covid-19 and Brexit;

    C. Ofcom reviewed more recent management accounting data from Openreach and found that it had achieved historic cost efficiencies of 3.1-4.4%/year and was forecasting future cost efficiencies of 4.1-5.3%/year, with the caveat that this was at the aggregate company-wide level and not specific to the regulated services; and

    D. Ofcom erred on the lower end of these modelled ranges because in its view the economic environment would make it harder to achieve cost savings over the relevant period.

75. Ofcom used this 3.5% target for Openreach, along with the costs of other network operators, to calibrate the bottom-up model for a hypothetical new entrant. It modelled some opex cost elements as being based on an identifiable cost driver (**"driver opex"**) and modelled the remainder as a percentage of the network's gross replacement cost (**"GRC opex"**). It assumed

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23 Ofcom, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26, March 2021, Annex 15, paras A15.4 and A15.8.

24 Ofcom, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26, March 2021, Annex 15, para A15.9.

25 Ofcom, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26, March 2021, Annex 14, paras A14.6, A14.79-A14.84,, A14.93-A14.94, and A14.100-A14.103.

a base case efficiency factor of 3% for the driver opex and assumed no efficiency factor for the GRC opex, though it noted that it applied assumptions to the opex trend as part of its calibration process in a way that reduced GRC opex by 1%/year.[26] These assumptions comprise a relatively minor part of Ofcom's analysis and accordingly it provides limited explanatory detail, which makes it difficult to verify their robustness.

76. The NZCC relied on these figures to set a 1% productivity factor for network opex and a 3% productivity factor for non-network opex (with some exceptions as noted above at para 61). However, it has not only placed an unusual amount of weight on Ofcom's assumptions, but it appears to have misinterpreted the relevant opex cost categories:[27]

    A. The driver opex elements (which received the 3% efficiency factor) appear to consist of a mix of network elements (e.g. poles, ducts, compensation for network failure) and non-network elements (e.g. systems and processing costs), with the cost drivers including things like number of new connections, line rentals, and metres of poles/ducts.

    B. Similarly, the GRC opex elements (which received the 1% trend reduction) also consist of a mix of network elements (e.g. repairs and maintenance) and non-network elements (including all corporate overheads).

    C. It therefore appears completely arbitrary that the NZCC has interpreted the 1% as relating to network opex and 3% as relating to non-network opex.

77. We emphasise that, because Ofcom's bottom-up analysis primarily related to hypothetical entry, it would not have faced the level of scrutiny and engagement from submitters as it would have if it had a consequential impact on a real firm's opex allowance. And while the top-down analysis Ofcom undertook for Openreach is more comparable to the exercise the NZCC is attempting to undertake for Chorus, it was not used for the purpose of setting charges for Openreach's active broadband products, which are not subject to cost-based price controls.[28] Additionally, as we noted in our report to Chorus that was provided to the IV, the 3.5% target for Openreach was based on short-term accounting data and so did not distinguish between catch-up and frontier shift.[29]

78. Another critical difference is that Ofcom's 3.5% target was within the range Openreach was proposing, and Ofcom even took a conservative approach compared to the level of future efficiencies suggested by Openreach's accounting data (albeit at an aggregate level). In contrast, here the NZCC is rejecting Chorus's own internal forecasts and the recommendation of the IV without explanation. As we discussed above in section 4.4, the evidence suggests that even Chorus's historic efficiency gain of 1.9%/year includes catch-up that will no longer be occurring in PQP2 and so is unlikely to be sustainable.

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26 Ofcom, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26, March 2021, Annex 14, paras A15.59-A15.62, and A15.66-A15.68.

27 Ofcom, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26, March 2021, Annex 14, para A15.59 and Table A15.1.

28 See, e.g. Tables 2.2 and 2.3 of Ofcom, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26, March 2021, Volume 1, which note that the charge control applied to most active services is "flat pricing in real terms" and Ofcom's statement at page 6 regarding fibre that *"We currently do not expect to introduce cost-based price controls until at least 2031."*

29 NERA, Regulatory Period 2 – Recommended options for applying a base-step-trend model, June 2023, p.32.

5. Conclusion regarding productivity factor for PQP2

79. Chorus proposed a productivity factor of 0% for every cost category given the productivity targets that are embedded in the step changes and elasticities.[30]
80. This was consistent with NERA's recommendation to Chorus which was provided to the IV, stating Chorus should apply a productivity trend of zero to avoid double counting the frontier shift embedded in the other mechanisms, which included material adjustments to the base year in the form of step changes.[31]
81. The IV agreed with our recommendation to Chorus with the caveat that, should the IT and solar projects not proceed, a conservative productivity factor of 0.25% would be warranted.[32] Although – as we set out in section 4.3 above – the step changes are significant enough that a productivity factor as high as 0.56% would be needed to produce an equivalent productivity target.
82. While the NZCC's productivity factors appear to reflect an expectation of catch-up productivity, our recommendation remains that the best way to account for catch-up productivity gains is through step changes. If a productivity factor is being used to set targets for catch-up productivity, great care needs to be taken to ensure that it is adequately discounted to reflect catch-up that has already been achieved through step changes, which the NZCC does not appear to have done.
83. We also remain of the view that there is a real risk of double-counting any frontier shift that is embedded in the step changes being applied to Chorus, especially given the step changes of $22 million are so significant.
84. Additionally, the proposed conservative application of the EDB elasticities is likely to understate the amount Chorus's opex allowance should scale with connection growth by approximately $3-5 million.
85. Overall, our view is that the productivity targets embedded in the network elasticity of 0.45, and the IT and solar step changes, err on the high side and are more likely than not to capture any productivity gains that could reasonably be expected of Chorus over PQP2 (including catch-up, scale economies, and frontier shift).
86. On this basis a further frontier shift target in the form of a productivity factor is unlikely to be warranted, and risks setting the opex allowance too low, which would not be in the long term interest of consumers. Even if the NZCC is satisfied that it has not already embedded frontier shift expectations in the elasticity and step changes, a frontier shift target in the form of a productivity factor should be substantially lower than what the NZCC has proposed (closer to the range of 0-0.5%).

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30 Chorus, Our Fibre Assets, November 2023, p.215.

31 NERA, Regulatory Period 2 – Recommended options for applying a base-step-trend model, June 2023, p.8.

32 Synergies Economic Consulting, Independent verification report – Chorus' PQP2 expenditure proposal (CY2025-2028), October 2023, pp.220-221.

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NERA
Level 11
15 Customs Street West
Auckland 1010, New Zealand
www.nera.com