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Implications of CEPA's draft findings for the NZCC's decisions on opex productivity for DPP4

Big 6 EDBs

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1. Introduction and summary

1. The NZCC is reviewing the productivity and efficiency of EDBs. As part of Phase 1 – a total factor and partial productivity analysis of the EDB sector – the NZCC has engaged Cambridge Economic Policy Associates (**CEPA**) to prepare a productivity study ("**the CEPA report**").[1]
2. The CEPA report estimated indices to quantify EDBs' total factor productivity (i.e. including both opex and flow of capital services as inputs) and opex partial factor productivity (i.e. including only opex).
3. CEPA found these indices declined across the period 2008-2023, for both exempt and non-exempt EDBs, because expenditure increased at a faster rate than measured outputs. It found that, for total factor productivity, most of the decline occurred between 2008 and 2014, with the indices only falling slowly or staying broadly constant between 2014 and 2023. On the other hand, for opex partial factor productivity, it found that the post-2014 decline was steeper than the pre-2014 decline, although this difference was smaller for non-exempt EDBs. This might suggest that it is easier to find efficiencies with capex than with opex.
4. In November 2024, NZCC will decide on the next default price-quality path (**DPP**) to apply to EDBs for DPP4 ("**the DPP4 reset**"). Regarding the CEPA report, the NZCC has stated *"We may use the phase 1 findings on TFP and 'opex' PFP as context for the draft decision on the DPP4 reset"*. One immediately relevant application in this context is to inform the NZCC's decision on EDBs' opex allowances for DPP4, including whether to apply a productivity target in the form of a partial productivity factor (**PPF**). The TFP analysis may also inform the NZCC's decision on the "X factor" used as part of smoothing the overall revenue allowance.
5. We have been engaged by the Big 6 EDBs to review CEPA's draft productivity and analyse the implications of its findings for the NZCC's task of setting a partial productivity factor for opex over DPP4.
6. Our findings are that:
   A. Productivity is simple in *concept* (doing more with less), but more difficult to *measure* accurately in practice. The productivity measure is only accurate if the assumed inputs and outputs are an accurate description of the services EDBs deliver.
   B. We agree with CEPA that other practitioners would reach similar findings regarding *measured* productivity – all the outputs that the NZCC currently collects data on as part of the Information Disclosure (**ID**) regime have been growing slower than expenditure. The specification of the econometric cost function or the productivity index (which in overly simplistic terms are different ways of weighting the outputs) is thus somewhat irrelevant as it will not change the directional finding of negative *measured* productivity.
   C. The question is then whether the observed negative *measured* productivity is evidence of negative *actual* productivity. As CEPA notes, it could be, but caution is warranted as negative measured productivity could be an artifact of the modelling approach (i.e. fail to account for all outputs, mismeasure capital inputs or not account properly for changing weather patterns).

[1] CEPA, EDB Productivity Study, prepared for the Commerce Commission – draft report, March 2024.

D. There is evidence of EDBs overspending allowances and earning returns below the regulatory WACC. Given the mechanistic base-step-trend model penalises EDBs for delivering outputs unrelated to growth in circuit length or customer numbers, this suggests that either EDBs are delivering uncompensated outputs that consumers value, or that EDBs are irrationally delivering outputs consumers don't value/the broader incentive framework is not working.

E. The combination of declining measured productivity, returns below the regulatory WACC, and expenditure in excess of allowances therefore suggests that the most likely explanation for declining measured productivity is that EDBs have been delivering uncompensated outputs that are valued by consumers.

F. Alternatively, if the NZCC's and CEPA's specification of outputs is correct and there has been a genuine decline in actual productivity, this suggests there are broader problems with the incentive regulation framework.

G. The presence of uncompensated outputs in the base-step-trend model means that EDBs need to achieve efficiency gains to deliver all the outputs valued by consumers without being financially penalised for doing so – i.e. they already face a form of productivity target.

H. Applying a further productivity target on top of this in the form of a positive opex PPF would essentially be a double counting and would be punitive. Providing an allowance that is not sufficient to deliver all outputs consumers value is unlikely to be in the long-term interest of consumers.[2]

I. If a more bottom-up approach to setting opex allowances is taken (such as that used in a CPP/IPP and in other jurisdictions), the NZCC could have more confidence that a sufficient opex allowance is being provided and thus in applying a positive productivity target.

7. In the rest of this report we:

A. Provide background on productivity, including what is conceptually, how it is measured, how productivity assumptions feed into the allowance setting process and an overview of CEPA's findings. (section 2);

B. Set out the implications for productivity measures and expenditure allowances if not all relevant outputs are measured (section 3);

C. Consider whether there is evidence to suggest there are missing outputs, in particular by assessing recent EDB expenditure (section 4); and

D. Set out some implications for the DPP4 reset productivity decisions (section 5).

[2] The presence of uncompensated outputs actually suggests there is a case for negative opex PFP factor.

2. Background on productivity

2.1. Productivity in concept

8. At its simplest, productivity is about producing more outputs while using fewer inputs. A productive firm is one that allocates its limited resources in the best possible way, using its inputs efficiently and intensely.
9. Competition is said to force firms to be productive, since unproductive firms will face higher costs at each level of output and will be unable to profitably operate at the market price. The premise of economic regulation is to promote equivalent outcomes in markets where there is little or no competition. This can include assessing whether firms are operating productively and determining an appropriate level of expenditure.

2.2. Measured productivity

10. Quantifying productivity involves making some assumptions about which outputs and inputs are relevant. This is generally simpler for a firm's inputs (typically expenditure and/or assets) than its outputs (which can be numerous and are not always measurable, requiring a proxy measure).
11. A productivity index is essentially a ratio of measured outputs to measured inputs, with each output and input being assigned a weight based on its importance. Limitations arise, as we return to later, when a portion of the included inputs relate to outputs that are excluded or imprecisely measured.
12. Jorgenson and Griliches, academics amongst the founding fathers of productivity analysis, have described productivity estimates as the "residual" or the "Measurement of Our Ignorance".[3] Measured productivity is actually a residual that measures the net impact of changes in unmeasured outputs and productivity (with respect to measured and unmeasured) on costs. For example, we can decompose measured opex productivity into two components:

    Measured Opex Partial Factor Productivity = productivity for measured outputs + changes to opex due to changes and productivity in unmeasured outputs.

13. Viewed this way, interpreting negative *measured* productivity as negative *actual* productivity implicitly assume that the second term on the right-hand side of the equation above is close to zero.

[3] Jorgenson, D.W. and Griliches, Z. (1967), The explanation of productivity change, Review of Economic Studies, vol. 34 (3) p.249

2.3. Relevance to NZCC's regulation of EDBs

2.3.1. Mechanics of how productivity flows through to DPP allowances

14. Assumptions about productivity play an important role in how the NZCC evaluates an appropriate level of expenditure for EDBs.

15. When the NZCC sets a default price-quality path (**DPP**) for EDBs, it determines an annual opex and capex allowance. If EDBs overspend these allowances, the incremental rolling incentive scheme (**IRIS**) penalises EDBs by reducing allowable revenue in future years (or conversely rewards them for underspending).

16. Opex allowances are determined mechanistically by forecasting opex using a base-step-trend (**BST**) model. In DPP3, this involved:[4]

    A. selecting a base year from the previous pricing period, which forms the starting point;

    B. including step changes to correct for exogenous differences between the pricing periods (e.g. changes to how costs are classified or additional expenditures distributors will incur (or stop incurring) during the regulatory period);

    C. adjusting for output trends – specifically, forecast growth due to changes in network scale (measured by the number of customers and length of the physical network);

    D. adjusting for input trends – specifically, changes in input prices that are beyond EDBs' control due to inflation; and

    E. applying an opex partial productivity factor (**PPF**), with a positive PPF scaling the allowance down and a negative PPF scaling the allowance up.

17. The opex PPF, in the NZCC's words, *"sets a baseline against which businesses who improve efficiency over the [DPP] period will be rewarded"*.[5] A high/positive PPF would effectively penalise EDBs that do not achieve measured productivity gains, while a low/negative PPF would reward those that do.

18. The NZCC has described the rationale for the BST model as following:[6]

    > *We have taken this approach because we consider that, when combined with the IRIS incentive scheme, it creates the right incentives for distributors to improve efficiency while at the same time providing an ex-ante expectation of a normal return.*
    >
    > *By linking future opex allowances to distributors' current revealed level of costs and predictable future changes, distributors should expect a normal return ex-ante, incentivising investment. By allowing distributors to keep a portion of any savings, they have an incentive to improve efficiency.*

19. On the other hand, capex allowances are determined less mechanistically and without a preemptive productivity adjustment.[7]

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4 DPP3 reasons paper, November 2019, para X43.

5 DPP3 reasons paper, November 2019, para 5.40.4.

6 DPP3 reasons paper, November 2019, para X44.

7 Specifically, as set out in DPP3 reasons paper:

20. Productivity also flows through to the X-factor, which relates to how revenue is smoothed over each DPP period.[8] Each EDB's maximum allowable revenue (**MAR**) increases year-on-year by CPI-X, where X ostensibly reflects the rate of change in EDB sector productivity relative to the economy as a whole (though sometimes alternative X-factors are set for non-productivity reasons).[9]
21. The NZCC also has a more general obligation to review the performance of EDBs, which includes the current study of EDBs' productivity and efficiency under which it commissioned the CEPA report. It has said it plans to embed periodic assessments and publications on EDBs' productivity and efficiency within its performance and understanding function.[10]
22. We expect that the results of this study will have implications beyond DPP expenditure allowances. For example, by informing the NZCC's overall evaluation of how well the price-quality regulatory regime is working. However, for the purposes of this report, we focus primarily on how CEPA's findings might flow through to the DPP4 reset.

2.3.2. Past DPP productivity decisions

23. In DPP3, the NZCC set an opex PPF of 0% indicating that they expected distributors to improve their productivity during DPP3 relative to historic performance. This view was based on evidence of positive productivity in electricity distribution sectors across the world and in comparable sectors within New Zealand, and an increased policy focus on innovation and technology.[11]
24. The NZCC accepted evidence we submitted that historic measured opex productivity was negative, but said it was unconvinced that past declining productivity is predictive of future declines. It found that:[12]
    A. setting a negative PPF might entrench these past declines and weaken incentives to improve efficiency; but

- The NZCC uses EDBs' asset management plans (AMPs) as the starting point, allowing EDBs to propose and forecast their own capex [para X55].
- In DPP3 it applied "*a series of caps or tests to assess whether the forecast expenditure is likely to be required and deliverable*", ultimately accepting any capex that satisfied these tests (while applying an aggregate cap of 120% relative to historic levels) [para X55].
- It explained that it considered "*this kind of scrutiny of AMPs creates better incentives for distributors to invest, through allowing expenditure where it appears reasonable and deliverable, but not where it does not*." [para X53]
- One of these tests does relate to productivity – capex may be declined if it causes an EDB's forecast per-connection spend to increase by more than 50% [para X7].

8 The X-Factor works in a present-value neutral way – it only changes the timing of cashflow within the regulatory period not their absolute level. DPP4 issues paper, 2 November 2023, para.5.26.1.

9 An alternative X-factor can be applied to individual distributors for non-productivity reasons such as to prevent price shocks to consumers or revenue shocks to the distributor. DPP3 reasons paper, November 2019, paras 6.4-6.12. DPP4 issues paper, 2 November 2023, para. 5.26.2

10 https://comcom.govt.nz/regulated-industries/electricity-lines/electricity-distributor-performance-and-data/productivity-and-efficiency-study-of-electricity-distributors

11 DPP3 reasons paper, November 2019, para. A152.

12 DPP3 reasons paper, November 2019, paras 5.66-5.69.

B. setting a positive PPF would have the effect of passing productivity gains onto consumers in anticipation of their discovery, which was not an appropriate way to incentivise EDBs to improve productivity; and

C. accordingly rejected both options.

25. In DPP3, the NZCC set a default X-factor of 0% for each distributor based on its analysis of PPF (discussed above).[13] For DPP4 the NZCC plans to retain a default X-factor of 0%.[14]

26. In previous DPP resets, the opex allowance has been set using the NZCC's base-step-trend approach. The NZCC plans to implement a similar approach to forecasting opex for DPP4, however it is considering a few alterations to reflect changing EDB investment and expenditure needs.

2.4. Overview of CEPA's findings

27. The CEPA report estimated indices to quantify EDBs' total factor productivity (i.e. including both opex and flow of capital services as inputs) and opex partial factor productivity (i.e. including only opex). For simplicity, we hereafter refer to flow of capital services as "capex".

28. CEPA tested two alternate approaches – an index-based approach and an econometric estimation:

A. **Index-based approach:** CEPA divided an output index by an input index to produce an annual productivity index. The output index was constructed by econometrically estimating an appropriate "price" for each relevant output and using this to weight the output volumes (essentially summing the "value" of each output to the EDB). This involves significant assumptions about the outputs that are relevant and the appropriate price of each. The input index was constructed similarly by summing the "cost" of each input (opex and/or capex) using an inflation weighting.

B. **Econometric approach:** CEPA econometrically estimated the relationship between outputs and each of total costs and operating costs for EDBs. It tested two different types of relationship, known as a Cobb-Douglas function and a Translog function respectively. The relevant output is a time trend which captures changes in costs not explained by the other variables included (and so is assumed to reflect a temporal change in productivity). The time trend can be indexed to produce a productivity index comparable to the index-based approach.

29. In producing the output indices and in selecting the relevant outputs for the econometric approach, CEPA used nine different model specifications, with each specification being a weighted combination of 2-4 outputs at a time. This means that CEPA considered a wider range of outputs than the NZCC has historically used in the DPP base-step-trend model (which

[13] The default X-factor is based on the long-run average productivity improvement rate of distributors in New Zealand or comparable countries relative to the economy as a whole. DPP3 reasons paper, November 2019, paras 6.4-6.12. DPP4 issues paper, 2 November 2023, para.5.26.2

[14] However, the NZCC has stated it is likely some alternate X-factors will be applied since many EDBs are forecasting a substantial increase in capex to meet growing electrification and resilience needs (which could result in substantial consumer price shocks or undue financial hardship to distributors). DPP4 issues paper, 2 November 2023, paras. H19-H21.

uses line length and customer numbers as the output drivers).[15] Table 2.1 below sets out the outputs and model specifications that were included in CEPA's analysis.

Table 2.1: EDB outputs included in CEPA's modelling

Output	Units	Description	Included in specifications
Circuit length	kms	The total length of the EDB's network.	1, 3, 4, 5, 6, 7
Customer numbers	# of ICPs	The number of connected premises.	1, 2, 3, 4, 8
Energy delivered	GWh	The volume of energy supplied by the EDB.	2, 3
Transformer capacity	MVA	The apparent power in the EDB's transformers in MVA (current multiplied by voltage).	2, 6
Ratcheted maximum demand	GW	The highest maximum hourly demand achieved in any previous year.	3, 4, 6, 7, 9
Reliability	minutes lost	Total customer interruption durations (planned and unplanned) in minutes for the year.	5
Overhead line capacity	MVA-kms	The apparent power in the overhead circuit in MVA (current multiplied by voltage), multiplied by the length of the overhead circuit.	8, 9
Underground line capacity	MVA-kms	The apparent power in the underground circuit in MVA (current multiplied by voltage), multiplied by the length of the underground circuit.	8, 9

Source: CEPA report, March 2024, Table 4.1 and Table 4.3.

30. Both approaches produced fundamentally similar results – indices that declined across the period 2008-2023, for both exempt and non-exempt EDBs.

31. The time profile of this finding differs between total productivity (**TFP**) and opex partial productivity (**opex PFP**). As set out in Table 3 of the CEPA report, for TFP CEPA found that most of the decline occurred between 2008 and 2014, with the indices only falling slowly or staying broadly constant between 2014 and 2023. Notably, this flattening coincides with the introduction of IRIS in November 2014.[16] For opex PFP it found that the post-2014 decline was steeper than the pre-2014 decline, although for non-exempt EDBs, the decline in opex PFP was similar pre-2014 (-1%) and post 2014 (-1.5%).[17] The different pattern for TFP and PFP is interesting and potentially suggests that EDBs have had greater *ability* to find efficiencies for capex than opex and/or (as we discuss further in this report) delivery of uncompensated outputs has primarily required opex.

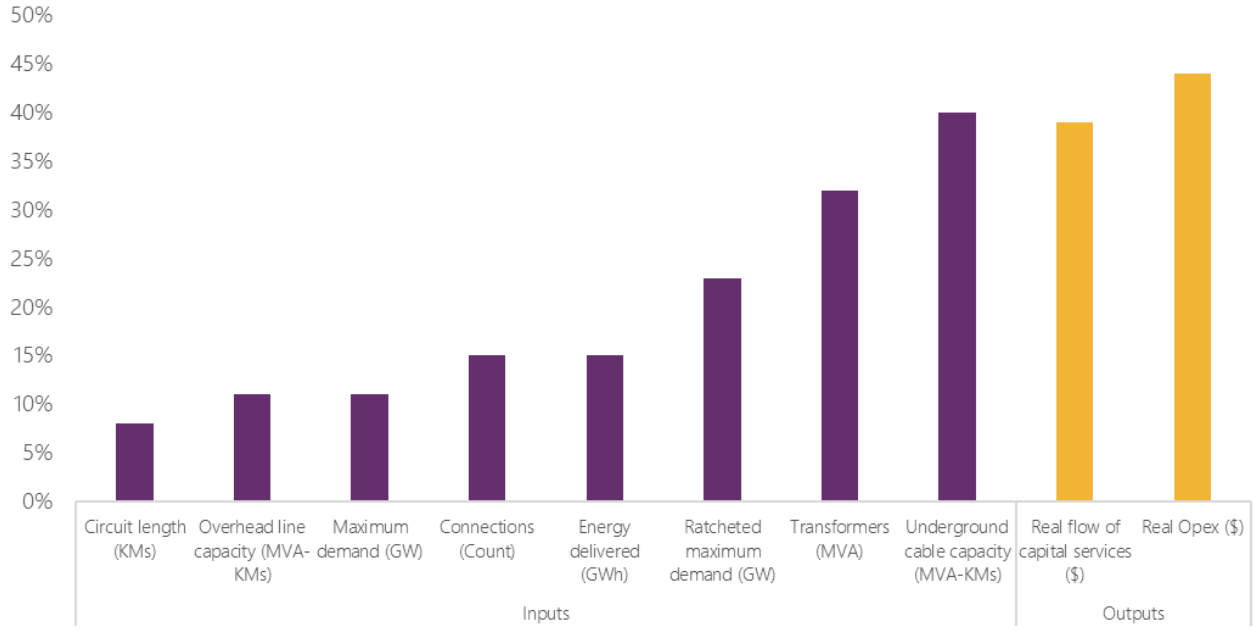
15 Although CEPA's Model 1 appears to resemble the NZCC's DPP3 output trends approach.

16 NZCC, Incremental Rolling Incentive Scheme Input Methodology Amendments Determination 2014, November 2014.

17 For exempt EDBs the decline post-2014 (-3.3%) is substantially greater than the pre-2014 decline (-0.3%).

32. These findings are not surprising given EDB expenditure generally grew faster than CEPA's measured outputs over the period. CEPA show this in Table 2. In some sense Table 2 is the most important table in the CEPA report. Figure 2.1 below reproduces this table as a bar chart with inputs and outputs coloured separately (with the reliability measures excluded given they would distort the scale of the graph).

Figure 2.1: Growth in measured outputs vs opex and flow of capital, 2008-2023



Source: NERA analysis of Table 2 of the CEPA report.

33. This figure demonstrates that:

    A. Any combination of outputs will find negative opex productivity over the period.

    B. TFP growth will be negative unless the inputs are almost entirely weighted towards capital and the outputs are almost entirely weighted towards underground cable capacity. This combination seems unrealistic and thus any plausible combination of inputs/outputs will find negative TFP over the period.

    C. Measures that more heavily weight ratcheted maximum demand, transformer capacity or underground cable capacity will find less negative productivity growth.

34. On the question of whether negative measured productivity should be interpreted as negative actual productivity, CEPA concluded that its results may not automatically provide conclusive evidence that actual EDB productivity has declined, noting the following potential alternative explanations/caveats:[18]

    A. not all of the changes in the output of EDBs being captured;

    B. capital costs not being handled correctly;

    C. reliability not being correctly valued;

[18] CEPA report, March 2024, p.60.

D. output prices being incorrect, or outdated by the end of the period; and/or

E. price deflators used to adjust outputs or inputs not being appropriate for EDBs.

35. B – E are technical issues around the measurement of productivity for a given set of inputs/outputs, and we have not explored these issues in this report as they seem unlikely to be material enough to alter CEPA's findings. Point A is a broader conceptual issue and the focus of this report (though we note it overlaps somewhat with point C).

3. Implications of unmeasured outputs for measuring productivity and setting allowances

3.1. Which outputs have been used to measure productivity and set allowances?

36. For the DPP3 opex allowances, the NZCC forecasted output changes in network and non-network opex using the forecasted change in an EDB's ICPs and total circuit length and rejected all proposed submissions for positive step changes.

37. Therefore, any increase in opex that did not correspond to a proportionate increase in ICPs and/or circuit length (e.g. because it contributed to some other output) would be implicitly assumed to be inefficient and (if consistent outputs are used for measuring productivity and scaling opex allowance) show as a decline in opex productivity. In other words, the EDB would not be compensated over the DPP period for opex that was used to produce any other output.[19]

38. For DPP4, the NZCC is proposing to expand on its previous approach to forecasting opex by adopting forecast capex as a predictor of non-network opex. The NZCC has stated it hopes the addition of forecast capex will improve opex forecasts in light of EDBs' increasing focus on investing to meet growth and renewal needs.[20]

39. The NZCC's previous productivity analysis, which we updated in our July 2019 report as part of the DPP3 process,[21] used three different productivity specifications. Each was a combination of circuit length, customer numbers, energy delivered, system capacity, and ratcheted maximum demand. Previous productivity measures have thus not always used outputs consistent with those used in the allowance setting process.

40. As set out above in section 2.4, CEPA's analysis included a more extensive range of outputs than is used in the NZCC's allowance-setting process or the NZCC's previous productivity analysis, including measures of overhead and underground line capacity and reliability. This means that CEPA's estimates of measured opex productivity will be different to the implicit measures of opex productivity embedded in the DPP3 (and DPP4) allowances, except where CEPA's output specification matches the NZCC's (as may be the case with CEPA's Model 1).

3.2. Why might there be missing outputs?

41. The DPP3 outputs – ICPs and circuit length – describe the extent of each EDB's network. This is only a partial view of an EDB's service offering.

42. CEPA's outputs describe the extent and capacity of each EDB's network. This covers most but not all dimensions of an EDB's service offering. There is some attempt to measure network

[19] In theory, outputs not compensated through the scale factors could be provided for through step changes. The step change process is however more suited to one-off changes in costs as opposed to gradual increase in the delivery of other outputs. Though we note the NZCC has signalled there may be a greater need for step changes going forward. DPP4 issues paper, 2 November 2023, pp.109-115.

[20] DPP4 issues paper, 2 November 2023, paras. 3.50-3.52.

[21] NERA, Opex Partial Factor Productivity for DPP3, July 2019.

quality, via the reliability measure, but as CEPA notes it is difficult to isolate the impact of an EDB's own actions on reliability (versus exogenous factors such as weather events).[22]

43. Other dimensions of an EDB's service offering which might incur opex and/or capex have not been accounted for.

44. We produced a December 2022 report for the Big 6 EDBs, which was submitted to the NZCC, that discussed some of these unmeasured and therefore uncompensated outputs (in terms of opex allowance). Table 3.1 below reproduces our list of examples from that report.[23]

45. CEPA discusses similar examples in its report as well as some more general examples of unmeasured outputs that EDBs allocate expenditure to – for example, preservation of aesthetic environment, and customer support. [24]

46. In submissions for DPP3, distributors advocated for step changes to reimburse them for opex resulting from many of the unmeasured outputs outlined in Table 3.1. However, the NZCC did not make any step changes in response to submissions due to its strict step change criteria.[25]

22 CEPA report, March 2024, section 2.3.3.

23 NERA, Innovation under the DPP: potential barriers and solutions, December 2022, Table 2.

24 CEPA report, March 2024, sections 2.3.4 and 6.1.

25 Under the NZCC's proposed criteria for DPP4 a step change must be significant, robustly verifiable, not be captured in the other components of the DPP allowance (base year, trend factors, capex, pass-through and recoverable costs, or reopeners), be largely outside the control of the distributor, and in principle, be applicable to most, if not all, distributors. DPP4 issues paper, 2 November 2023, para D87.

Table 3.1: Examples of unmeasured outputs produced by EDBs

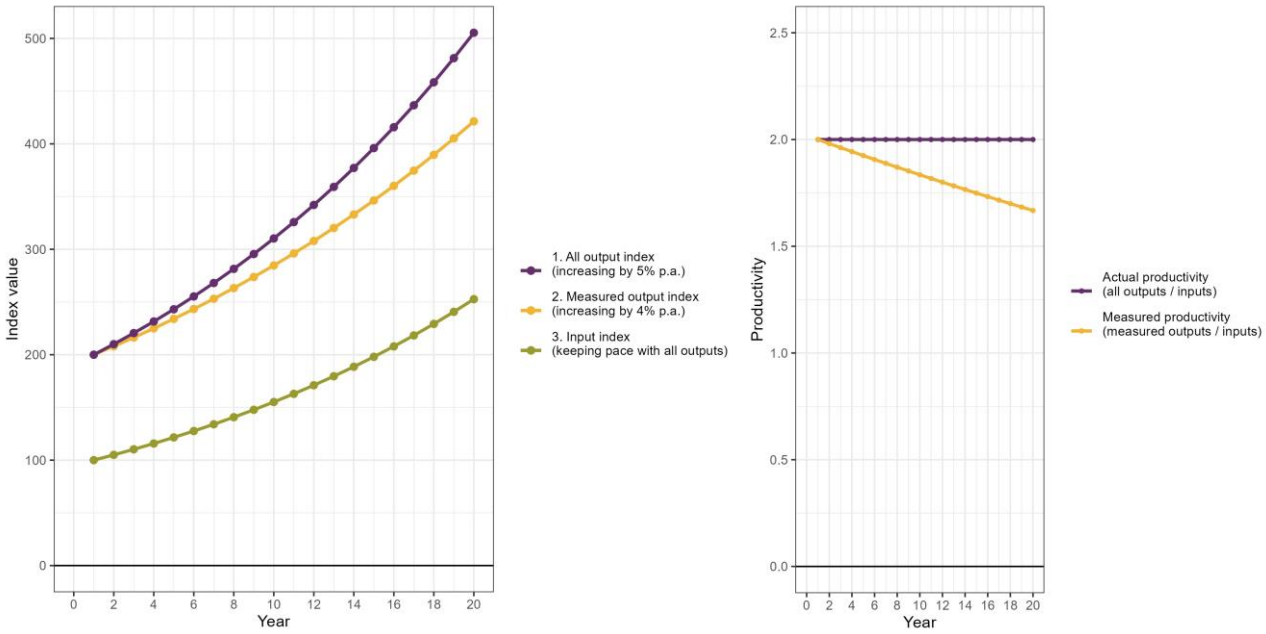
Category	Output	Period
Consents, regulation, and compliance *EDBs now face regulations (or other pressures) to deliver additional uncompensated "outputs". These additional (uncompensated) outputs add cost*	**Traffic Management Compliance:** Increasingly stringent safety regulations require crews to set up and manage traffic at any project. Traffic management add costs by extending the time taken and cost to complete a job.	Historical
	Safety for the Public and EDB staff (distinct from traffic management compliance): For example, *Electricity (Hazard from Trees) Regulations 2003* require EDBs to remove trees sufficiently near to electricity lines. Tree removal can only occur via negotiation with tree owners which can deliver an uncertain outcome of indeterminate cost. Another example is the *Health and Safety and Work Act 2015*, which may increase costs to work on electrified (live) lines.	Historical
	Regulatory/ financial compliance: In general, more complex disclosures (IDs & AMP) from NZCC, code changes and distribution pricing work programme from the Electricity Authority, more complex Accounting Standards (e.g., IAS 16) and share market disclosures (e.g. ESG).	Historical
	Resource Consents: Examples include council signoffs such as approval of works impacting parking and footpaths, district plan reviews (including submission, hearings, mediations etc.).	Historical
New product/service *EDBs are increasingly providing a new product or service which wasn't provided historically (or was provided less)*	**Non-network solutions/flex services:** EDBs are increasingly (or will in the future) be finding opex solutions to what were traditionally capex problems. An example is non-network solutions, which reduce the size of the grid.	Forward
	ESG and carbon footprint: expenses that reduce an EDBs ESG impact. For example, by reducing carbon emissions.	Forward
	Stakeholder engagement: Increasing expectations of "stakeholder journey" from council to network planning, which requires EDBs to allocate more FTEs.	Recent / Forward
	Connecting/Integrating DER: This includes connecting solar panels to the grid; batteries, and network planning for large new loads.	Forward
Digitisation & IT *EDBs are providing new digital products and services*	**Smart meters:** greater opex required to access smart meter data to monitor the network. Also, costs involved in turning this data into insights.	Historical / Forward
	General digitisation (including cybersecurity): For instance, maintaining a website (or app) to provide information to customers on the grid including data on repair times and planned outages. Cybersecurity likely to become increasingly important as household defer more to smart technologies such as time of day charging for EVs.	Historical / Forward
	LV visibility/ monitoring /Data acquisition: Understanding the impact on the grid of emerging technologies such as batteries and solar panels requires increased information and understanding about the LV networks. Collecting and using this data, however, is costly.	Historical / Forward
Network resilience *EDBs are incurring costs to make their networks more resilient to climate change, weather, and natural disasters (e.g., earthquakes)*	**Climate and natural disaster resilience:** Greater spending to increase the resilience of the network e.g., because of flood mitigation, black start resilience (biofuels for generators), earthquake measures, responding to faults in more frequent severe weather etc.,	Historical / Forward
	Insurance: Protects customers from paying more after a major event (e.g., earthquake, cyclones).	Historical / Forward

3.3. How does this impact EDBs?

47. If an EDB maintained its output growth rate for measured outputs over a given period, and maintained its expenditure growth rate except for a small increment each year to improve one of its unmeasured outputs (e.g. customer support), this would appear as a steady decline in its productivity index.

48. For example, Figure 3.1 below sets out a simplified and hypothetical scenario where an EDB's measured outputs grow at a rate of 4% p.a., but its total outputs grow at a rate of 5% p.a. due to an additional 1pp p.a. growth in unmeasured outputs. The model illustrates that, if the EDB's input growth keeps pace with total output growth, its measured productivity (using a simple index-based approach) will appear to decline over a 20-year period, even though its actual productivity is exactly constant.

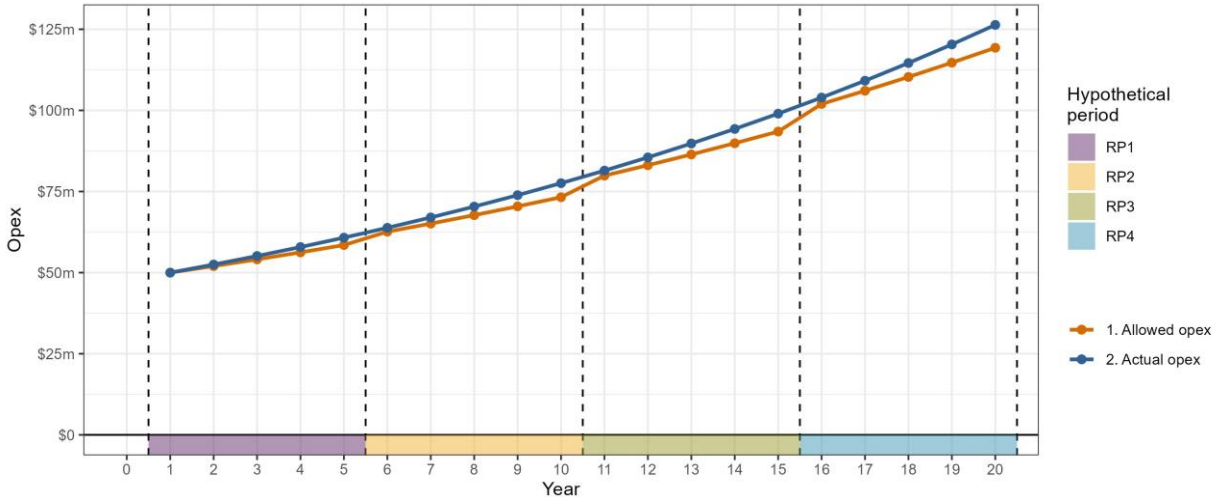
Figure 3.1: Hypothetical illustration of measured productivity decline caused by total outputs growing faster than measured outputs



Note: The input index beginning at 100 and the output indices beginning at 200 is arbitrary and for illustrative purposes. This is also the case for the choice of 5% and 4% for actual output growth and measured output growth respectively (with the 1pp difference being due to hypothetical unmeasured outputs).

49. This might flow through to the EDB's allowance-setting and expenditure in a couple of ways. For example, if we start by assuming an opex PPF of 0% and that the opex allowance grows in line with the measured outputs, then if an EDBs actual opex grows in line with growth in actual outputs, it would be overspending its opex allowance by the end of each 5-year regulatory period (RP). The disparity would widen over a 20-year period (see Figure 3.2 below), despite the fact that actual opex in Year 4 of the one regulatory period sets the base year for the next regulatory period.

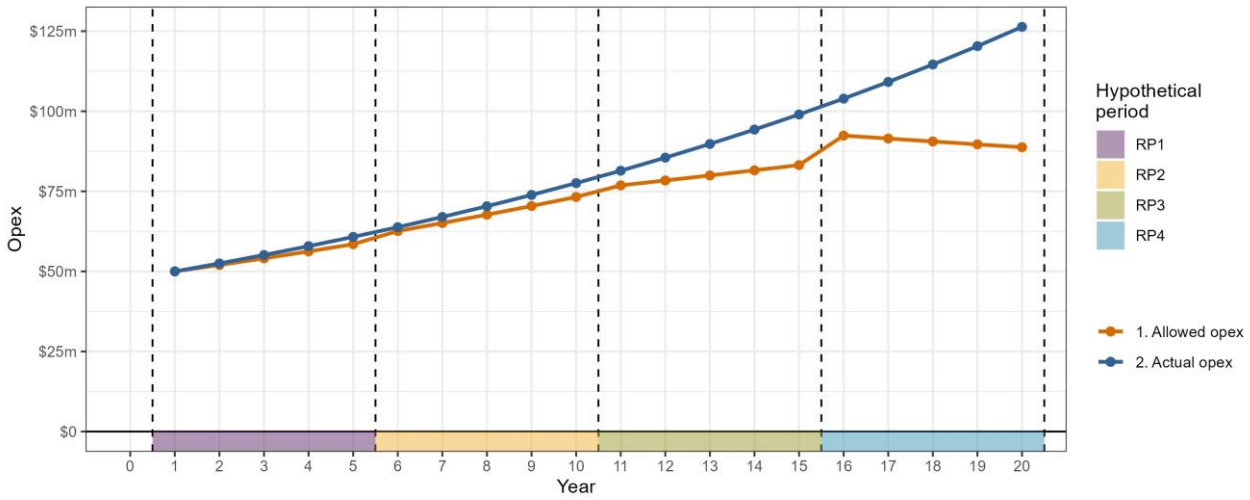
Figure 3.2: Hypothetical illustration of how the presence of unmeasured outputs would cause a mechanistic base-step-trend model to set insufficient opex allowances



Note: This is a hypothetical and highly simplified version of the base-step-trend model. Year 1 allowed opex of each RP period (except for RP1) is based on Year 4 of the previous period (and adjusted for two years of trend). In RP1, the Year 1 allowed opex is set equal to actual opex, which we assume is $50 million. The only trend included is a 4% annual increase on previous allowed opex, reflecting the annual 4% growth of measured outputs. Actual opex always exceeds this amount because we assume it grows by 5% p.a., keeping pace with total outputs (including unmeasured ones). There are no step changes.

50. The issue would be further exacerbated by applying a productivity target in the form of a positive opex PPF. To illustrate this, Figure 3.3 below reproduces Figure 3.2 but with a 2% opex PPF in RP3, and a 5% opex PPF in RP4.

Figure 3.3: Previous model extended to include a 2% opex PPF in RP3 and a 5% opex PPF in RP4



Note: This is a hypothetical and highly simplified version of the base-step-trend model. Year 1 allowed opex of each RP period (except for RP1) is based on Year 4 of the previous period (and adjusted for two years of trend). In RP1, the Year 1 allowed opex is set equal to actual opex, which we assume is $50 million.
There are two trends:

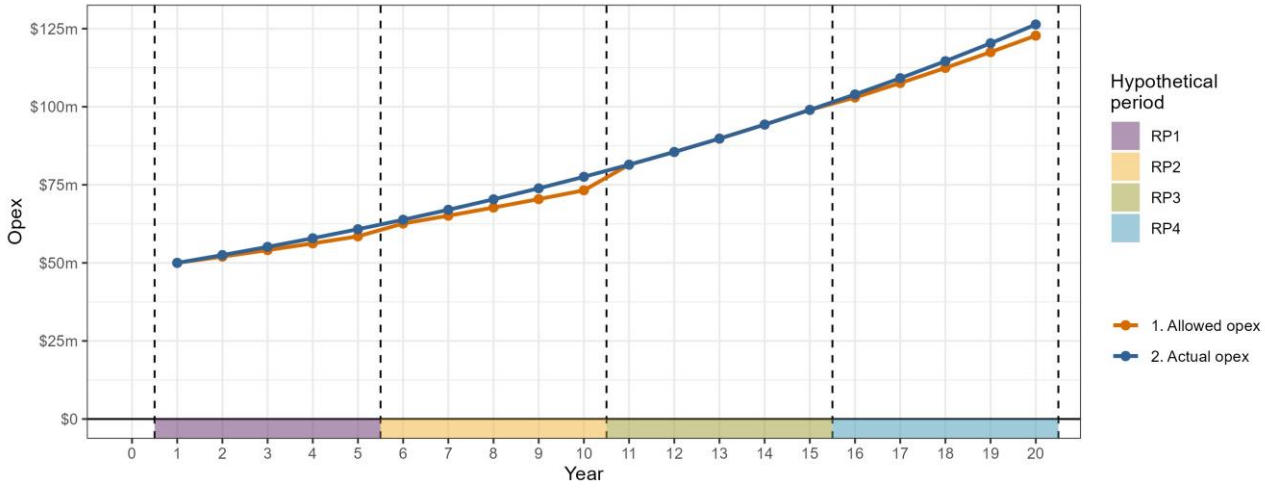
- *A 4% annual increase in previous allowed outputs, reflecting the annual 4% growth of measured outputs.*
- *A 2% opex PPF in RP3 and a 5% opex PPF in RP4. In both cases, the opex PPF is subtracted from the 4% output trend.*

Actual opex always exceeds this amount because we assume it grows by 5% p.a., keeping pace with total outputs (including unmeasured ones). There are no step changes.

51. Conversely, the problem could be corrected by applying a negative opex PPF that is equal to the gap between the measured output trend and the actual output trend. In the case of our hypothetical scenario, this would be an opex PPF of -1% (the difference between 4% and 5%).

52. However, to implement this solution, it would be necessary to ensure that the same output trends are being captured in the allowance-setting and the measurement of productivity for the PPF (which as we note above at 40 may not be the case), otherwise a discrepancy may remain. To illustrate this, Figure 3.4 below shows that an opex PPF of -1% in RP3 resolves the overspend, but an opex PPF of only -0.5% in RP4 (which might arise because the PPF analysis suffers from fewer missing outputs than the allowance-setting analysis) would reopen the gap.

Figure 3.4: Previous model extended to include a -1% opex PPF in DPP3 and a -0.5% opex PPF in DPP4



Note: This is a hypothetical and highly simplified version of the base-step-trend model. Year 1 allowed opex of each RP period (except for RP1) is based on Year 4 of the previous period (and adjusted for two years of trend). In RP1, the Year 1 allowed opex is set equal to actual opex, which we assume is $50 million.
There are two trends:

- *A 4% annual increase in previous allowed outputs, reflecting the annual 4% growth of measured outputs.*
- *A -1% opex PPF in RP3 and a -0.5% opex PPF in RP4. In both cases, the opex PPF is subtracted from the 4% output trend.*

Actual opex grows by 5% p.a., keeping pace with total outputs (including unmeasured ones). Therefore, it matches allowed opex in RP3 which applies a 5% trend. There are no step changes.

53. We also note that the issue is unlikely to be addressed by step changes, which would at best work to properly align the base year with the allowance that would be sufficient to deliver the efficient required opex in Year 1 of each DPP period. However, the mismatching trends would continue to cause allowed opex to fall below this level in subsequent years. Which is to say, step changes solve the problem of one-off increases or decreases in costs, but do not easily account for trend changes in costs.[26]

54. In addition, stakeholders have expressed concerns over the strictness of this criteria in submissions for DPP4,[27] yet, it is unlikely the Commission will ease the evidence threshold in

[26] In theory, the step change could overcompensate in the base year, such that the trends would diverge over the period in an NPV-neutral way, but it would be difficult to execute this accurately.

[27] For example, Aurora Energy's submission on the DPP4 issues paper, 19 December 2023, pp.11-12. Powerco's submission on DPP4 issues paper, 19 December 2023, pp.19-22.

the future due to the information asymmetry for positive and negative step changes (distributors will only report positive step changes).

55. The NZCC plans to keep the same step change criteria as for DPP4 as in DPP3, though the Commission does recognise that there may be a greater need for step changes in opex as distributors undertake new functions, embrace new technologies, and respond to legislative changes. As such, the Commission has expanded on how it proposes to assess the criteria and the kinds of evidence it would require, which could result in positive step changes for DPP4.[28]

3.4. What does this do to EDBs' incentives?

56. In practice, to deliver unmeasured outputs that require opex, an EDB must either:
    A. find productivity gains on its measured outputs; or
    B. overspend its opex allowance and face IRIS penalties.
57. This disincentivises EDBs from allocating opex to unmeasured outputs, which is likely to be inefficient if those outputs are valued by consumers. As we set out in our December 2022 report, this is essentially a barrier to innovation since many of the unmeasured outputs require innovation to deliver.[29]
58. Or it will cause EDBs to systematically incur losses, which will likely damage investment incentives.
59. There is also a procedural bias towards capex in the allowance setting process. If those same unmeasured outputs can be delivered using capex, an EDB may be able to include that in its capex allowance provided it satisfies the NZCC's capex tests and does not exceed the aggregate 120% threshold.[30] As we discuss in our December 2022 report, and was originally put forward by the NZCC, this is one of the factors creating a perverse incentive for EDBs to inefficiently prefer capex solutions to equivalent opex solutions.[31] To the extent procedural requirements for opex and capex result in unmeasured outputs being delivered using capex when opex would be more efficient, this results in higher costs being incurred and is not in the long term interests of consumers.
60. As we described in our 2019 report, in other regulatory regimes with similarities to NZ (Australia, the UK and Canada), the opex allowance-setting more closely resembles how the capex allowance is set in NZ, in the sense of being a more bottom-up process.[32]

28 DPP4 issues paper, 2 November 2023, pp.109-115.

29 NERA, Innovation under the DPP: potential barriers and solutions, December 2022, section 4.3.2.

30 Noting that delivering unmeasured outputs using capex would still show up as declining total factor productivity.

31 NERA, Innovation under the DPP: potential barriers and solutions, December 2022, section 4.3.3.

32 NERA, Opex Partial Factor Productivity for DPP3, July 2019, Table 2.1.

4. What can we infer from EDBs' recent expenditure?

61. The CEPA report finds that EDB productivity has been declining since 2008 but has only fallen slowly or stayed broadly constant since 2014. It suggests this trend could be an artefact of the modelling approach:[33]

> *While the methods used here show an apparent decline in productivity, this could be an artefact of the modelling approaches used here, such as failing to correctly account for all of the outputs of an EDB, the difficulty in measuring the use of capital inputs, or other factors such as changing weather patterns.*

62. In the previous section we discussed the potential problem that CEPA acknowledge of uncompensated outputs and how it may affect EDBs through the scale factors and the productivity assumption in the base-step-trend model.

63. In this section we consider evidence around EDB's actual expenditure compared to their allowances (which they are financially punished if they exceed) (section 4.1) and overall returns 4.2) and what this means for how CEPA's productivity evidence should be interpreted (section 4.3).

64. In particular, we find that EDBs have been overspending their opex allowances despite the financial penalty they face from doing so, and that this has been manifesting itself as returns below the NZCC's allowed cost of capital. This could be consistent with worsening productivity over the same period but, given EDBs are financially punished for this decline in productivity, it seems more likely that EDBs are instead delivering outputs they are not compensated for under the current framework. Alternatively, if the NZCC's and CEPA's specification of outputs is correct and there has been a genuine decline in productivity, this suggests there are broader problems with the incentive regulation framework.

4.1. EDBs appear to be overspending their allowances

65. There is evidence of EDBs consistently overspending their opex allowances over the past decade.

66. We have data on the opex allowances of the 17 non-exempt EDBs from 2015 to 2025, as set out in the NZCC's DPP2 and DPP3 opex projections.[34] In this section, we compare these allowances against the actual (and forecast) opex incurred by each EDB over the same period, as revealed by information disclosure data.

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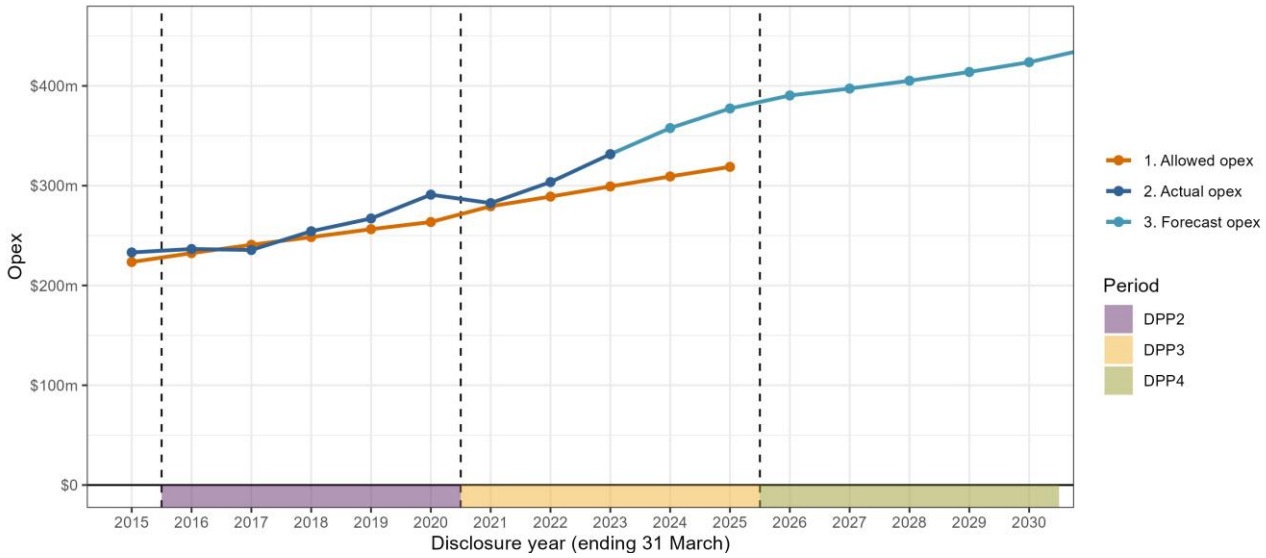
33 CEPA report, March 2024, p.8.

34 NZCC, Opex projections model – EDB DPP 2015-2020, November 2014, retrieved from https://comcom.govt.nz/regulated-industries/electricity-lines/electricity-lines-price-quality-paths/electricity-lines-default-price-quality-path/2015-2020-electricity-default-price-quality-path; NZCC, Opex projections model -EDB DPP3 final determination, November 2019, retrieved from https://comcom.govt.nz/regulated-industries/electricity-lines/projects/2020-2025-electricity-default-price-quality-path; NZCC, Opex projections model – WELL DPP3 final determination, November 2020, retrieved from https://comcom.govt.nz/regulated-industries/electricity-lines/projects/wellington-electricitys-20222025-dpp; NZCC, Powerco's transition to the 2020-2025 DPP – Opex projections model, August 2022, retrieved from https://comcom.govt.nz/regulated-industries/electricity-lines/projects/powercos-20232025-dpp.

67. One caveat is that 4 of the non-exempt EDBs[35] went on CPPs at some point during this period and Centralines became consumer-owned and therefore exempt from an allowance in 2022 (together, **"non-DPP EDBs"**). The other 12 remained on DPPs throughout the whole period (**"DPP EDBs"**). Since our focus is on the potential issues created by DPP allowance-setting, we exclude the observations in which CPPs were in effect, which means we also exclude the non-DPP EDBs from some aggregate totals.

68. Figure 4.1 below summarises the comparison of allowed versus actual (and forecast) opex across the 13 DPP EDBs. It shows that, in aggregate, over DPP2 and DPP3, the DPP EDBs overspent their opex allowance more often than not. The gap widened in DPP3 compared to DPP2. The total net opex residual[36] (i.e. the difference between the blue and orange lines) was an overspend of $43.0m in DPP2 and a projected overspend of $157.0m in DPP3 (including forecast opex).

Figure 4.1: Allowed vs. actual (and forecast) opex for the 12 DPP EDBs (combined), 2015-2025



Source: Information disclosure schedules 6b and 11b; and DPP2/DPP3 opex projections.
Note: Only non-exempt EDBs that are subject to price-quality regulation are included. Centralines is excluded from the total due to becoming consumer-owned in 2022.
Aurora, Orion, Powerco, and Wellington Electricity are excluded from the total due to being put on CPPs during the relevant period.
Forecast opex is as of the 2023 disclosures.

69. Figure 4.2 breaks this comparison down into individual EDBs, including the 5 non-DPP EDBs (whose CPP/exempt periods are shaded in grey)[37]. This figure shows that 12 out of the 17 EDBs

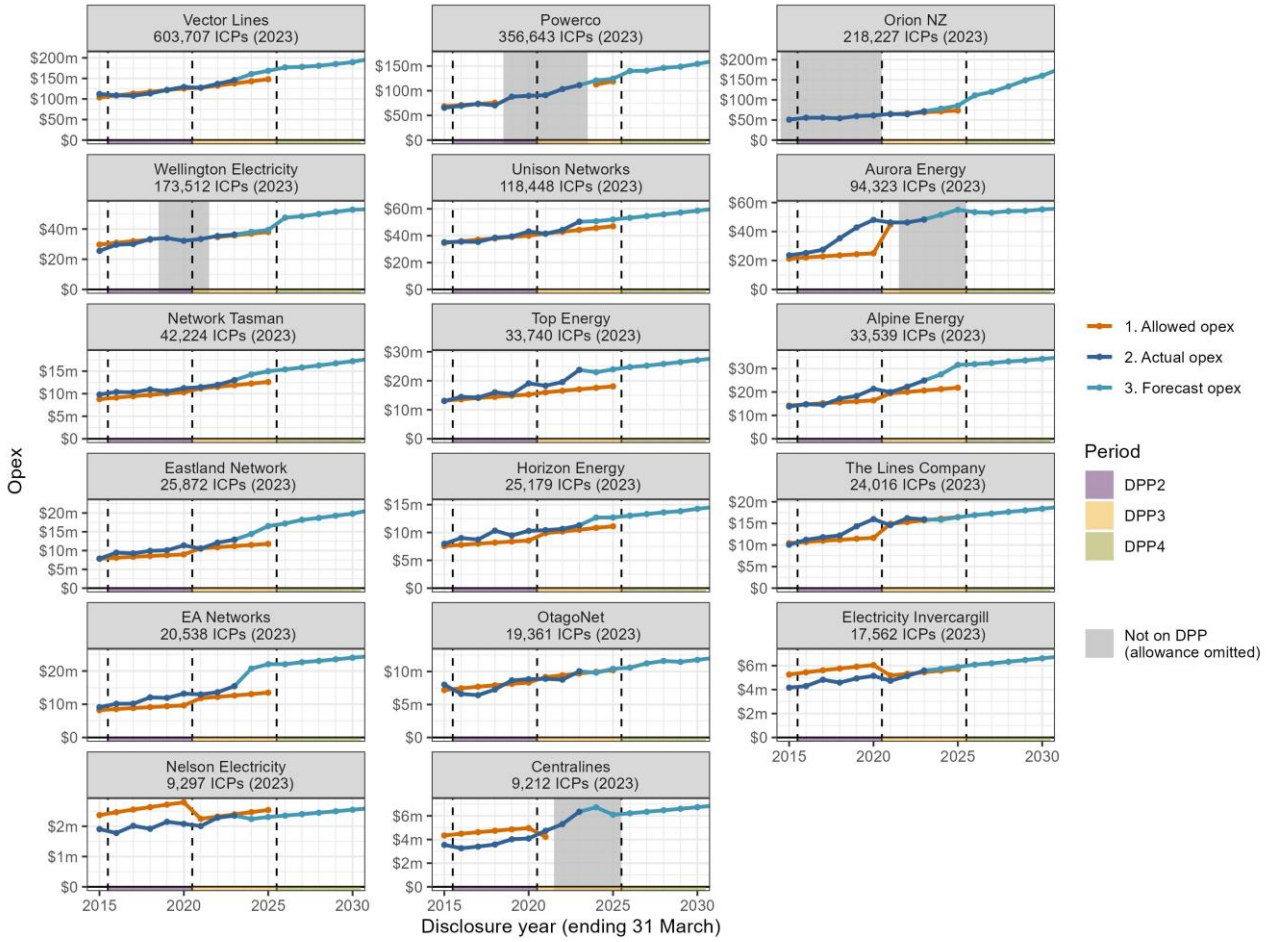
35 Aurora Energy, Orion NZ, Powerco, and Wellington Electricity.

36 The opex residual is calculated as actual opex – allowed opex. It is positive if the EDBs overspent their allowance, or negative if the EDBs underspent their allowance. When we average or sum the residuals together, we include both the positive and negative residuals.

37 Note that, even though Orion technically transitioned back to a DPP in 2020, we include this year as part of its CPP period since its transitional pricing for that year was a continuation of its CPP pricing. E.g. see NZCC, Orion's transition to the default price-quality path, retrieved from https://comcom.govt.nz/regulated-industries/electricity-lines/projects/orions-transition-to-the-dpp.

have a projected net opex overspend between 2015 and 2025 (i.e. total opex, including forecast, exceeds total allowed opex over the period).

Figure 4.2: Allowed vs. actual (and forecast) opex for the 17 non-exempt EDBs (individually), 2015-2025



Source: Information disclosure schedules 6b and 11b; and DPP2/DPP3 opex projections.
Note: Only non-exempt EDBs that are subject to price-quality regulation are included. Only DPP allowances are included. We exclude the years in which an EDB was not on a DPP. Forecast opex is as of the 2023 disclosures.

70. Figure 4.3 below illustrates annual opex residuals for each non-exempt EDB, including the fact that overspending is frequent. In the 9 disclosure years from 2015 to 2023 (i.e. excluding forecast overspend):[38]

    A. 11 out of the 17 non-exempt EDBs had a net opex overspend;

    B. 9 out of 12 DPP EDBs overspent their opex allowances in at least 5 years;

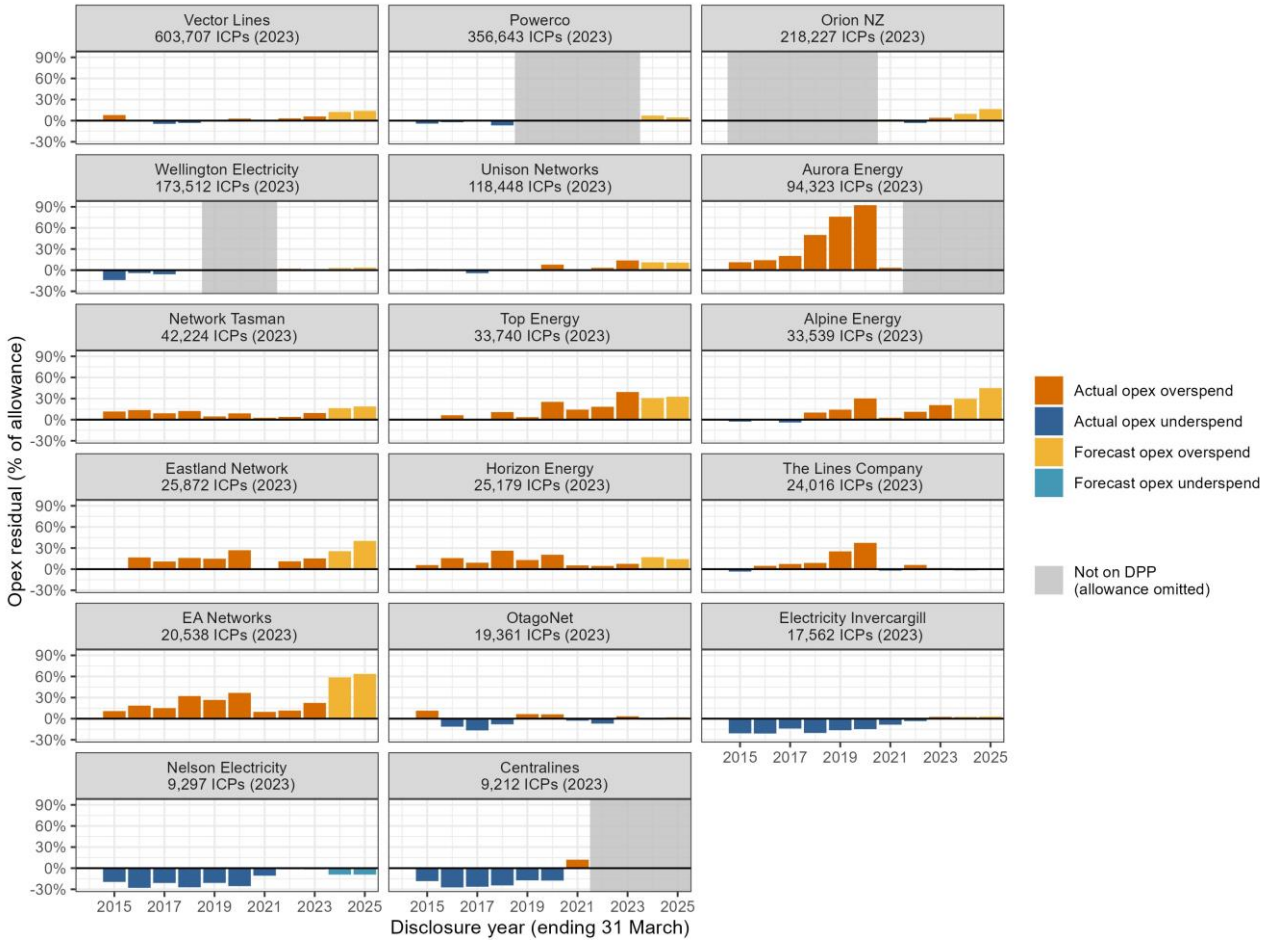
    C. 7 out of 12 DPP EDBs overspent their opex allowances by at least 5% in at least 5 years;

    D. 3 out of 5 non-DPP EDBs overspent their opex allowances in at least half of their DPP years; and

[38] NERA analysis of information disclosure data and DPP2/DPP3 opex projections.

E. 1 out of 5 non-DPP EDBs overspent their opex allowances by at least 5% in at least half of their DPP years.

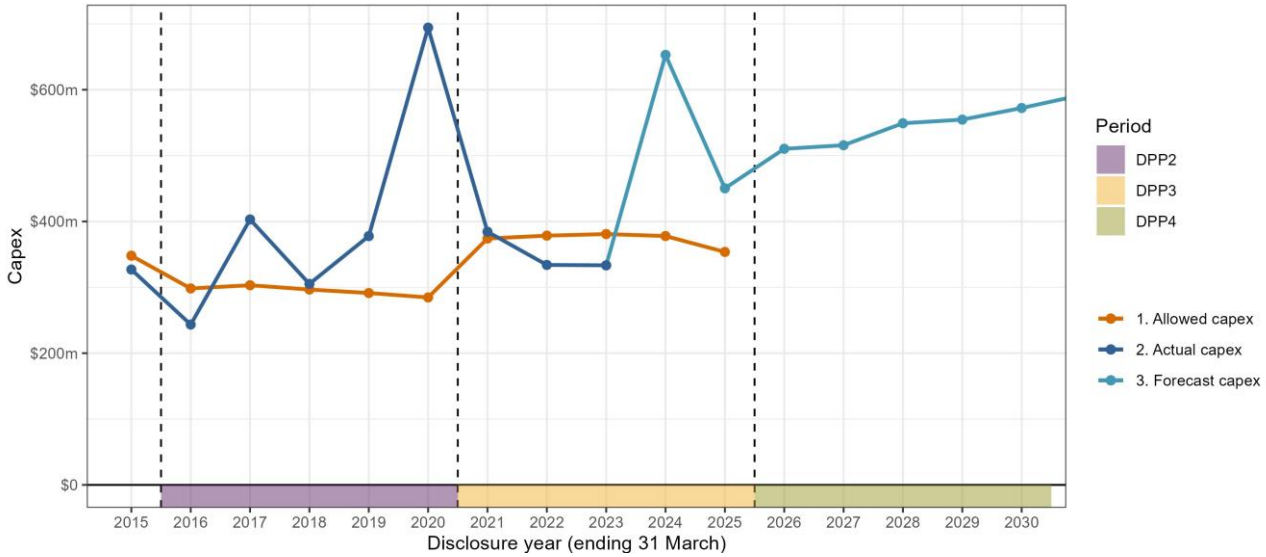
Figure 4.3: Opex residual as a % of allowed opex for the 17 non-exempt EDBs (individually), 2015-2025



Source: Information disclosure schedules 6b and 11b; and DPP2/DPP3 opex projections.
Note: Only non-exempt EDBs that are subject to price-quality regulation are included. Only DPP allowances are included. We exclude the years in which an EDB was not on a DPP. Forecast opex is as of the 2023 disclosures.

71. While the focus of our discussion thus far has been opex, given the context of our report is what CEPA's productivity findings imply for the NZCC's decision about the opex PFP for DPP4, a similar broad trend is observable for capex, as shown in Figure 4.4 below.

Figure 4.4: Allowed vs. actual (and forecast) capex for the 13 DPP EDBs (combined), 2015-2025



Source: Information disclosure schedules 4 and 11a; and DPP2/DPP3 capex projections.
Note: Only non-exempt EDBs that are subject to price-quality regulation are included. Centralines is excluded from the total due to becoming consumer-owned in 2022. Aurora, Orion, Powerco, and Wellington Electricity are excluded from the total due to being put on CPPs during the relevant period. Forecast opex is as of the 2023 disclosures.

72. It is reasonable to expect that EDBs might occasionally overspend allowances due to exceptional circumstances or miscalculation. However, we would expect the IRIS penalties to sufficiently deter any rational business from overspending consistently.

4.2. EDBs appear to be earning subnormal returns on investment

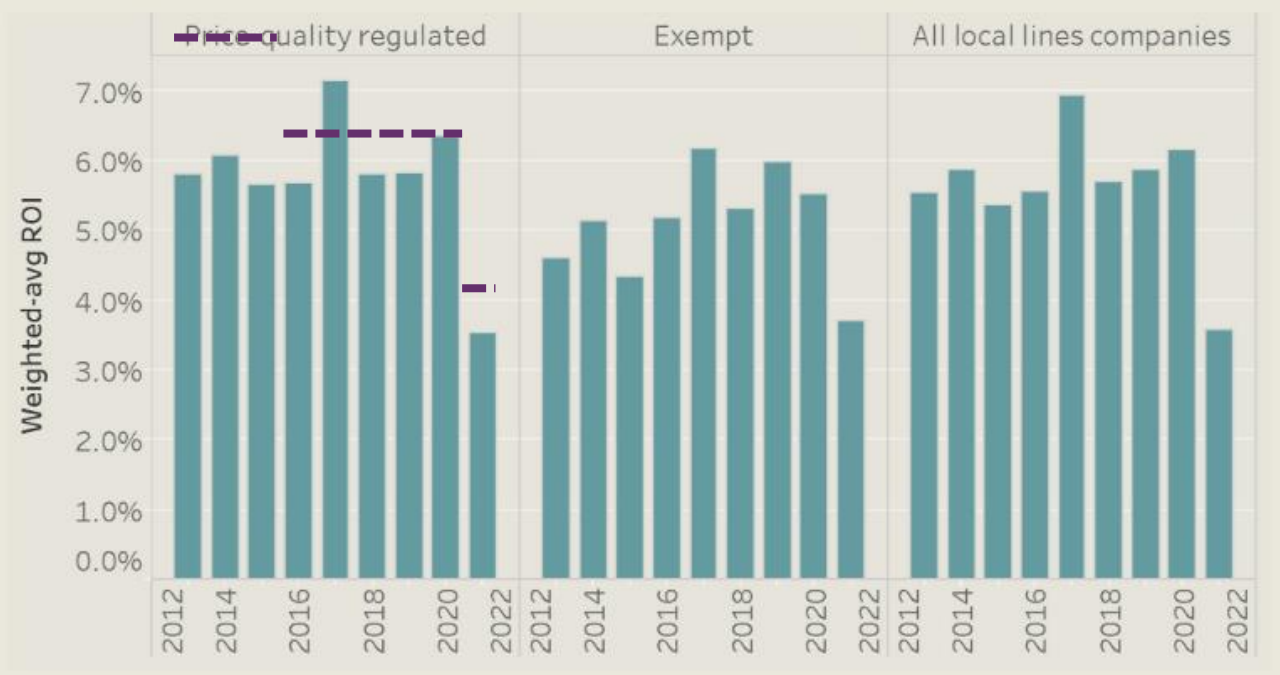
73. In its May 2022 IM review process and issues paper, the NZCC found that EDB industry returns were typically below regulatory weighted average cost of capital (**WACC**), indicating EDBs were potentially loss-making in economic terms.[39]

74. A slightly updated version of this analysis (also from the NZCC) is reproduced in Figure 4.1 below. Note that the NZCC estimated WACC for the price-quality regulated firms at 7.8% for 2011-2015, 6.4% for 2016-2020, and 4.2% for 2021-2025.[40]

[39] Because shareholder capital could have earned more in other investments. NZCC, Part 4 Input Methodologies Review 2023 – process and issues paper, May 2022, para 10.75.

[40] NZCC, Trends in local lines company performance, July 2022, p.43.

Figure 4.5: NZCC analysis illustrating subnormal EDB weighted average returns on investment, 2013-2021 (regulatory WACCs overlaid with purple dotted lines)



Source: NZCC, Trends in local lines company performance, July 2022, Figure 39.
Note: The regulatory WACCs were outlined by the NZCC at p.43 and have been overlaid on the chart by NERA.

75. The NZCC raised two possible explanations for the subnormal returns – voluntary undercharging and declining productivity:[41]

> *These profitability outcomes are consistent with weak or negative productivity growth (ie, costs growing more than revenues), but also with voluntary undercharging (ie, regardless of costs, undercharging results in lower revenue.*

76. All else equal, non-exempt EDBs should have less incentive to voluntarily undercharge than exempt consumer-owned EDBs (who may do it to benefit their consumer owners). Indeed, part of the purpose of price-quality regulation is to prevent firms from extracting excess profits, which raises questions about the purpose and design of the regime if firms subject to PQ are systematically undercharging.[42]

77. Therefore, of the NZCC's two explanations, on its face declining productivity is the most relevant for non-exempt EDBs. However, we note that there is a third possible explanation: reduced profitability due to EDBs overspending their allowances in order to deliver uncompensated outputs, as discussed in section 3.

41 NZCC, Part 4 Input Methodologies Review 2023 – process and issues paper, May 2022, para 10.77.

42 That said, we have not conducted an exhaustive analysis of the governance arrangement of all of the non-exempt EDBs.

4.3. EDBs may be becoming more productive in order to achieve delivery of unmeasured outputs

78. EDBs are facing increasing demand to deliver unmeasured outputs. We set out a number of these in Table 3.1 above, including an indication of whether demand for these outputs is likely to continue to affect EDBs on a forward-looking basis.

79. Many of the forward-looking outputs related to:

    A. new products and services (e.g. connecting distributed energy resources (DERS), increased stakeholder engagement);

    B. digitisation and IT (e.g. smart meters, website improvements, cybersecurity); and

    C. network resilience (e.g. flood mitigation, black start resilience, insurance).

80. In the DPP4 issues paper, the NZCC emphasised the growing importance of some of these outputs – noting, for example, the *"increased uptake of flexibility services and distributed energy resources"* and that *"[n]etwork resilience has been an increasing focus for EDBs and consumers following recent extreme weather events"*.[43]

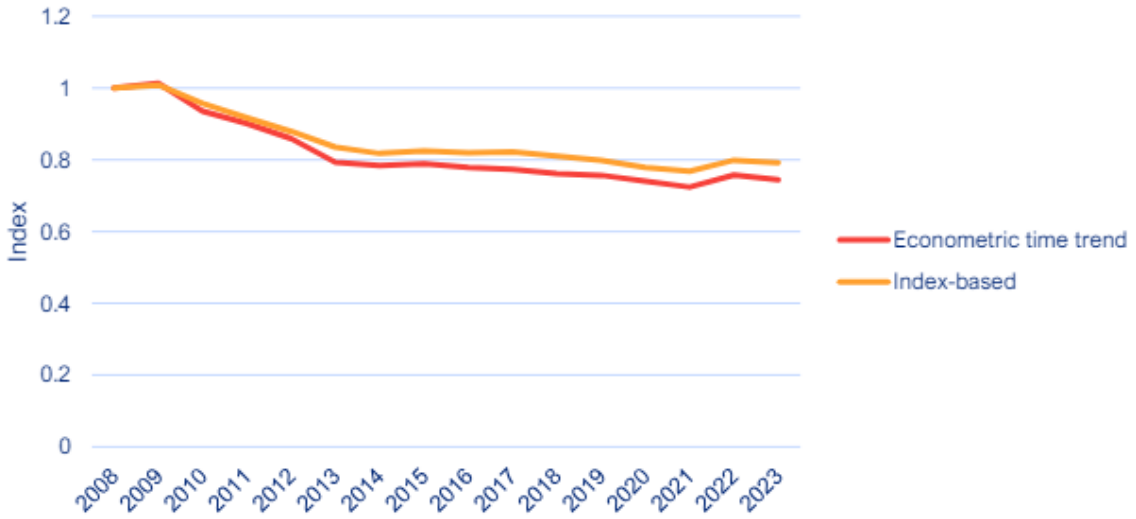
81. CEPA observed a productivity decline, i.e., opex and capex growing faster than measured outputs (though as Figure 2.1 shows, opex has been growing faster than the capital input, which explains why the decline in opex PFP is greater than the TFP decline). But at least some of this opex and capex must be attributable to the unmeasured outputs (which are not free), which likely explains at least part of the observed overspending we discuss above in section 4.1.

82. This implies that CEPA's observed decline must be at least somewhat overstated, as we demonstrate in our hypothetical model at Figure 3.1 above.

83. Interestingly, in the case of TFP, CEPA found that most of the observed TFP decline occurred between 2008 and 2014, with the indices only falling slowly or staying broadly constant between 2014 and 2023, as we reproduce in Figure 4.6 below.

[43] DPP4 issues paper, November 2023, X9-X12.

Figure 4.6: CEPA's total factor productivity indices for all EDBs, using ICPs + circuit length as outputs and opex + capex as inputs, 2018-2023

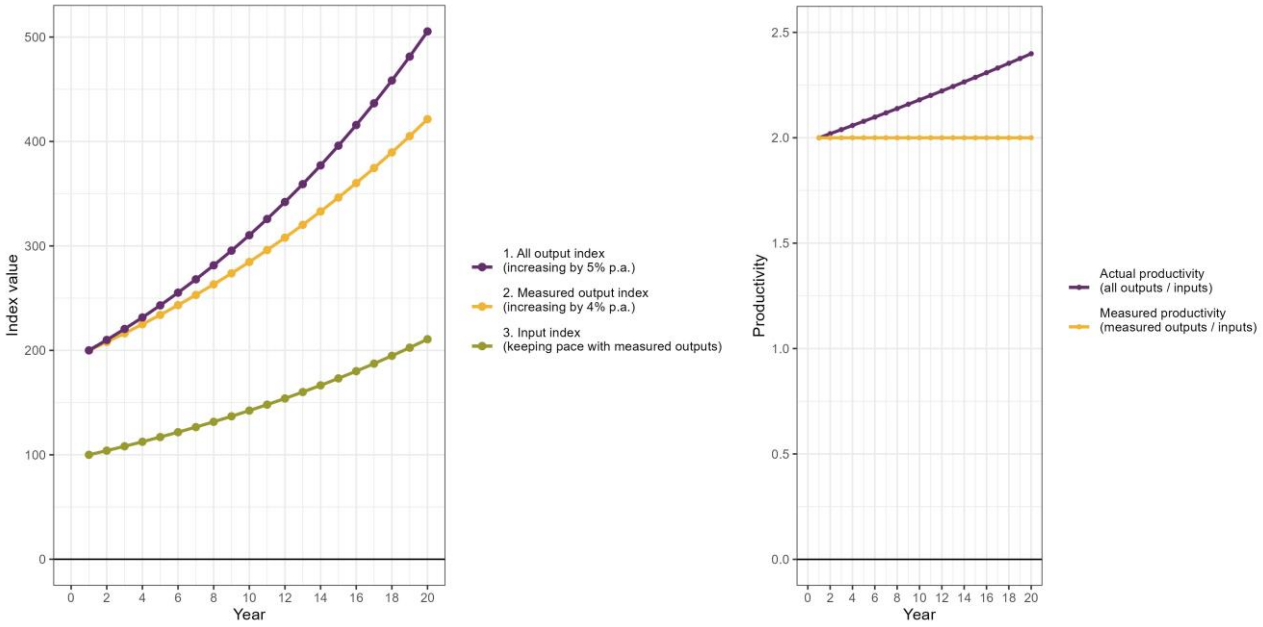


Source: CEPA report, March 2024, Figure 14.

84. In other words, *measured* TFP productivity has been relatively stable over the past decade. This would require EDBs achieving *gains* in actual productivity to offset the increased delivery of unmeasured outputs.

85. This phenomenon can be illustrated with a modified version of our hypothetical scenario from section 3.3 above, where the input index keeps pace with measured outputs instead of total outputs. We present this modified scenario in Figure 4.7 below.

Figure 4.7: Hypothetical illustration of actual productivity increase to offset effect of total outputs growing faster than measured outputs



Note: The input index beginning at 100 and the output indices beginning at 200 is arbitrary and for illustrative purposes. This is also the case for the choice of 5% and 4% for actual output growth and measured output growth respectively (with the 1pp difference being due to hypothetical unmeasured outputs).

86. Even though opex PFP has continued to decline, this could still be consistent with actual productivity in measured outputs increasing. For example, see our equation at 12 above that decomposes measured opex partial productivity into two components. It may simply be that the increase in actual productivity in measured outputs (first component) is offset by the increase in opex required to deliver unmeasured outputs (second component).

87. CEPA appears to cast doubt on whether unmeasured outputs are driving the observed productivity decline since their impact is not evident in the growth of any particular opex category or sub-category (suggesting that there may instead be a general decline in productivity or broader exogenous cost pressures faced by EDBs).[44] However, we note that the effect of unmeasured outputs would not necessarily manifest as disproportionate growth of a particular opex category since:

    A. There are likely to be unmeasured outputs incurring both network and non-network opex. For example, of the categories we identify at 79 above, digitisation & IT may incur more non-network opex but network resilience is likely to incur network opex.

    B. Even the opex sub-categories are large buckets which are likely to include many different types of expenditure. For example, CEPA finds that non-network opex accounts for ~60% of total opex, and that business support accounts for ~60% of non-network opex.[45] It follows that business support accounts for ~36% of all opex. This does not allow for a granular analysis of the cost drivers that fall within the business support sub-category; it is entirely possible that unmeasured outputs are putting upwards pressure on business support costs, but EDBs are simultaneously finding offsetting efficiencies on other costs within this sub-category.

    C. Capex bias (which we discuss above at 59) may be causing unmeasured outputs to be addressed through capex wherever possible, avoiding the inflation of any single opex category. Though given opex growth has exceeded growth in the capital input, this unlikely to be the entire explanation.

44 CEPA report, March 2024, p.64.

45 CEPA report, March 2024, pp.62-63.

5. Implications for DPP4

88. The combination of declining measured productivity, returns below the regulatory WACC and expenditure in excess of allowances suggests that the most likely explanation for declining measured productivity is that EDBs have been delivering uncompensated outputs, which they would only do if they were valued by consumers.

89. If this is the case, then EDBs need to achieve efficiency gains to deliver all the outputs valued by consumers without being financially penalised for doing so. Put another way, the presence of uncompensated outputs in the allowance-setting process is essentially a form of productivity target.

90. Therefore, applying a further productivity target on top of this in the form of a positive opex PPF would essentially be a double counting and imposing a punitive productivity target.[46]

91. This conclusion is a function of the mechanistic allowance setting process used by the NZCC for setting opex, which is unlikely to be a complete specification of EDB's outputs, particularly as the role of EDBs is changing. If a more bottom-up approach to setting opex allowances was taken (as occurs under a CPP/IPP), the NZCC could have more confidence that a sufficient opex allowance is being provided and thus in applying a positive productivity target.

92. It is also possible that the declining measured productivity is explained by either/both:

    A. EDBs delivering outputs that are <u>not</u> valued by consumers despite being financially punished for doing so; and/or

    B. the allowance-setting process being a complete specification of the outputs that EDBs are delivering, and they have been less productive over time despite being financially punished for doing so.

93. Either of these explanations raise broader questions about the effectiveness of the regulatory framework and the incentives it places on EDBs to be efficient.

[46] If anything, there is evidence that a negative opex PPF would be justified.

NERA

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