evoenergy

Appendix 4.2: Competition Economists Group (CEG) Benchmarking Evoenergy’s productivity

Access Arrangement Information

ACT and Queanbeyan-Palerang gas network 2026–31

June 2025

Benchmarking EVO productivity

A report for Evoenergy

February 2025

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Evoenergy

CEG COMPETITION ECONOMISTS GROUP

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List of abbreviations

GDB	Gas Distribution Business
EVO	Evoenergy
Opex	Operating expenditure
TFP	Total Factor Productivity
MTFP	Multilateral TFP

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1 Executive Summary

1. Evoenergy (EVO) has asked CEG to perform an analysis of trends in absolute and relative productivity of EVO's operating expenditure (opex).

1.1 Approach

2. This report follows the methodology in CEG's 2004 report for JGN[1] used to assess relative productivity. This report uses additional data compared to CEG (2004) (data until 2024 for EVO and 2023 for other GDB's who responded to our information request and/or had publicly available information).

3. We conducted our analysis based on data from 8 Australian and 4 New Zealand GDBs.

4. We examine the relative opex productivity of EVO compared to other GDBs using productivity indices and partial performance indicators. A productivity index is a measure of how efficiently a firm uses opex and capital inputs to produce its outputs. We adopt two types of productivity indices, the Fisher index and the multilateral approach. The multilateral approach allows us to compare how a GDB uses its opex to produce its output over time in comparison to other GDBs. Whereas the Fisher approach allows us to examine how the efficiency has change over time but not relative to other GDBs.

5. We also examine opex per customer as a partial performance indicator while attempting to control for other factors determining cost. This allows us to make a comparison of opex per customer across GDB's with different characteristics. Additional factors that we attempt to control for include customer and energy density.

6. The data for the eight Australian GDBs were sourced from a commercial-in-confidence survey of GDBs. The detailed data surveys were sent to the major Australian GDBs, covering key output and input values, price and quantity information over the period from 1998 or 1999 to the latest year where data is available.

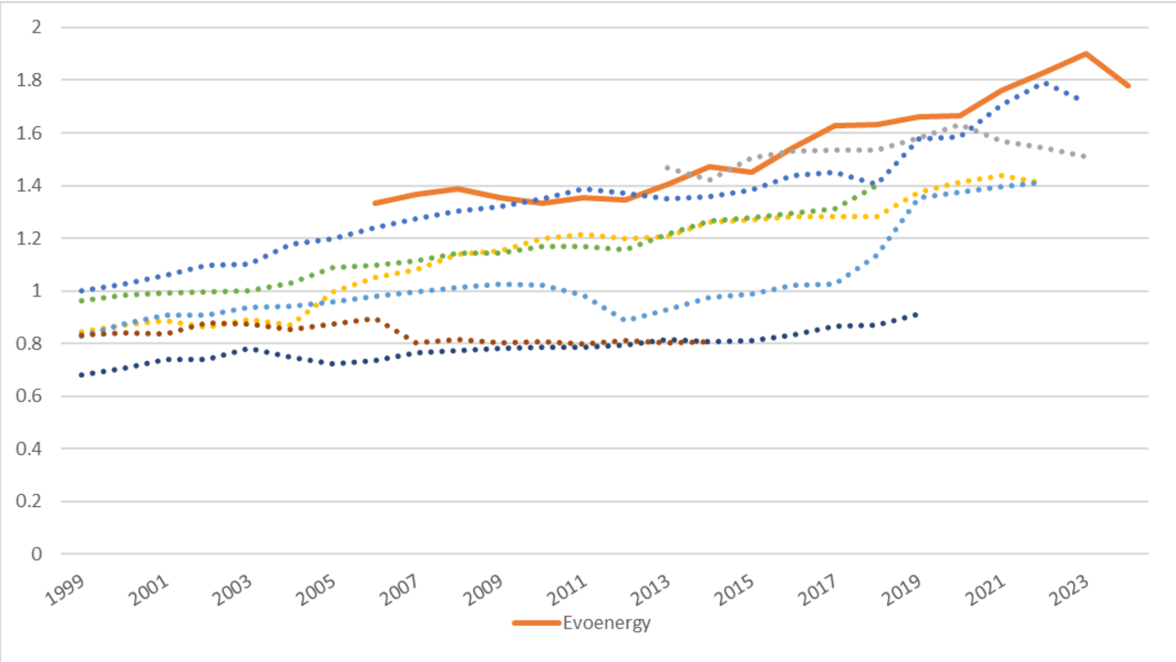
7. In the case of missing data from the survey, we relied on publicly available data from the Regulatory Information Notices (RINs) published by AER. For the New Zealand GDBs, data has been sourced from publicly available data published by the New Zealand Commerce Commission (NZCC) and from annual reports.

1.2 Results (efficiency of EVO base year opex)

8. Figure 1-1 below presents a time series of the Australian and New Zealand GDB Multilateral Total Factor Productivity (MTFP) index. This metric allows for a comparison across firms and across time. The solid orange line shows EVO's productivity measure, and the dotted lines show the productivity measure of other Australian and New Zealand GDBs.

[1] CEG, Benchmarking and forecasting JGN opex, a report for JGN, March 2024. Available here.

Figure 1-1: MTFP index

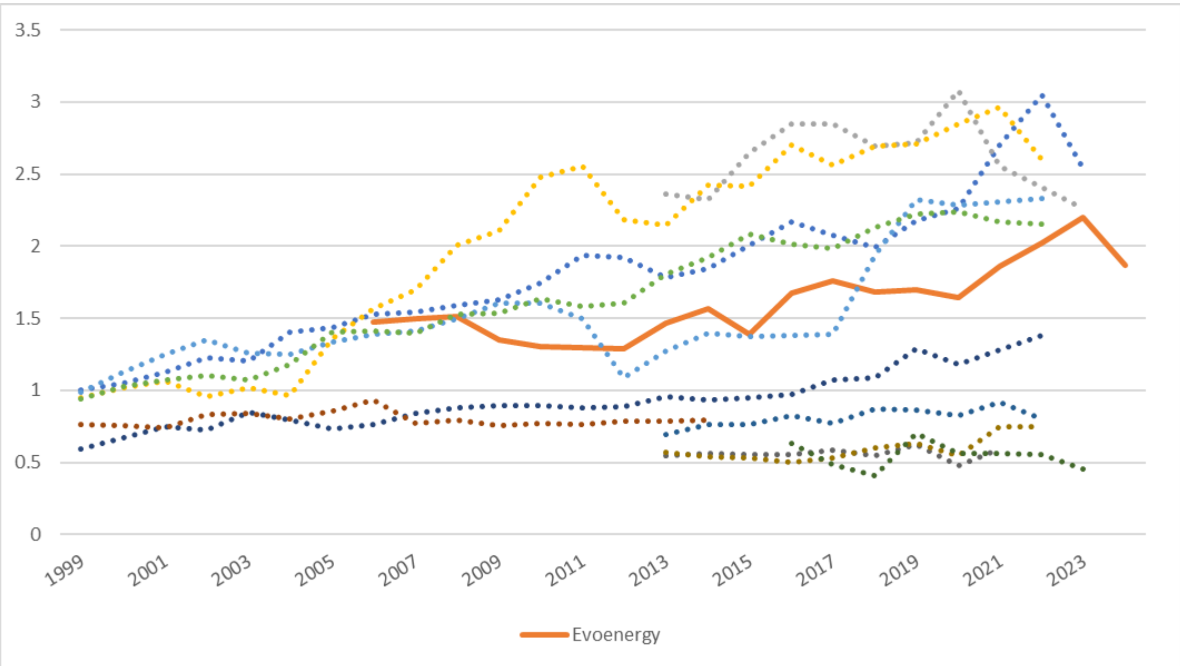


EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

9. This figure highlights that EVO's productivity consistently ranks at or near the top amongst all the GDBs.

10. Figure 1-2 below presents a time series of the Australian and New Zealand GDB Multilateral Opex Partial Factor Productivity (PFP) index. Compared to the MTFP, the Multilateral Opex PFP compares the efficiency in the use of opex only, rather than all inputs, across firms and across time.

Figure 1-2: Multilateral Opex PFP index

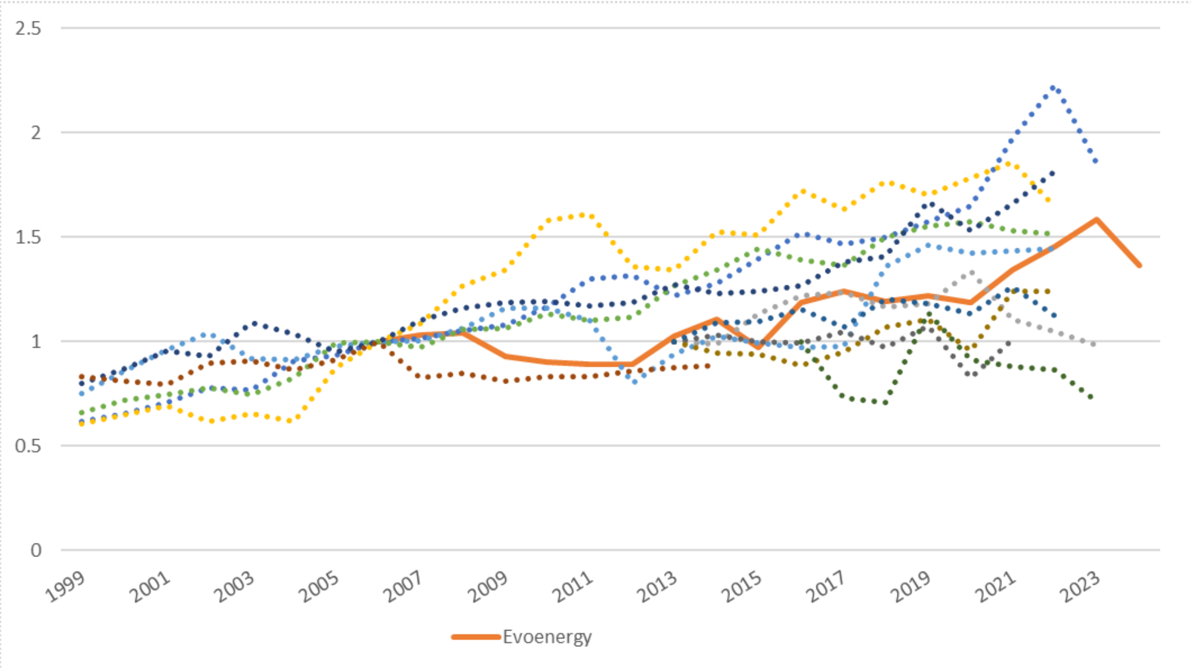


EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

11. This figure shows that EVO consistently ranks in the middle amongst all the GDBs. Even though EVO's productivity is at the average level compared to other GDBs for opex, it is the most efficient GDB for capital use. This is why EVO's overall efficiency is the highest, or second highest, compared to other Australian and New Zealand GDBs.

12. Figure 1-3 below shows the change in opex partial factor productivity (PFP) over time for each of the GDBs in Australia and New Zealand. The PFP index allows comparisons of productivity growth rates across firms but not of productivity levels (all firms have an index value of 1.0 in 2006). The solid orange line shows EVO's productivity measure, and the dotted lines show the productivity measure of other Australian and New Zealand GDBs. Figure 1-3 shows that EVO's opex productivity growth has been at the average level compared to other Australian and New Zealand GDBs.

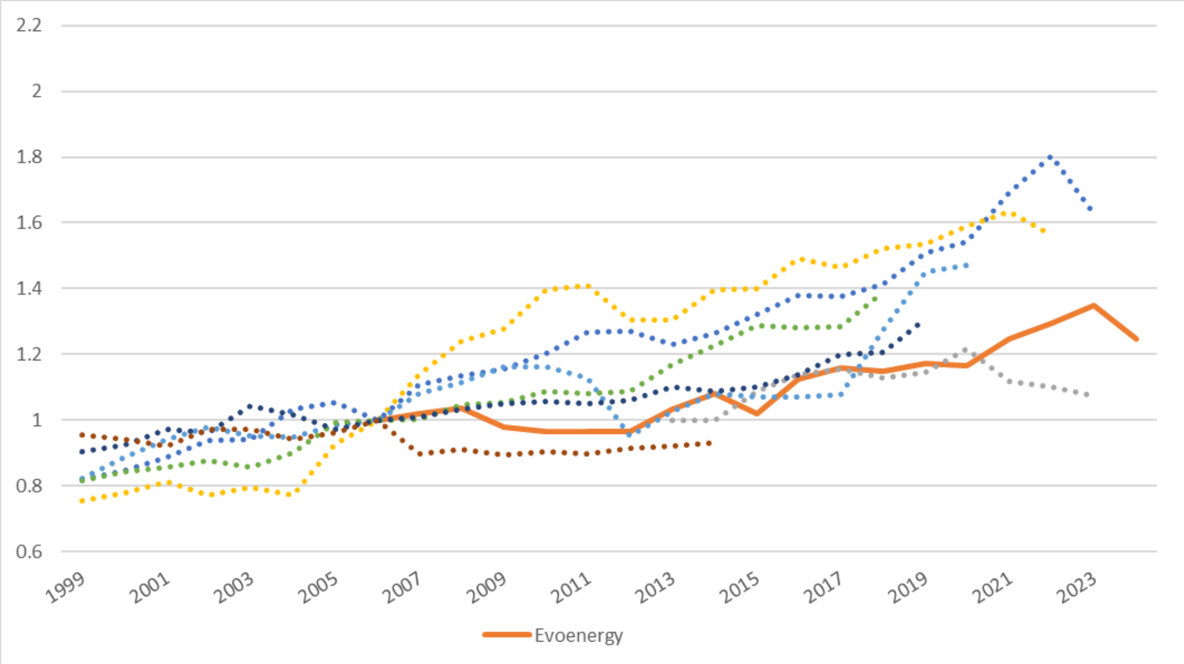
Figure 1-3: Opex partial factor productivity (PFP) index comparison



EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

13. Figure 1-4 shows the change in total factor productivity (TFP) at each GDBs. As with PFP, this index allows comparison of growth rates in productivity but not levels. Figure 1-4 shows relatively higher "catch up" growth in productivity in other GDBs. Notwithstanding the higher productivity growth rate since 2006 for other GDBs, EVO remains the most efficient GDB as demonstrated in Figure 1-1. That is, EVO's lower growth rate since 2006 is consistent with EVO being closer to the frontier efficiency in 2006 (with less scope for catch up growth).

Figure 1-4: Total factor productivity (TFP) index comparison



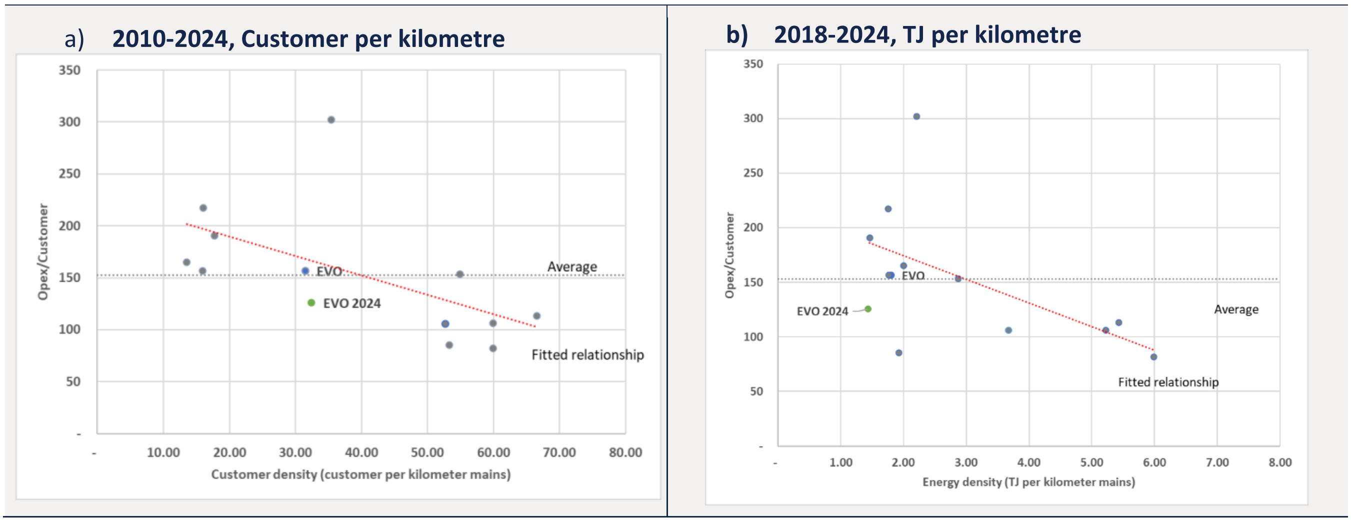
EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

14. The evidence outlined above supports a conclusion that EVO is operating efficiently.

15. Consistent with this, and as illustrated in Figure 1-5 below, EVO' opex per customer is below the average and predicted level when a simple comparison of opex to customer or energy density is made with the other Australian and New Zealand GDBs. This holds true whether the comparison is made over the period 2010 to 2018[2] or over the more recent period. Figure 1-5 plots opex per customer on the vertical axis and network density on the horizontal axis (either customer or energy density). In both cases, EVO's average opex per customer from 2010 and onwards and the opex per customer in 2024 are below the predicted level for a firm with EVO's network density.

[2] 2022 is chosen as the last year sample to due to data availability across of Australian and New Zealand GDBs.

Figure 1-5: Opex per customer (2022 AUD)



16. This outcome supports a conclusion that EVO's level of operating costs is efficient relative to average industry level. This conclusion is consistent with evidence from the analysis of EVO's MTFP and TFP indices.

2 Introduction

17. Evoenergy (EVO) has commissioned Competition Economists Group (CEG) to provide advice on the productivity and benchmarking of its gas distribution operations.

18. This report covers three areas of analysis

i. Partial Performance Indicators (PPI): This report presents partial indicator comparisons between a set of 8 Australian and 4 New Zealand gas distribution businesses (GDBs). These partial performance indicators are analogous to those published by the Australian Energy Regulator for electricity distribution businesses (AER 2014).[3] The indicators compare the opex cost per customer across GDBs.

ii. Productivity Indices: This analysis examines EVO's total factor productivity (TFP) and partial factor productivity (PFP) trends and compares against the productivity trends of other Australian GDBs over time. This part of the study also provides a comparative analysis of EVO's productivity levels against other Australian GDBs using multilateral TFP (MTFP).

19. This report has the following structure:

- Section 3 examines EVO's partial productivity measure compared to other Australian and New Zealand GDBs.
- Section 4 examines EVO's productivity index to compare the trend in productivity overtime and its relative efficiency compared to other Australian and New Zealand GDBs.
- Appendix A provides a list of the GDBs included in the study.
- Appendix B provides a discussion on the data used in this study.
- Appendix C discusses the methodology adopted in calculating the trend in opex productivity and comparison using productivity indices.

[3] AER 2014, "Electricity Distribution network service providers, Annual benchmarking report, November 2014

3 Partial productivity analysis

20. We begin by examining EVO's opex efficiency by comparing opex per customer across GDBs. Opex per customer is the most important criteria in evaluating the efficiency of GDBs. According to the AER:[4]

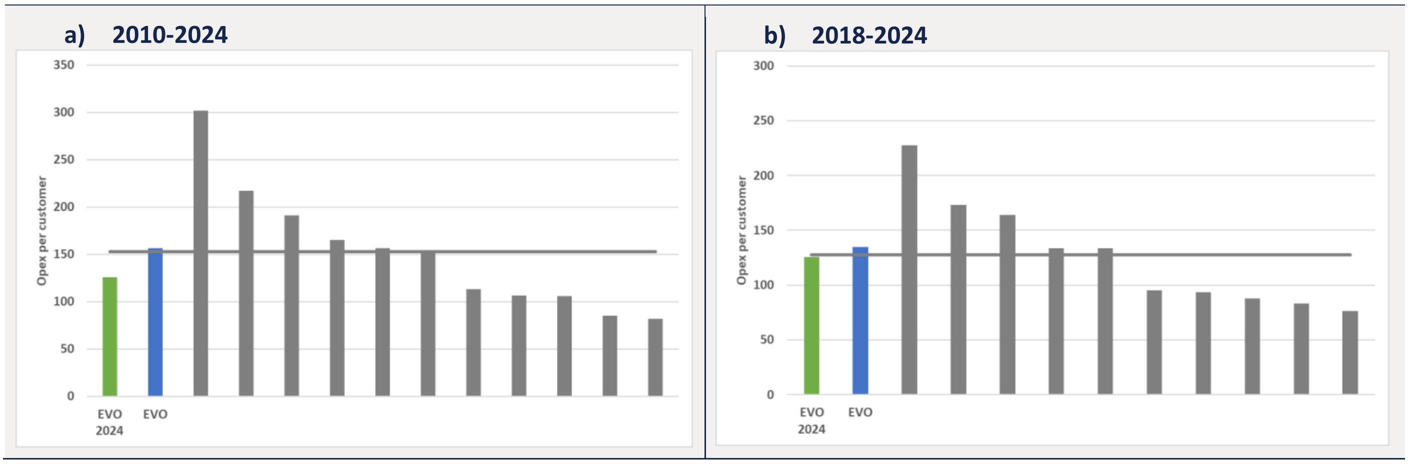
> *We consider that the most significant output of distributors is customer numbers. The number of customers on a distributor's network will drive the demand on that network. Also, the comparison of inputs per customer is an intuitive measure that reflects the relative efficiency of distributors.*

21. The measure of opex covers regulated distribution activities only and excludes all capital costs. It includes all operating costs allowed by the regulatory authorities, including directly employed labour costs, contracted services, materials and consumables, administration costs and overheads associated with operating and maintaining the distribution service. It excludes unaccounted for gas for all the GDBs as this is treated differently in Victoria compared to the other Australian States and excluding this item provides the best basis for like–with–like comparisons.[5]

22. The Australian GDBs opex cost data is first converted to nominal terms (where necessary) using the "All Groups Consumer Price Index" and the equivalent is done for New Zealand GDBs. The nominal series is then converted to real series in 2024 dollars using the same price index. The New Zealand GDBs opex data is converted to the 1999 base year using NZ CPI and then converted to Australian dollars using the FY1999 average monthly exchange rate data published by the Reserve Bank of Australia (RBA).[6] The Australian CPI index is used to express monetary values in 2024 Australian dollar.

23. The average opex per customer across Australian and New Zealand GDBs is illustrated by Figure 3-1 below – with EVO's average opex highlighted in blue (and green for 2024 opex). The result indicates that EVO's opex per customer is consistently near industry average (when compared between long run period (2010-2022)[7] and the shorter run period (2018-2022).

Figure 3-1: Actual opex per customer (2024 AUD)



4 AER 2014, "Electricity Distribution network service providers, Annual benchmarking report, November 2014 Page 23

5 Similar adjustments are adopted in EI 2019 report where *"unaccounted for gas allowances for non-Victorian GDBs have been excluded to put those GDBs on a comparable basis with Victorian reporting"* (EI 2019 page 88)

6 This approach is consistent with an assumption that, in the long run, exchange rates are driven by changes in the price level between countries.

7 2022 is chosen as the last year sample to due to data availability across of Australian and New Zealand GDBs.

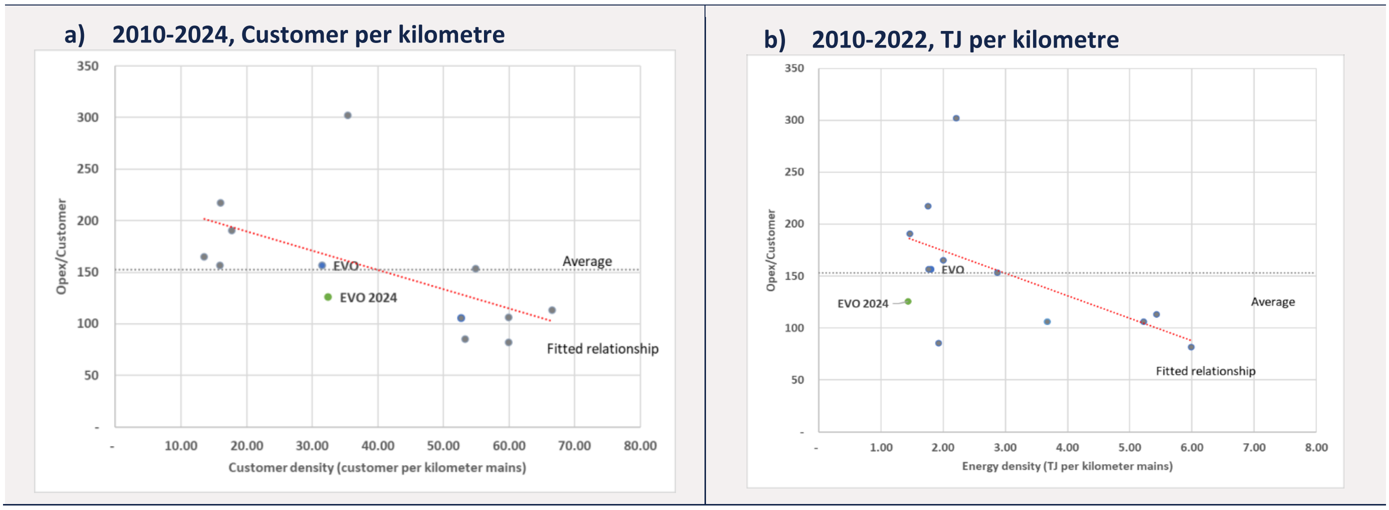
24. Opex per customer may vary with network characteristics such as the density of the network. Figure 3-2 below compares each GDB's opex per customer against their network density. Network density can be measured by either customer per kilometre or TJ per kilometre.

25. The grey line in Figure 3-2 shows the average opex per customer (this is the same horizontal line as is shown in Figure 3-1) and the red line shows the fitted relationship between opex per customer and network density (the horizontal axis). There is a decreasing relationship between opex per customer and density – with the GDB's that have the highest density tending to have the lowest opex per customer.

26. In Figure 3-2-a and Figure 3-2-b the blue dot is EVO's opex per customer and network density over the 2010 to 2024 period and is directly comparable to the dots for other GDBs. We also show a green dot for EVO which is the most recent year estimate.

27. EVO's opex per customer is at the average GDBs' opex per customer (grey line) and below the average opex per customer conditional on network density (red line). This indicates that even controlling for density, EVO has a below average opex per customer.

Figure 3-2: Opex per customer (2022 AUD)



28. In the most recent year (2024), EVO's opex per customer (green dot) has been below its average over 2010-24 and is below what would be expected after taking into consideration its higher customer density per kilometre in 2024 (see Figure 3-2 a). Also, if network density is measured in terms of TJ per kilometre, EVO's 2024 opex is also lower even when associated with lower network density (see Figure 3-2 b). The reduction in energy density may have occurred due to a reduction in consumption per customer. This may be due to gas appliances becoming more energy efficient or reduction in the number of home appliances that use gas (noting that the ACT Government has policies to encourage switching of appliances from gas to electric).[8]

[8] https://www.climatechoices.act.gov.au/energy/switching-from-gas

4 Productivity indices

29. This part of our report focuses on the total and partial factor productivity performance of EVO's gas distribution business for the period from 2005 to 2024. Measures of productivity indices are calculated using time series and multilateral indices. These are used to compare EVO's productivity growth rates and productivity levels, respectively, with those of other GDBs in Australia and New Zealand.

30. The index analysis (Section 4.1) involves forming indices of outputs and inputs using the Fisher index method. This index provides the best measures of the relative changes over time of inputs and outputs for each GDB. The analysis includes three outputs (throughput, customer numbers and system capacity) and eight inputs (opex, lengths of transmission pipelines, high pressure pipelines, medium pressure pipelines, low pressure pipelines, and services, meters and other capital).

31. This specification is consistent with the analogous electricity distribution output and input specification presented in AER (2013)[9] and annually updated by the AER. The time series productivity indices use the first year of data as the base–year for each individual GDB, and the analysis provides estimates of productivity growth over the period 1999 to 2024.

32. There are two types of indices, total factor productivity (TFP) and partial factor productivity (PFP). PFP is a partial measure of productivity in which the measure of output is compared against a subset of inputs. TFP measures the productivity of outputs against all inputs used in the production. While these measures are useful for understanding trends across time, they cannot simultaneously be used to compare productivity levels across time and between GDBs due to the violation of the statistical property of transitivity (see Appendix C.4 for a technical description).

33. We then extend this analysis by introducing the Multilateral TFP (or MTFP) index (in Section 4.2). Multilateral TFP is a method of measuring the TFP levels of all the GDBs in the sample using a common base and a more complex indexing method. This indexing method allows the TFP levels of different GDBs to be compared against each other.

34. The MTFP yields less precise measures of the change in productivity over time compared to the Fisher index method and is therefore only used for comparing TFP levels of GDBs in this report.

4.1 PFP and TFP trends

35. The purpose of a productivity index is to measure the relative ratio of an index of outputs compared to an index of inputs. Indices are constructed by aggregating prices or quantities of products that may be measured in different units and therefore cannot be aggregated based on a simple average.

36. Productivity is measured by expressing output as a ratio of inputs used. There are two types of productivity measures: total factor productivity (TFP) and partial factor productivity (PFP). TFP measures total output relative to an index of all inputs used. Output can be increased by using more inputs, making better use of the current level of inputs and by exploiting economies of scale. The TFP index measures the impact of all the factors affecting growth in output other than changes in input levels. PFP measures outputs relative a subset of inputs (e.g. labour productivity is the ratio of output to labour input).

37. PFP and TFP indices have a number of advantages including:

    i. indexing procedures are simple and robust.

[9] AER. 2013. "Better Regulation Explanatory Statement: Expenditure Forecast Assessment Guideline"

ii. they can be implemented when there are only a small number of observations.

iii. the results are readily reproducible.

iv. they have a rigorous grounding in economic theory.

v. the procedure imposes good disciplines regarding data consistency; and

vi. they maximise transparency in the early stages of analysis by making data errors and inconsistencies easier to spot than using some of the alternative econometric techniques.

38. The output and input indices are constructed using a formulation known as the Fisher ideal index. Similar to calculating the weighted average of outputs and inputs, one of the key benefits of the Fisher index is its ability to deal with changing weights over time. A detailed discussion of the Fisher index is contained in Appendix C.3.

39. The outputs produced by GDBs are defined in this study as:[10]

i. Customers: Connection dependent and customer service activities are proxied by the GDB's number of customers, and

ii. System capacity: The system capacity measure is the volume of gas held within a gas network converted to standard cubic meters using a pressure correction factor based on the average operating pressure.

iii. Throughput: The quantity of the GDB's throughput is measured by the number of TJs of gas supplied. It is the sum of energy supplied to all customer segments (e.g. residential, commercial and large industrial customers).

40. We've adopted the same output weights as CEG (2024) which followed EI report (2019) [11] (49% customers and 38% system capacity, 13% throughput). [12] Adoption of this weight is appropriate given the consistency in the use of this weight in the benchmarking of GDBs. The same weights were used in 2012 by Economic Insights in its report for Envestra Victoria, Multinet and SP Ausnet.[13] Economic Insights continued to use the same weights in its 2020 report for AGN SA.[14] The weights are constructed based on the share of each output's estimated costs in the total estimated costs for all GDBs over a period. In the case of fixed weights, where weights don't change over time, the Fisher formulation is equivalent to weighted average.

41. Figure 4-1 shows the trends in EVO's outputs over time and its output index, it shows the number of customers (dashed grey), and system capacity (dashed yellow) has increased for EVO, but a reduction in the amount of gas (dashed red) delivered over time. The weighted average of the outputs is summarised by the output index shown in solid blue.

[10] Details on the outputs are in Appendix C.1.5Appendix C.1

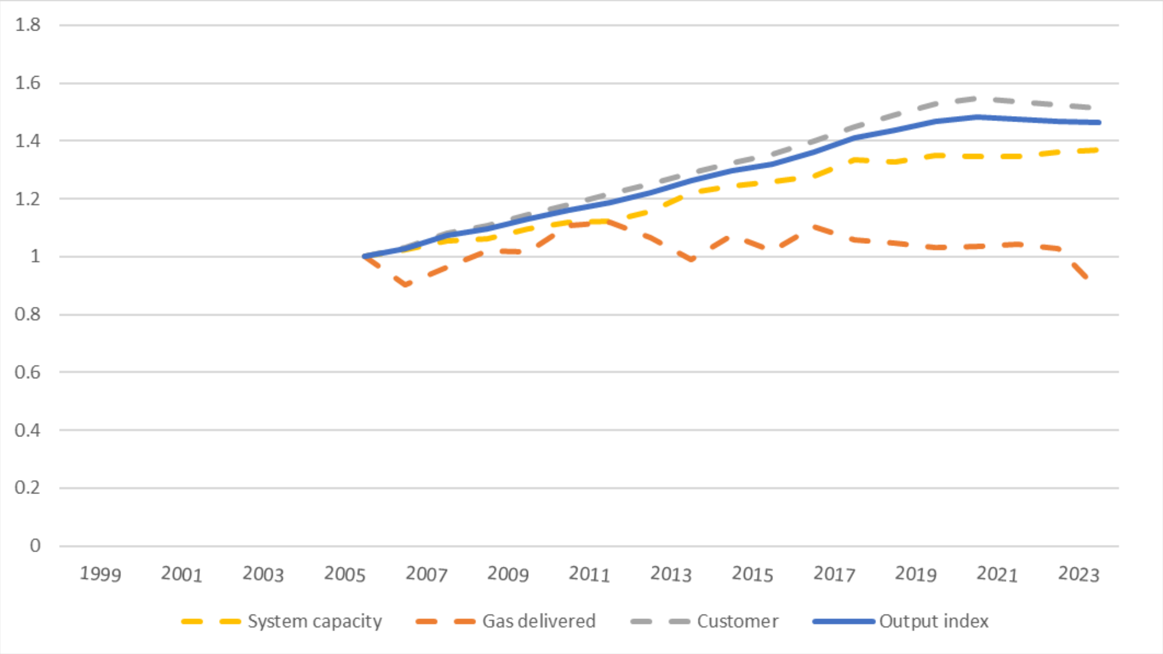
[11] EI report (2019), Relative Efficiency and Forecast Productivity Growth of Jemena Gas Networks (NSW), 24 April 2019

[12] See page 38 in EI report (2019), Relative Efficiency and Forecast Productivity Growth of Jemena Gas Networks (NSW), 24 April 2019

[13] EI Report (2012), The total Factor Productivity Performance of Victoria's Gas Distribution Industry, 26 March 2012

[14] EI Report (2020), The Productivity Performance of Australian Gas Networks' South Australian Gas Distribution System, 15 June 2020

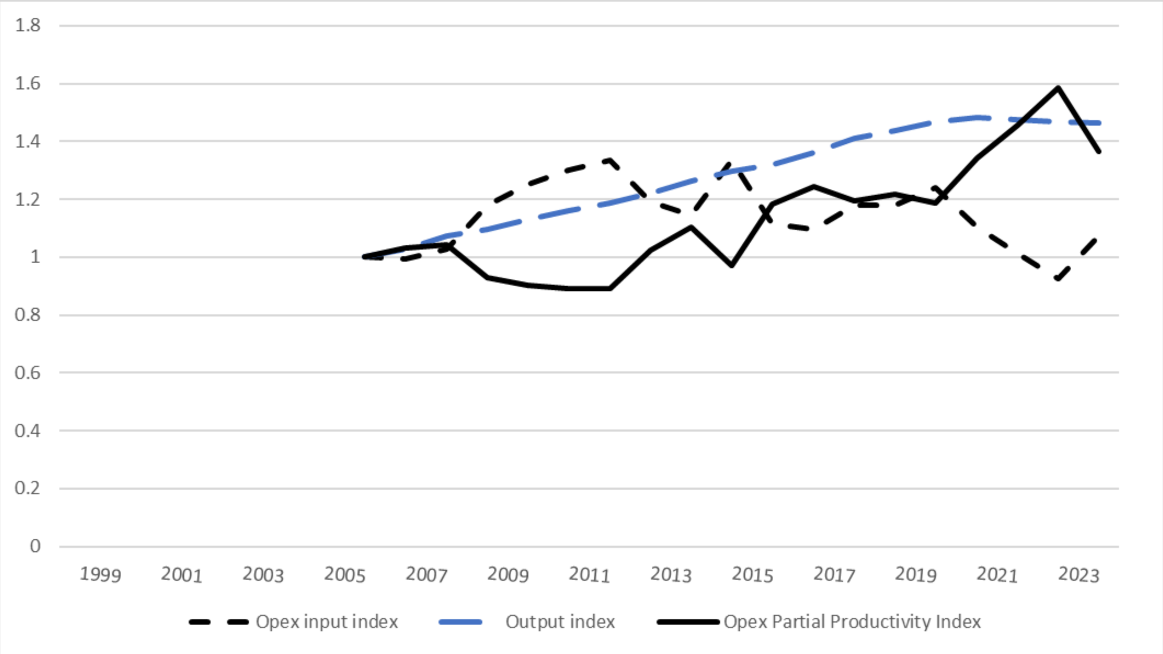
Figure 4-1: Trend in EVO outputs



EVO data from 2006 to 2024.

42. Figure 4-2 shows the growth in real opex and real outputs. When the output index is divided by the opex input index, it shows the trend of opex partial productivity over time. Opex PFP has increased materially over time due to the increase in output and similar levels of opex over time.

Figure 4-2: EVO opex productivity index



EVO data from 2006 to 2024.

43. EVO's 2024 output per dollar of opex is approximately 1.4 times the base level measured in 2006. This is due to EVO:

i. Increasing its real operating expenditure by 7% between 2006 and 2024; while

   ii. delivering a 46% increase in outputs over the same period

44. We now turn our analysis to TFP calculations that take account of both opex and capital inputs used by GDBs. The relevant inputs that we consider in our analysis include:[15]

   i. Opex: The quantity of the GDB's opex is derived by deflating the value of opex by the opex price deflator.

      i. Australian opex cost data are converted to real values using 62% weight on Electricity, water and gas wage price index and 38% weight evenly divided between Domestic Materials; Data processing, web hosting and electronic information storage services; Legal and accounting services; Market research and statistical services; and Other administrative services.[16]

      ii. Similar New Zealand indices are used for New Zealand GDBs' opex. The costs are converted to the FY1999 base year so that the New Zealand data are then converted to Australian dollars using the FY1999 average monthly exchange rate data published by the RBA. Then the Australian index is used to express monetary values in 2024 Australian dollar.

   ii. Capital:

      i. Transmission network: The quantity of transmission network for each GDB is proxied by its transmission pipeline length.

      ii. High pressure network: The quantity of each GDB's high pressure network is proxied by its high-pressure pipeline length.

      iii. Medium pressure network: The quantity of each GDB's medium pressure network is proxied by its medium pressure pipeline length.

      iv. Low pressure network: The quantity of each GDB's low pressure network is proxied by its low-pressure pipeline length.

      v. Services network: The quantity of each GDB's services network is proxied by its estimated services pipeline length.

      vi. Meters: The quantity of each GDB's meter stock is proxied by its total number of meters.

      vii. Other assets: The quantity of other capital inputs is proxied by their deflated asset value. The assets are deflated using the CPI.

45. Each capital input is weighted based on the relative contribution of their asset value in the aggregate value of the regulatory asset base (RAB).

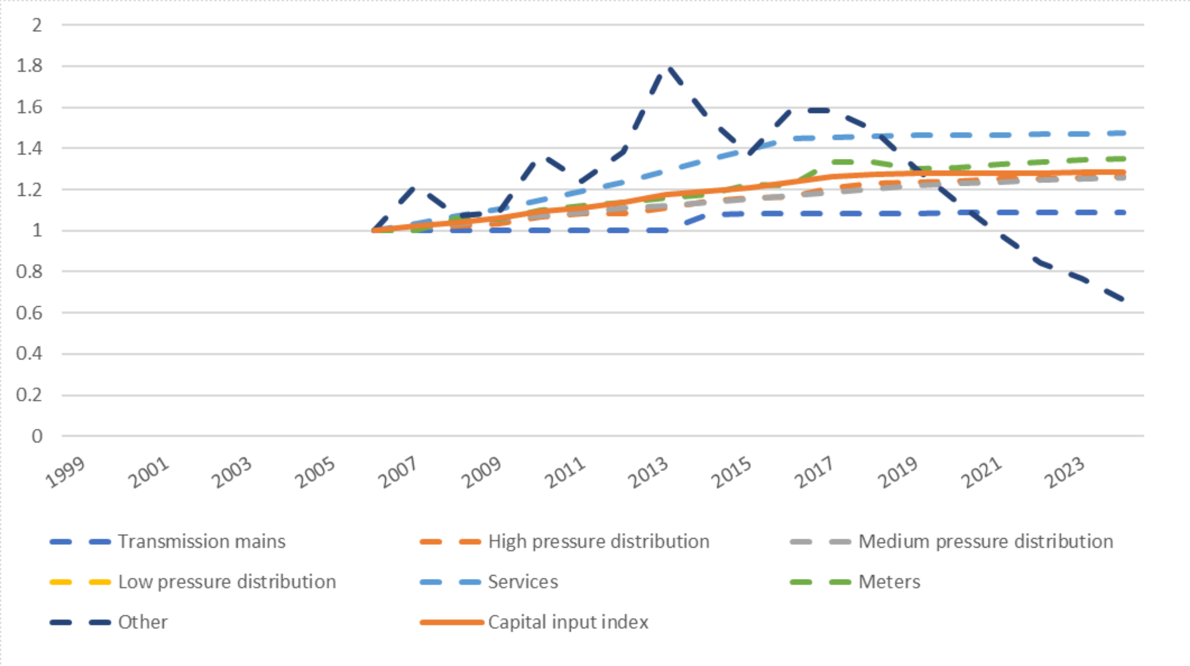
46. The trend of each capital input is shown in Figure 4-3 as the dashed lines. The weighted average, calculated using the Fisher index, is shown in the solid orange line.[17]

[15] Details on the inputs are in Appendix C.2.

[16] The weights are consistent with EI report (2019). See page 39 in EI report (2019), Relative Efficiency and Forecast Productivity Growth of Jemena Gas Networks (NSW), 24 April 2019

[17] Due to change in weights over time, the Fisher index differ from a simple weighted average.

Figure 4-3: EVO capital inputs

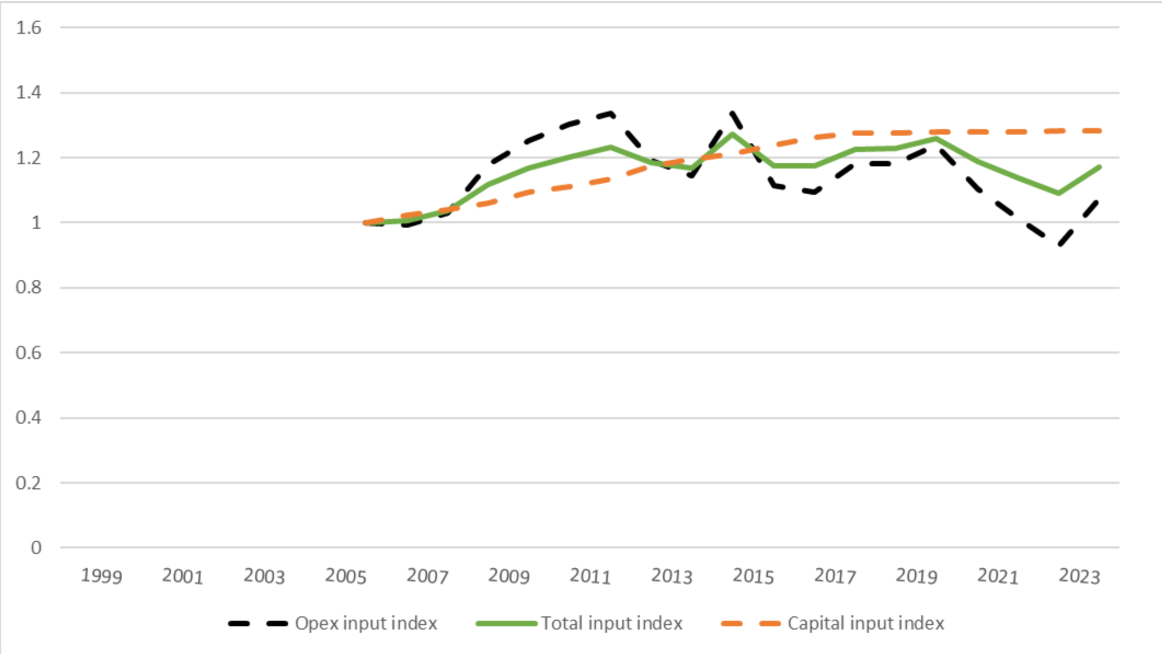


EVO data from 2006 to 2024.

47. The capital inputs are combined with opex to form the aggregate input index. The weighting used to combine opex and capital inputs is based on the relative contribution to the cost of capital and opex. Cost of capital is proxied using the difference between revenue and opex. We adopted this approach based on historical precedents.[18] The input indices are shown in Figure 4-4, which shows that, while capital inputs have increased slightly over time, opex has remained similar over the same time period. The net result is a small increase in total input used.

[18] See page 36 in EI report (2019), Relative Efficiency and Forecast Productivity Growth of Jemena Gas Networks (NSW), 24 April 2019

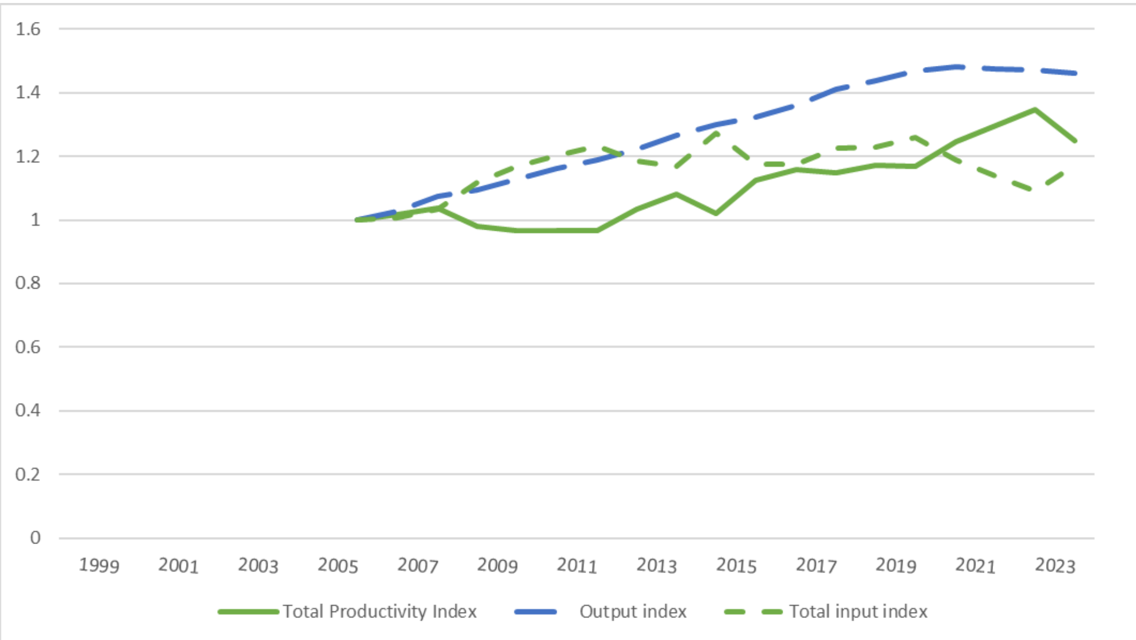
Figure 4-4: EVO input index



EVO data from 2006 to 2024.

48. The ratio of the output index and aggregate input index gives the TFP index. This is shown in Figure 4-5 below which highlights that output has increased at a higher rate than inputs over the same period. As a result, EVO has experienced an increase in TFP of 1.25 over time. That is, EVO is 25% more efficient in 2024 than in 2006 (produces 25% more output per unit of input).

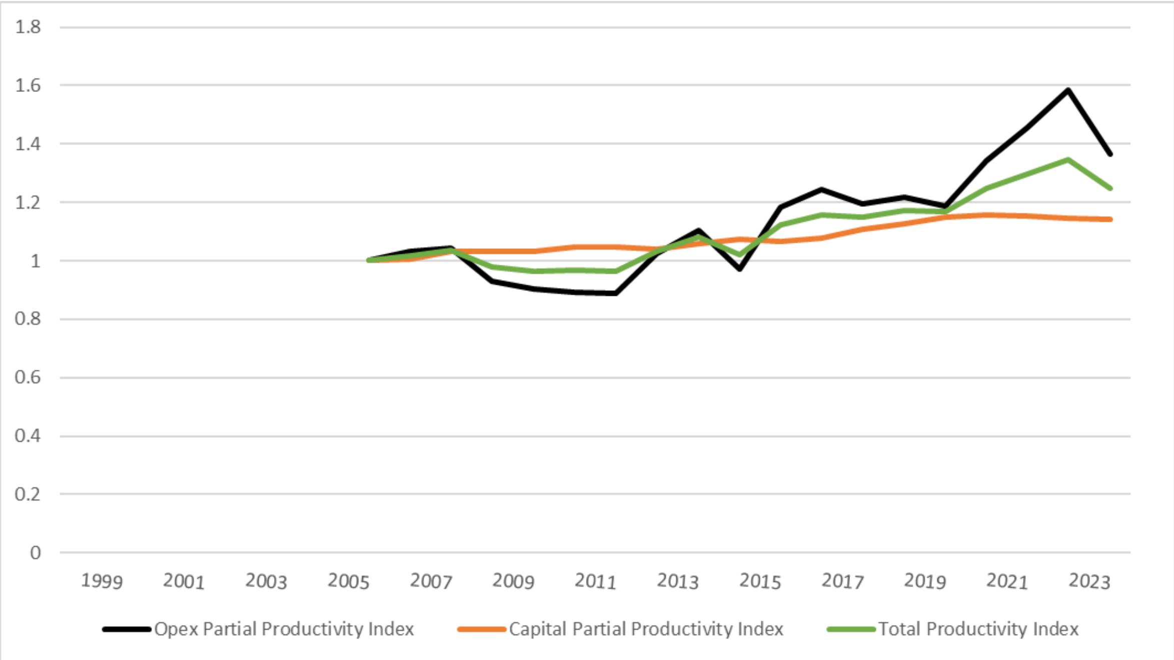
Figure 4-5: EVO TFP index



EVO data from 2006 to 2024.

49. Figure 4-6 shows all three of EVO's productivity indices: opex, capital and total productivity. It shows an increase in productivity across opex and capital inputs.

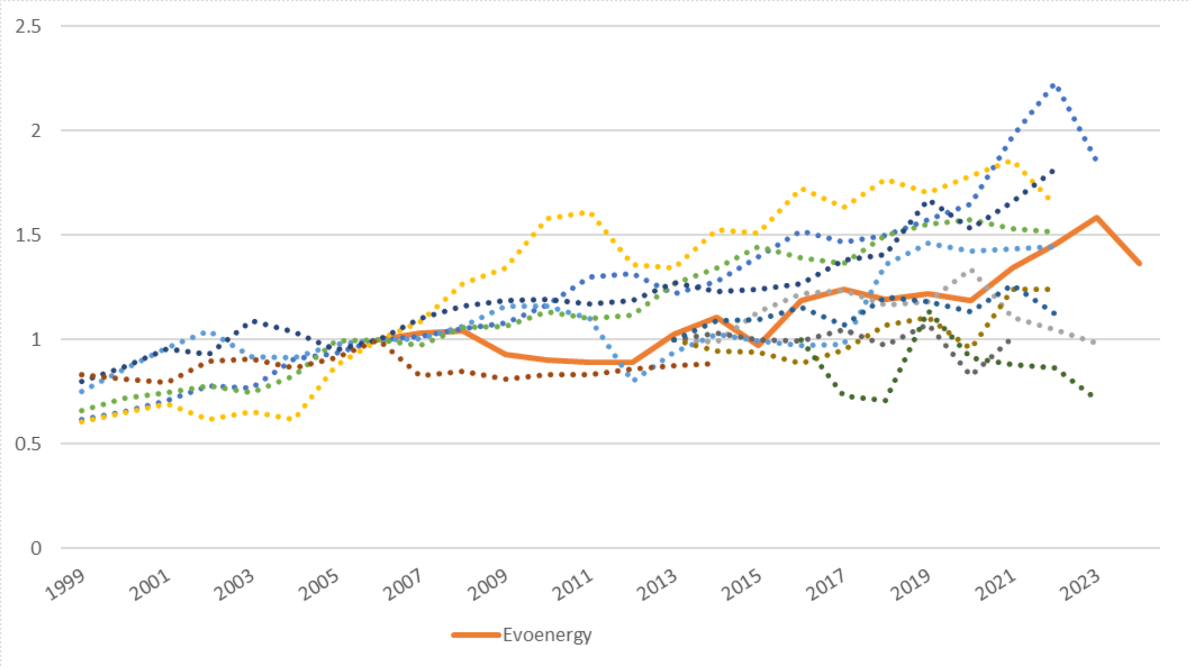
Figure 4-6: EVO TFP and PFPs



EVO data from 2006 to 2024.

50. Figure 4-7 compares opex PFP trends across GDBs. It can be seen that EVO's productivity growth is near the median with 5 out of the other 10 Australian and New Zealand GDBs having achieved higher productivity growth over the period. It should be noted that the index only determines the change in efficiency over time and does not compare productivity across firms. This is because, all GDBs, are normalised to 1 in 2006. In other words, the absolute level of the lines in Figure 4-7 does not describe relative productivity – only the change in productivity since 2006.

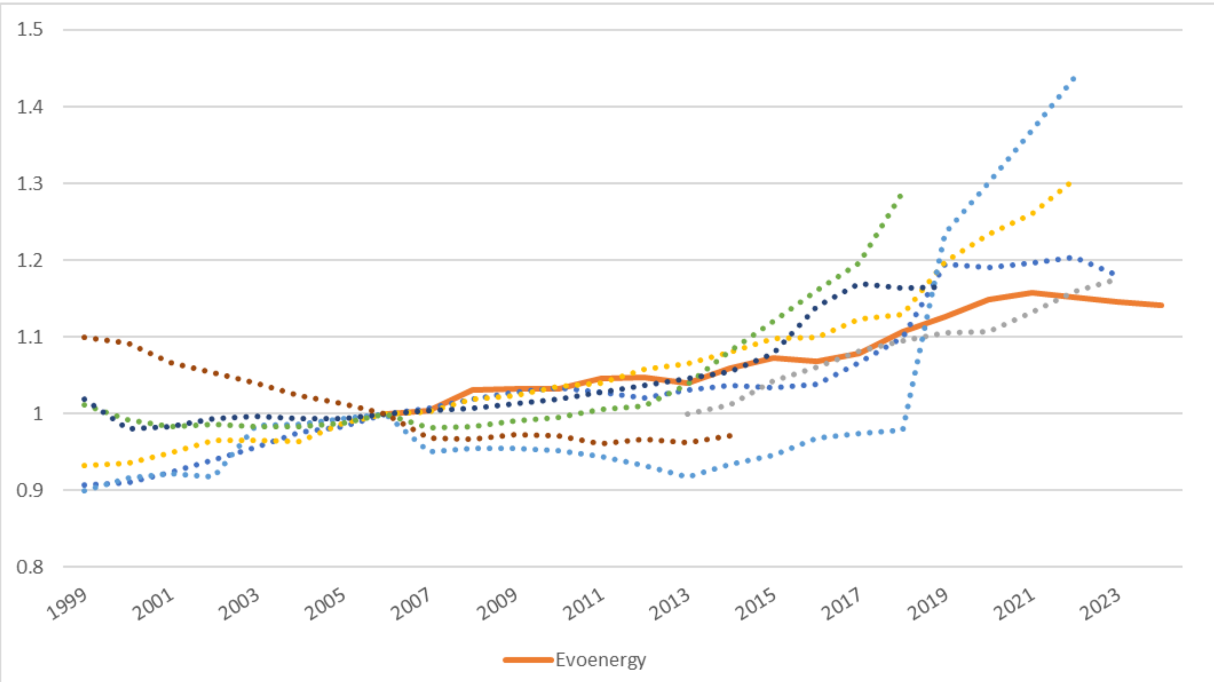
Figure 4-7: Opex partial productivity index comparison



EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

51. EVO's partial capital productivity has also increased at a similar rate to other GDBs. Like Figure 4-7, the index only determines the change in efficiency over time and does not compare productivity across firms (because all GDBs, are normalised to 1 in 2006).

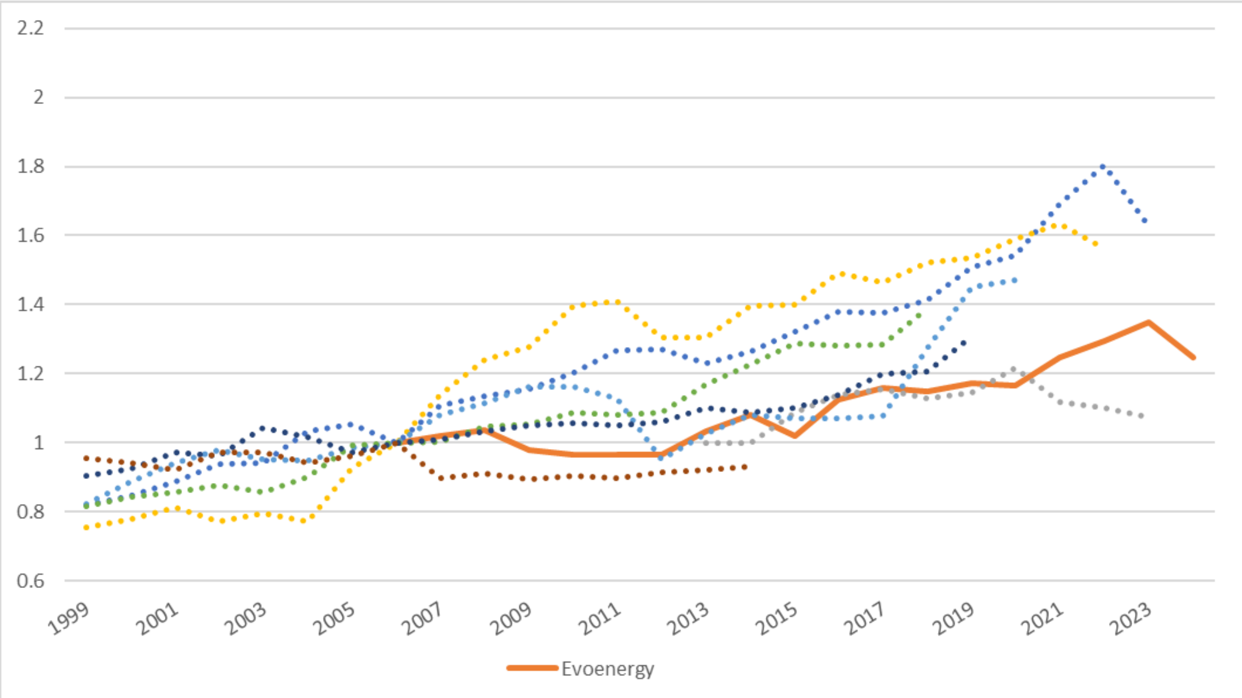
Figure 4-8: Capital partial productivity index comparison



EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

52. Figure 4-9 below shows EVO's total factor productivity growth since 2006 and compares it against the growth of other GDBs. Like the previous two figures, the index only determines the change in efficiency over time and does not compare productivity across firms (because all GDBs are normalised to 1 in 2006).

Figure 4-9: Total factor productivity index comparison



EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

4.2 Multilateral productivity index

53. This section presents the productivity index calculated based on the multilateral translog TFP (MTFP) index methodology. Traditional productivity index measures allow a comparison of productivity either across time or across firms. However, they are not useful in determining relative productivity differences across both time and firms due to the inability to satisfy the transitivity requirement.

54. An example of transitivity is if A is twice as efficient as B and B is twice as efficient as C, then A ought to be four times as efficient as C. Traditional productivity index measures maintain transitivity when comparisons are made either across time or across firm, but not when comparisons are made across time and firms.

55. To address this limitation of traditional productivity indices, Caves, Christensen and Diewert (1982) developed the MTFP index which satisfies the requirement of transitivity when comparisons are made across time and firms. The trade-off is that this methodology imposes assumptions on the data and, therefore, an element of scepticism is appropriate when comparing efficiency across firms and across time. Details on the methodology are in Appendix C.4.

56. We have applied the MTFP methodology to produce 3 indices which can be compared across time and GDBs, which include the:

i. Multilateral Opex PFP index,

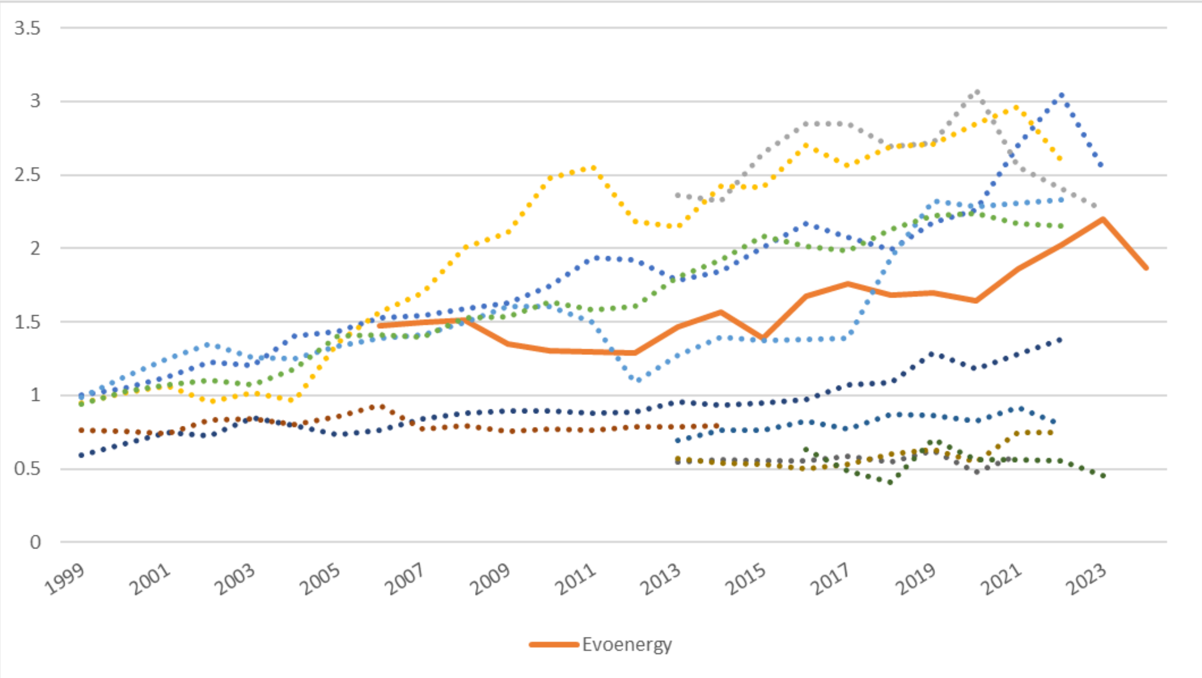
ii. Multilateral Capital PFP index, and

iii. MTFP index

57. These differ in the same ways as the non-multilateral versions of each index (i.e., being derived from an opex or capital index or both).

58. Figure 4-10 shows EVO's opex partial productivity compared across time and compared to other Australian and New Zealand GDBs. The result shows EVO consistently ranks in the middle amongst all the GDBs.

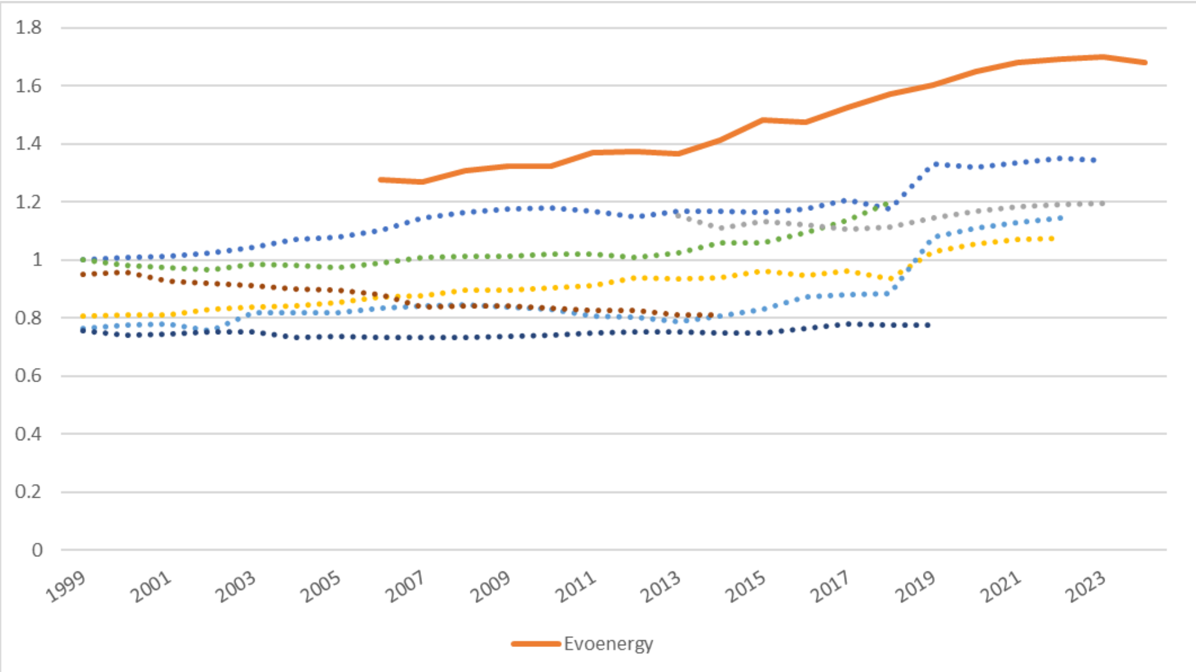
Figure 4-10: Multilateral Opex PFP index



EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

59. Figure 4-11 compares EVO's capital productivity against Australian GDBs. This figure shows that EVO is ranked at the top Australian GDBs consistently over time.

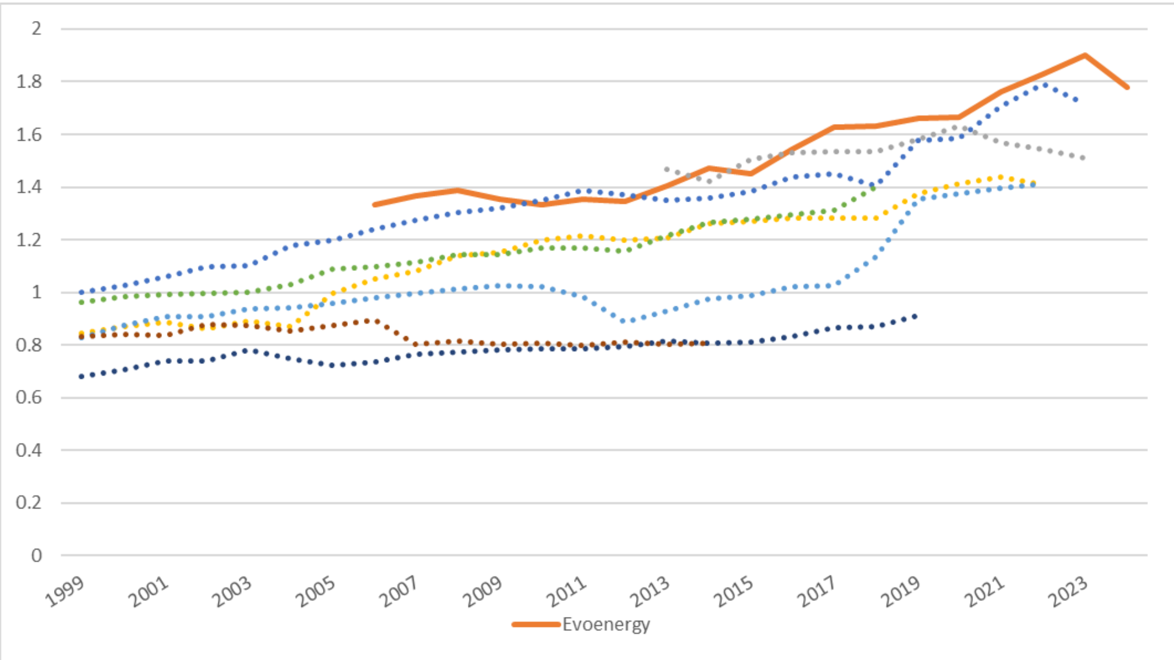
Figure 4-11: Multilateral Capital PFP index



EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

60. Figure 4-12 compares EVO's total productivity against Australian GDBs. It can be seen that on this measure, EVO is the most efficient firm since 2016.

Figure 4-12: Multilateral total factor productivity index



EVO data from 2006 to 2024. Comparison made against Australian and New Zealand GDBs where data is available. Series only reports to 2023, so GDBs that provided 2024 data cannot be identified.

5 Conclusion

61. Partial productivity analysis suggests that EVO has lower than average opex per customer compared to other GDB's in general and, especially when adjusted for differences in network density.

62. Our analysis on the Multilateral Opex PFP, Multilateral Capital PFP and MTFP indices suggest that EVO ranks as the most efficient GDB when examined from the perspective of total factor productivity and has average Multilateral Opex Partial Factor Productivity (PFP) index. EVO has had roughly average growth in opex partial factor productivity since 2006.

63. This evidence outlined supports a conclusion that EVO is operating efficiently.

Appendix A List of GDBs included in this study

64. The Australian and New Zealand GDBs included in this study are

i. AGN Queensland

ii. AGN South Australia

iii. AGN Victoria

iv. ATCO

v. AusNet

vi. Evoenergy

vii. First Gas

viii. GasNet

ix. JGN

x. Multinet

xi. Powerco

xii. Vector

Appendix B Data

65. The analysis of the opex partial performance indicator section of the report uses a dataset that includes 12 GDBs, including 8 Australian and 4 New Zealand GDBs. The data for the eight Australian GDBs (AusNet, AGN QLD, AGN SA, AGN Vic, Evoenergy, ATCO, JGN and Multinet) is sourced from survey data obtained for this study and publicly available Regulatory Information Notices (RINs) published by AER. For the New Zealand GDBs included in this study, data has been sourced from publicly available data published by the New Zealand Commerce Commission (NZCC) and from annual reports.

66. Data used includes throughput, customer numbers, tariff V customers, pipeline characteristics, opex, capex and regulatory asset value.

67. The detailed data surveys carried out for the major Australian GDBs followed a common format, covering key output and input value, price and quantity information over the period from 1998 or 1999 to the latest year available (either 2022 or 2023). In cases where we were not provided data from the survey, data from the AER RINs have been used to supplement the missing observations in a manner that is consistent with the survey.

68. While every effort has been made to make the supplement of the missing observations with the RINs, the limitations of currently available public domain data need to be recognised. Data coverage of some of the business environment variables is less complete. In a few cases missing observations were estimated based on growth rates for the variable or a related variable before and after the missing year. Interpolation or extrapolation are used where necessary. While every effort has been made to make the publicly available data used in this study as consistent as possible, the limitations of currently available public domain data need to be recognised.

69. In a number of cases adjustments were made to ensure the data related to comparable activities and measures (e.g. unaccounted for gas allowances for non-Victorian GDBs have been excluded to put GDBs on a comparable basis with Victorian reporting). The data used for the Australian GDBs cover only the regulated (or previously regulated) activities. Data relating to large industrial users whose supply is not regulated are not included.

70. The measure of opex covers regulated distribution activities only and excludes all capital costs. It includes all non–capital costs allowed by the regulatory authorities, including directly employed labour costs, contracted services, materials and consumables, administration costs and overheads associated with operating and maintaining the distribution service. It excludes unaccounted for gas for all the GDBs as this is treated differently in Victoria compared to the other Australian States and excluding this item provides the best basis for like–with–like comparisons.

Appendix C Methodology for productivity index

71. Productivity is a measure of the physical output produced from the use of a given quantity of inputs. All enterprises use a range of inputs including labour, capital, land, fuel, materials and services. If the enterprise is not using its inputs as efficiently as possible then there is scope to lower costs through productivity improvements. This may come about through the use of better-quality inputs including a better trained workforce, adoption of technological advances, removal of restrictive work practices and other forms of waste, and better management through a more efficient organisational and institutional structure. When there is scope to improve productivity, this implies there is technical inefficiency, but this is not the only source of economic inefficiency. For example, when a different mix of inputs can produce the same output more cheaply, given the prevailing set of inputs prices, there is allocative inefficiency.

72. Productivity is measured by expressing output as a ratio of inputs used. There are two types of productivity measures: total factor productivity (TFP) and partial factor productivity (PFP). TFP measures total output relative to an index of all inputs used. Output can be increased by using more inputs, making better use of the current level of inputs and by exploiting economies of scale. The TFP index measures the impact of all the factors affecting growth in output other than changes in input levels. PFP measures one or more outputs relative to one particular input (e.g. labour productivity is the ratio of output to labour input). Total factor productivity is measured by the ratio of an index of all outputs (Q) to an index of all inputs (I):

$$TFP = Q/I$$

73. The rate of change in TFP between two periods is measured by:

$$\%T\dot{F}P = \%\dot{Q} - \%\dot{I}$$

where a dot above a variable represents the change of the variable over time.

74. To measure productivity performance, data on the price and quantity of each output and input is required as well as data on key operating environment conditions. The study requires quantity data because productivity is essentially a weighted average of the change in output quantities divided by a weighted average of the change in input quantities. Although the weights are complex and vary depending on the technique used, for outputs they are derived from the share of each output in total revenue or, alternatively, from output cost shares and for inputs from the share of each input in total costs. To derive the revenue and cost shares the value of each output and input is required, i.e. the input (or output) price times its quantity. Hence, both the price and quantity of each output and input or, alternatively, their values and quantities, or their values and prices is required. To derive output cost shares additional information on how cost drivers link to output components should be obtained. This is usually derived from estimation of econometric cost functions.

Appendix C.1 Output

75. The outputs produced by GDBs are defined in this study as:

i. Customers: Connection dependent and customer service activities are proxied by the GDB's number of customers.

ii. System capacity: The system capacity measure is the volume of gas held within a gas network converted to standard cubic meters using a pressure correction factor based on the average operating pressure. The volume of the distribution network is calculated based on pipeline length data for high, medium and low distribution pipelines and estimates of the average diameter of each of these pipeline types, which differ between networks. The quantity of gas contained in the system is a function of operating pressure. Thus, a conversion to an equivalent measure using a pressure correction factor is necessary to allow for networks' different operating pressures.[19]

iii. Throughput: The quantity of the GDB's throughput is measured by the number of terajoules of gas supplied. It is the sum of energy supplied to all customer segments: residential, commercial and large industrial customers.

76. To aggregate a diverse range of outputs into an aggregate output index using indexing procedures, weights need to be allocated to each of the three outputs. We adopt the same weighting as EI report (2019)[20] which is throughput of 13 per cent, for customers of 49 per cent and for system capacity of 38 per cent. The same weighting has been adopted since 2012 by Economic Insights in its report for Envestra Victoria, Multinet and SP Ausnet.[21] The same weights are used as recently in Economic Insights' report for AGN SA in 2020[22] and Quantonomics' report for ATCO in 2023.[23]

Appendix C.2 Inputs

77. The inputs used by GDBs are defined in this report as:

i. Opex: The quantity of the GDB's opex is derived by deflating the value of opex by the opex price deflator. As noted above, the opex values supplied by the GDBs were consistent with the GDBs' Regulatory Accounts but the focus has been on ensuring data reflects actual year–to–year operations. A number of accounting adjustments such as allowance for provisions have been excluded as they do not reflect the actual inputs used by the businesses in a particular year which is what is needed for TFP purposes.

To ensure consistency across GDBs, a number of adjustments have been made to the functional coverage of opex to ensure more like–with–like comparisons between GDBs. Government levies and unaccounted for gas are excluded from opex for all GDBs. Carbon costs are excluded where separately identified.

Australian opex cost data are converted to real values using 62% weight on Electricity, water and gas wage price index and 38% weight evenly divided between Domestic Materials; Data processing, web hosting and electronic information storage services; Legal and accounting services; Market research and statistical services; and Other administrative services.[24]

Similar New Zealand indices are used for New Zealand GDBs' opex. The costs are converted to the FY1999 base year so that the New Zealand data are then converted to Australian dollars using the FY1999 average monthly exchange rate data published by the RBA. Then the Australian index is used to express monetary values in 2022 Australian dollar.

ii. Transmission network: The quantity of transmission network for each GDB is proxied by its transmission pipeline length.

[19] For Ausnet, Multinet ang AGN SA, distribution pipeline data is not provided. Therefore, we adopt Victorian GDBs average pressure for high, medium and low-pressure pipelines. See page 19 in EI (2012) "The total Factor Productivity Performance of Victoria's Gas Distribution Industry" 26 March 2012

[20] See page 38 in EI report (2019)

[21] EI Report (2012), The total Factor Productivity Performance of Victoria's Gas Distribution Industry, 26 March 2012

[22] EI Report (2020), The Productivity Performance of Australian Gas Networks' South Australian Gas Distribution System, 15 June 2020

[23] Quantonomics (2023), Benchmarking Study of the Western Australian gas distribution system. 10 May 2023

[24] The weights are consistent with EI report (2019). See page 39 in EI report (2019)

iii. High pressure network: The quantity of each GDB's high pressure network is proxied by its high-pressure pipeline length.

iv. Medium pressure network: The quantity of each GDB's medium pressure network is proxied by its medium pressure pipeline length.

v. Low pressure network: The quantity of each GDB's low pressure network is proxied by its low-pressure pipeline length.

vi. Services network: The quantity of each GDB's services network is proxied by its estimated services pipeline length.

vii. Meters: The quantity of each GDB's meter stock is proxied by its total number of meters.

viii. Other assets: The quantity of other capital inputs is proxied by their deflated asset value. Other capital comprises city gate stations, cathodic protection, supply regulators and valve stations, SCADA and other remote control, other IT and other non–IT.

78. The starting point for asset values for each GDB is based on the regulatory asset base (RAB) valuation in an initial year (1997, 1998 to 1999) for 12 asset categories. Asset life and remaining asset life estimates were provided for each GDB for each of the asset categories, as well as estimated asset lives for capex using the same asset categories. Disaggregated constant price depreciated capital stock estimates are formed by rolling forward the opening asset values by taking away straight–line depreciation based on remaining asset life of the opening capital stock and adding in yearly constant price capital expenditure and subtracting yearly constant price depreciation on capital expenditure for each year calculated using straight line depreciation based on asset–specific asset lives.

79. The input weight given to opex is simply the ratio of opex to total revenue. The aggregate capital input weight is simply given by one minus the opex share. It is then necessary to divide this overall capital share among the seven capital asset inputs. This is done using the share of each of the seven asset categories' asset values in the total asset value for that year.

Appendix C.3 Total factor Productivity

80. Index numbers are a quantitative method developed in economics for aggregating prices or quantities of products that may be measured in different units and hence cannot be aggregated by summation or simple averages. Index numbers normally measure relativities, such as changes from one period to another or comparisons between other situations, such as comparisons between localities or groups of consumers.

81. To operationalise TFP measurement the method needs to combine changes in diverse outputs and inputs into measures of changes in total outputs and total inputs. That is, it is necessary to develop an index for all the outputs produced by a business and another for all the inputs used by the business. The four most popular index formulations are:

i. the Laspeyres base period weight index.

ii. the Paasche current period weight index.

iii. the Fisher ideal index which is the square root of the product of the Paasche and Laspeyres index; and

iv. the Törnqvist index.

82. We adopt EI report (2019)'s approach in using the Fisher idea index to measure productivity. EI report (2019) used the Fisher idea index based on research by Diewert (1992)[25] which found the Fisher idea index to be best suited to TFP calculations based on its test of conditions that a productivity index should satisfy.

83. Mathematically, the Fisher ideal output index is given by:

$$Q_t = \left[\left(\frac{\sum_i P_{i,0}Y_{i,t}}{\sum_i P_{i,0}Y_{i,0}}\right)\left(\frac{\sum_i P_{i,t}Y_{i,t}}{\sum_i P_{i,t}Y_{i,0}}\right)\right]^{0.5}$$

Where Q_t is the Fisher ideal output index at time t, $P_{i,t}$ is the output share of output i at time t and $Y_{i,t}$ is the quantity of output i at time t.

84. Similarly, the Fisher ideal input index is given by:

$$I_t = \left[\left(\frac{\sum_j W_{j,0}X_{j,t}}{\sum_j W_{j,0}X_{j,0}}\right)\left(\frac{\sum_j W_{j,t}X_{j,t}}{\sum_j W_{j,t}X_{j,0}}\right)\right]^{0.5}$$

Where I_t is the Fisher ideal input index at time t, $W_{i,t}$ is the input share of input j at time t and $X_{i,t}$ is the quantity of input i at time t.

85. The Fisher ideal TFP index is then given by.

$$TFP_t = {Q_t}/{I_t}$$

86. For partial productivity index, the productivity is calculated against a subset of the inputs $TFP_t = {Q_t}/{I_{M,t}}$ where $I_{M,t} = \left[\left(\frac{\sum_j^M W_{j,0}X_{j,t}}{\sum_j^M W_{j,0}X_{j,0}}\right)\left(\frac{\sum_j^M W_{j,t}X_{j,t}}{\sum_j^M W_{j,t}X_{j,0}}\right)\right]^{0.5}$.

Appendix C.4 Multilateral total factor productivity

87. Traditional measures of TFP have enabled comparisons to be made of rates of change of productivity between GDBs or across time but have not enabled comparisons to be made of differences in the absolute levels of productivity in combined time series, cross section GDB data. This is due to the failure of conventional TFP measures to satisfy the important technical property of transitivity. This property states that direct comparisons between observations m and n should be the same as indirect comparisons of m and n via any intermediate observation k.

88. Caves, Christensen and Diewert (1982)[26] developed the multilateral translog TFP (MTFP) index measure to allow comparisons of the absolute levels as well as growth rates of productivity. It satisfies the technical properties of transitivity and other characteristics which are required to accurately compare TFP levels within panel data. This approach has previously been adopted in productivity benchmarking of GDBs.[27]

89. The multilateral translog index is given by:

[25] Diewert, W.E. (1992), "Fisher Ideal Output, Input , and Productivity Indexes Revisited", Journal of Productivity Analysis, Vol 3, Pages 211-248

[26] 66. Caves, Christensen and Diewert (1982), "The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity, Econometrica, Vol. 50, No 6

[27] See chapter 6 in EI report (2019).

$$\ln\left({}^{TFP_m}/_{TFP_b}\right) = \sum_i \frac{(R_{im} + \overline{R_\iota})\left(\ln Y_{im} + \overline{\ln Y_\iota}\right) - (R_{ib} + \overline{R_\iota})\left(\ln Y_{ib} + \overline{\ln Y_\iota}\right)}{2} + \sum_j \frac{\left(S_{jm} + \overline{R_J}\right)\left(\ln X_{jm} + \overline{\ln X_J}\right) - \left(S_{jb} + \overline{R_J}\right)\left(\ln Y_{jb} + \overline{\ln Y_J}\right)}{2}$$

Where:

TFP_m is the total factor productivity for observation m. Each observation is a value for a GDB at a given time. b is denoted for the base observation.

R_{im} is the revenue share of output i for observation m.

$\overline{R_\iota}$ is the average revenue share of output i across time and GDBs.

Y_{im} is the quantity of output i at for observation m.

$\overline{Y_\iota}$ is the average quantity of output i across time and GDBs.

S_{jm} is the cost share of input j for observation m.

$\overline{S_\iota}$ is the average cost share of input i across time and GDBs.

X_{jm} is the quantity of input i for observation m.

$\overline{X_\iota}$ is the average quantity of input i across time and GDBs.

90. This formula gives the proportional change in TFP between an observation (denoted as m) and the base (denoted as b). The MTFP index for observation m is then calculated by taking exponential of the change calculated above.

$$MTFP_m = e^{\left[\ln\left({}^{TFP_m}/_{TFP_b}\right)\right]}$$

91. The index for the base is naturally equal to 1. Due to the transitivity characteristics of MTFP, the methodology is invariant to which observation is set as the base year.