Transport

Overview

1 The transport assessment covers state and territory (state) expenses on urban and non-urban public transport services. It has the following components:

- urban transport
- non-urban transport.

2 The assessment recognises that transport expense needs are influenced by the following.

- Demand — urban centres with above-average population-weighted density have higher demand for public transport, which results in higher spending needs.
- Supply — the population of an urban centre and the presence of heavy rail influence the supply of public transport services. Passenger numbers (heavy rail, bus and light rail) are used to measure the amount of public transport provided in an urban centre. Urban centres with higher passenger numbers need to provide more public transport and have higher spending needs.
- Presence of transport modes — urban centres that require ferry services have higher spending needs.
- Topography — urban areas with greater slope have higher spending needs.
- Network complexity — urban centres with greater road travel distances have higher spending needs.
- Wage costs — states facing higher cost pressures have higher spending needs.
- Regional costs — the cost of providing services increases as the level of remoteness increases.

Actual state expenses

3 The first step in calculating assessed expenses is identifying actual state expenses.[1] States collectively spent 5.7% of their total recurrent expenses on public transport in 2022–23. Table 1 shows expenses broken down by component and Table 2 shows actual expenses by state.[2]

[1] Adjusted budget calculations use ABS Government Financial Statistics data to determine actual state expenses. For further details see the adjusted budget chapter of the *Commission's Assessment Methodology*.

[2] Tables in this chapter, unless otherwise stated, use 2022–23 data.

Table 1 Transport expenses by component, 2022–23

	2022-23	
	$pc	$m
Urban transport	604	15,899
Non-urban transport	65	1,700
Total	**669**	**17,599**
Proportion of total expenses (%)		**5.7**

Table 2 Transport expenses by state, 2022–23

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
Transport ($m)	7,527	4,594	2,827	1,536	744	107	222	41	17,599
Transport ($pc)	913	684	525	542	405	187	482	165	669
Proportion of total expenses (%)	**7.6**	**5.8**	**4.8**	**4.5**	**4.0**	**1.5**	**3.5**	**0.7**	**5.7**

Structure of assessment

4 The transport assessment comprises 2 components: urban and non-urban transport. Table 3 outlines the drivers that influence spending needs in each component.

Table 3 Structure of the transport assessment

Component	Driver	Influence measured by driver
Urban transport	Urban centre characteristics	Population-weighted density, use and presence of public transport modes, distance to work and topography influence the use and cost of services.
	Urban population	Urban transport services vary by the share of the state population living in urban areas.
	Wage costs	Differences in wage costs between states affect costs.
Non-urban transport	Equal per capita	Population drives the use and cost of services.
	Wage costs	Differences in wage costs between states affect costs.
	Regional costs	The cost of providing services increases as the level of remoteness increases.

Data

5 The data used in the assessment are outlined in Table 4.

Table 4 Data used in the transport assessment

<table>
<tr><th rowspan="2">Source</th><th rowspan="2">Data</th><th colspan="3">Update</th><th rowspan="2">Component</th></tr>
<tr><th>Regression</th><th>Variables applied to coefficients</th><th>Other</th></tr>
<tr><td>States</td><td>Net expense data</td><td>5 yearly during methodology reviews (a)</td><td></td><td></td><td>Urban transport</td></tr>
<tr><td>Geoscience Australia</td><td>Significant Urban Area slope</td><td>5 yearly during methodology reviews</td><td>Each census</td><td></td><td>Urban transport</td></tr>
<tr><td>Bureau of Infrastructure and Transport Research Economics</td><td>Kilometres travelled</td><td>5 yearly during methodology reviews</td><td>Annually, until 2026 Census data are available</td><td></td><td>Urban transport</td></tr>
<tr><td rowspan="6">ABS</td><td>Significant Urban Area and Urban Centre and Locality classifications</td><td rowspan="6">5 yearly during methodology reviews</td><td>Each census</td><td></td><td>Urban transport</td></tr>
<tr><td>Census journey to work data (method of travel to work)</td><td>Each census</td><td></td><td>Urban transport</td></tr>
<tr><td>Square kilometre population</td><td>Annually(b)</td><td></td><td>Urban transport</td></tr>
<tr><td>Census journey to work (distance to work)</td><td>Each census</td><td></td><td>Urban transport</td></tr>
<tr><td>Significant Urban Area population data</td><td>Annually</td><td></td><td>Urban transport</td></tr>
<tr><td>State population data</td><td></td><td>Annually</td><td>Urban and Non-urban transport</td></tr>
</table>

(a) In the 2026 Update, the regression will be updated with state net expense data for 2023–24. After this, expense data will remain fixed until the next review.

(b) Population-weighted density is lagged by one year. This is because ABS population data for the square kilometre grid are not available until late March.

Note: Data for the wage costs adjustment are also included in this assessment.
The adjusted budget data sources are outlined in the adjusted budget chapter of the *Commission's Assessment Methodology*

Assessment method

6 The urban transport component uses a regression-based approach reflecting the conceptual drivers of urban transport costs. This is blended with state shares of urban populations.[3]

7 The non-urban transport component is assessed using a state's population share (equal per capita).

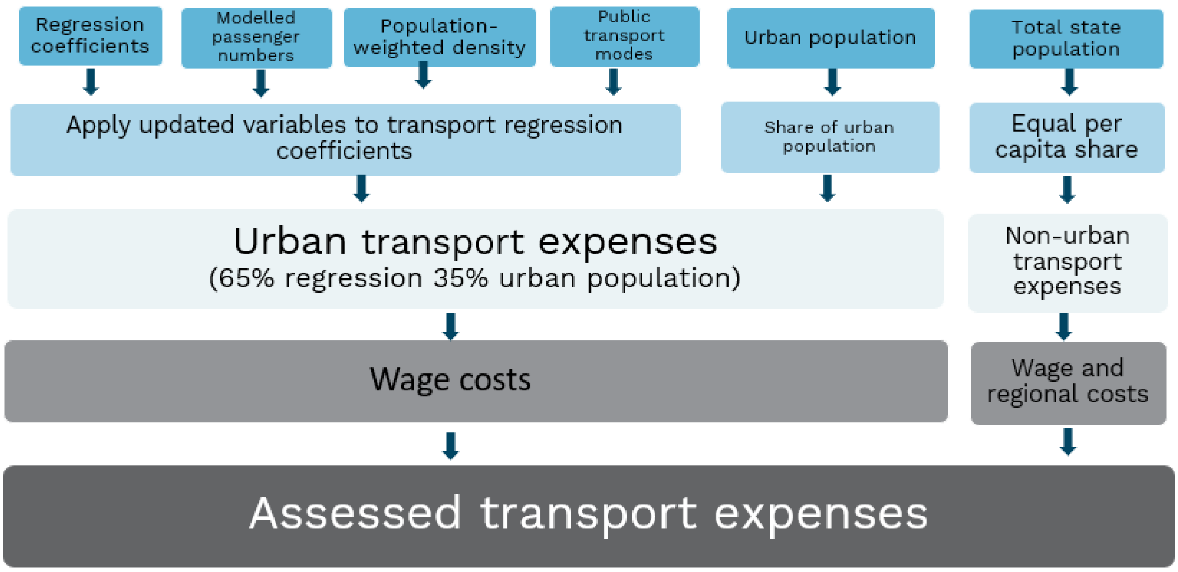
8 For both components, a wage cost adjustment is made to reflect differences in wage costs across states.

9 For the non-urban transport component, an additional regional cost adjustment is made to reflect the higher cost of providing transport services in remote areas.

10 For more information about these adjustments, refer to the wage costs and geography chapters of the *Commission's Assessment Methodology*.

11 Figure 1 presents a stylised flow diagram of the transport assessment.

Figure 1 Stylised representation of the transport assessment



[3] Blending was introduced in the 2020 Review to account for the inherent limitations in the model relating to the use of proxies and limited data. The blending shares are outlined below from paragraph 40.

Urban transport

12 Figure 2 shows the method used to assess urban transport expenses in each state.

Figure 2 Urban transport component assessment (recurrent)

Step 1: Estimating urban centre characteristics regression coefficients

Estimate the impact which population-weighted density, passenger numbers, distance to work, slope, and ferries have on net urban transport expenses.

↓

Step 2: Applying the urban centre characteristics regression coefficients

The regression's coefficients are applied to data for each significant urban area to obtain estimated net expenses.

↓

Step 3: Estimating state expenses

The estimated per capita expenses are applied to the population of each Significant Urban Area aggregated by state to derive estimated urban transport spending.

↓

Step 4: Blending with urban population

The state shares of estimated transport spending are then blended with state shares of urban populations to derive a state's assessed urban transport spending.

↓

Step 5: Applying wage costs

A wage cost adjustment is applied to account for the relative wage differences between states which affect the cost of providing urban transport services.

Urban centre characteristics

Step 1 - Estimating urban centre characteristics regression coefficients

13 The Commission uses a regression model to calculate the net per capita costs of providing public transport in an urban area. The regression model allows the Commission to estimate the impact of urban centre characteristics on net per capita spending on urban transport.

14 Expenses and urban characteristics are assessed based on Significant Urban Areas, defined by the ABS as urban areas with a population above 10,000 (see Attachment A).

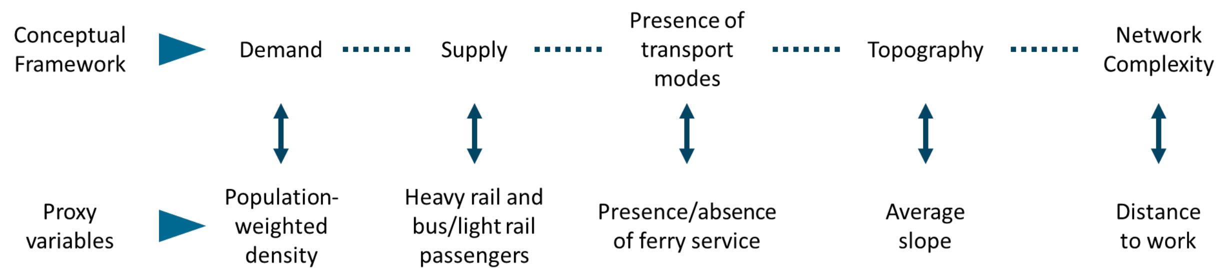
Conceptual drivers of urban transport spending

15 The variables selected for use in the regression model are based on the conceptual drivers of urban transport spending. They are: demand for urban transport, supply of urban transport services, network complexity, topography and the presence of transport modes. To capture these characteristics, proxy variables are used.

Proxy variables to capture drivers of urban transport spending

16 Figure 3 shows the proxy variables used to capture drivers.

Figure 3 Urban centre characteristics recognised in the transport regression model and the explanatory variables used to represent them



17 **Demand** is captured by population-weighted density. Higher density is associated with an increase in congestion on public roads, and a greater reliance on public transport. This higher demand for public transport necessitates the use of more frequent or higher capacity public transport services, which raises net expenses.

18 **Supply** is captured by heavy rail passenger numbers and bus and light rail passenger numbers.[4] Heavy rail accounts for high-capacity public transport, while bus and light rail services account for low-capacity public transport. This recognises that once cities become sufficiently large, heavy rail networks are unavoidable. Bus and light rail passengers are combined into a single measure as they are substitute forms of transport.

19 **Presence of transport modes** is represented by a ferry dummy variable to ensure the model captures all transport modes.

20 **Topography** is captured by slope. Slope reflects differences in the topographic features of urban areas, which can influence transport spending.

21 **Network complexity** is captured by distance to work. It reflects increased costs associated with the greater complexity of transport networks. As urban cities extend, the complexity of individual trips increases, often requiring multi-modal interchanges and routes.

How variables are measured for use in the urban centre characteristics regression

22 Variables are derived for all urban areas across Australia. The assessment uses the ABS definition of an urban centre, Urban Centres and Localities contained within

[4] The model assumes the supply of public transport services (measured using passenger numbers) is equal to demand (measured using population-weighted density).

Significant Urban Areas. See Attachment A for more details on the specification of urban areas and methods described below.

23 **Population-weighted density ($density_i$).** First, the population density of cells in the square kilometre grid within an urban area is calculated.[5] The density of the cells is then weighted by their share of the urban area population. For example, if a cell has a density of 100 and a population share of 0.1, its contribution to population-weighted density is 10. The population-weighted density contribution of all cells are then combined to derive the population-weighted density of an urban area.

24 **Actual passenger numbers ($pax_{i,B+LR}$) ($pax_{i,HR}$).** Passenger numbers are estimated for bus and light rail and heavy rail separately. Use rates for each mode are calculated by taking commuter use as a proportion of total urban area population. Commuter numbers are used as they reflect peak load on urban transport systems. Use rates are multiplied by the urban area populations to obtain actual passenger numbers. For example, if a third of commuters use heavy rail, heavy rail passenger numbers are estimated to equal one third of the urban area population. To account for economies of scale in public transport provision, the log of actual passenger numbers is used.

25 Use rates are then indexed using Bureau of Infrastructure and Transport Research Economics data on passenger kilometres travelled.[6] This adjustment will be removed if 2026 Census commuter data are incorporated into the assessment.[7]

26 **Distance to work ($dist_i$).** Distance to work is calculated as the shortest distance between an individual's residence and their place of work.[8]

27 **Slope ($slope_i$).** First, the average slope of Urban Centres and Localities is derived using data from Geoscience Australia. The slope of these Urban Centres and Localities are then weighted by their share of the total area of a Significant Urban Area. The weighted values for the Urban Centres and Localities with the urban area are combined to calculate the average slope of the area.

28 **Presence of a ferry service ($ferry_i$).** An urban area is identified as having a ferry service if it has a ferry service that operates wholly within the urban area.[9]

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[5] Urban Centres and Localities are used as the sub-areas within Significant Urban Areas.

[6] This adjustment was introduced in the 2025 Review to address the continued use of 2016 Census commuter data in the model. 2021 Census commuter data could not be incorporated into the assessment because they were impacted by COVID-19 restrictions.

[7] The assessment will be updated with 2026 Census data if they are deemed fit for purpose. Data are likely to be available for the 2028 Update.

[8] 2021 Census journey to work data are used. Because census respondents were required to provide their usual place of work, the Commission considered these data were not impacted by COVID-19 restrictions.

[9] Ferries that operate between Significant Urban Areas are not considered to be operating urban transport services. In the 2025 Review, 6 urban areas were identified as having an urban ferry service, Sydney, Melbourne, Brisbane, Perth, Newcastle-Maitland and Hobart.

Running the urban centre characteristics regression

29 The regression model can be specified as:

$$net\ exp_i = \beta_0 + \beta_1 density_i + \beta_2 ln(pax_{i,HR}) + \beta_3 ln(pax_{i,B+LR}) + \beta_4 dist_i + \beta_5 slope_i + \beta_6 ferry_i$$

30 The regression coefficients applied in the 2025 Review are provided in Table 5.

Table 5 Urban characteristics regression results, 2022–23

Variable	Coefficient
	($ per capita)
Intercept	-197.22
Population-weighted density	0.16
Heavy rail passengers (logged)	9.08
Bus and light rail passengers (logged)	10.74
Median distance to work	2.08
Average slope	12.51
Ferry dummy variable	40.45

Note: The urban transport regression uses net expense data from 2022–23.
80 urban areas with available data were used to estimate the regression.
These coefficients will be revised in the 2026 Update with 2023–24 state net expense data.

31 The regression estimates the impact of urban characteristics on the net per capita expenses in an urban area. For example, as Table 5 shows, an additional person per square kilometre in an urban area increases public transport demand and results in an additional cost of $0.16 per person.[10]

32 2022–23 state net expense data for each urban area are used to estimate costs associated with the drivers of need identified above.[11] For some smaller urban areas, a minimum cost of $20 per capita is applied to account for the fixed costs associated with transport services.

Step 2 - Applying the urban centre characteristics regression coefficients

33 To obtain spending estimates, the regression coefficients are applied to the characteristics for each individual Significant Urban Area.

34 For some variables, annual data can be used to account for the changing nature of urban areas, while other variables will remain fixed until new data become available. Table 6 outlines when variables are updated and the corresponding methods.

[10] Costs are applied to populations in urban areas.

[11] An average of 2022–23 and 2023–24 net expense data will be incorporated into the model in the 2026 Update.

Table 6 Updating variables applied to the regression coefficients

Variable	Updated	Method
Population-weighted density	Annually[(a)]	Same method used in the regression
Passenger numbers	Annually	Modelled passenger numbers, indexed by BITRE (see below)
Distance to work	When new census data become available	Same method used in the regression
Slope	When new census data become available	Same method used in the regression
Ferry	When new urban ferry services begin or existing ferry services cease	Urban areas included as required

(a) Population-weighted density is lagged by one year. This is because ABS population data for the square kilometre grid is not available until late March.

35 The urban areas to which the regression variables are applied will be updated following the release of the next Australian Statistical Geography Standard (expected in the 2028 Update).

Modelling passenger numbers

36 To remove the potential influence of policy decisions which can affect public transport use, passenger numbers are modelled using a separate regression model. The regression model assumes there is a constant relationship between the percentage growth in urban populations (pop_i) and the percentage growth in total passenger numbers (pax_i). This is captured by using the logarithm of both variables in the regression. The presence of rail is represented as a dummy variable ($train_i$), recognising the need for high-capacity public transport where passenger numbers are very high.

37 This model can be specified as:

$$ln(pax_i) = \beta_0 + \beta_1 ln(pop_i) + \beta_2 train_i$$

38 Consistent with the method used for estimating actual passenger numbers in the regression, Bureau of Infrastructure and Transport Research Economics data are used to index pre-pandemic data until 2026 Census data are available.

Step 3 - Estimating state expenses

39 Following application of the regression model the estimated per capita expenses for each urban area are multiplied by its population to obtain total net expenses. These expenses are aggregated by state to obtain total state net expenses.

Step 4 - Blending with urban population

40 The net expenses derived using the urban centre characteristics regression model are blended with state shares of urban populations.[12]

41 A blending ratio of 65:35 (urban centre characteristics regression model to urban population shares) will be applied to the recurrent transport assessment until

[12] Blending was introduced in the 2020 Review to account for the inherent limitations in the model relating to the use of proxies and limited data.

2026 Census commuter data are incorporated in the method for modelling passenger numbers. After this, the blending ratio will return to 75:25.[13]

42 Table 7 shows the relative shares of Significant Urban Area populations.

Table 7 State shares of urban populations, 2022–23

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
	%	%	%	%	%	%	%	%	%
Urban population share	31.5	26.2	20.0	11.1	6.8	1.7	2.1	0.7	100

Step 5 - Applying wage costs

43 Wage costs are a significant share of the total cost of providing urban transport services. Differences in wage costs between states affect the cost of providing urban transport services. The urban transport assessment uses the Commission’s general method for measuring the influence of wage costs. Details on how this is calculated are in the wage costs chapter of the *Commission’s Assessment Methodology*.

44 Expenses are then rescaled again to total urban transport expenses, giving final assessed expenses.

Non-urban transport

45 The non-urban transport assessment is based on state populations to recognise that people in urban and non-urban areas utilise non-urban transport services.

46 There are also adjustments for wages and regional costs (see Table 8).

Table 8 Non-urban transport, 2022–23

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
Equal per capital share	533	434	348	183	119	37	30	16	1,700
Wage cost adjustment	-2	-2	1	1	0	0	0	2	0
Regional cost adjustment	2	0	-2	1	-1	-1	1	0	0
Assessed expenses	**533**	**432**	**347**	**185**	**118**	**37**	**30**	**18**	**1,700**

Transport investment

Urban transport

47 The urban centre characteristics regression model used in the assessment of urban transport recurrent expenses is also used in the urban transport investment assessment.

[13] In the 2025 Review the blending ratio was temporarily increased to 65:35. This was to recognise data issues arising from COVID-19 which necessitated the continued use of older data. It was decided the ratio will be returned to 75:25 when fit-for-purpose 2026 data are available. This is likely to be the 2028 Update. See the transport chapter of *Review Outcomes* for more details.

48 The urban centre characteristics regression model is blended with urban population-squared at a ratio of 75:25.[14] Unlike urban population in the recurrent assessment, population-squared is not used to account for data limitations in the model. It is used to recognise the linear relationship between assets per capita and urban transport asset needs. This suggests that, compared with recurrent costs, infrastructure costs grow at a faster rate as population increases.

Non-urban transport

49 Investment in non-urban transport is distributed based on state populations.[15]

GST distribution in the 2025 Review

50 Table 9 shows the GST impact of the assessment in the 2025 Review.

Table 9 GST impact of the transport assessment, 2025–26

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total effect
	$m	$m	$m	$m	$m	$m	$m	$m	$m
Urban transport	1,052	480	-710	-196	-273	-207	-48	-98	1,532
Non-urban transport	-1	-2	-1	3	-1	0	0	2	5
Total ($m)	**1,051**	**478**	**-711**	**-193**	**-275**	**-207**	**-48**	**-96**	**1,529**
Total ($pc)	**121**	**67**	**-124**	**-63**	**-144**	**-358**	**-99**	**-372**	**55**

Note: Magnitude and direction of GST impact can change from year to year.

[14] Maintaining the blending ratio for investment in urban transport recognises that investment decisions were not as strongly affected by COVID-19 restrictions as recurrent spending.

[15] See the investment chapter of the *Commission's Assessment Methodology* for full description of the investment assessment methodology and the GST impacts.

Attachment A

Regression — urban centre characteristics

51 In the 2020 Review the Commission engaged a consultants, Jacobs and Synergies economic consulting, to identify a measure of urban transport needs.[16] The model proposed by the consultants and adopted by the Commission identifies the effect of urban centre characteristics on the level of net per capita expenses.

52 The model of urban transport characteristics is specified below.

$$net\ exp_i = \beta_0 + \beta_1 density_i + \beta_2 ln\ (pax_{i,HR}) + \beta_3 ln(pax_{i,B+LR}) + \beta_4 dist_i + \beta_5 slope_i + \beta_6 ferry_i$$

53 Where $net\ exp_i$ is net per capita state expenses on public transport by urban centres.

- Population-weighted density ($density_i$) is a proxy used to represent demand for public transport.[17] It is calculated as the sum of density of each square kilometre grid in all Urban Centres and Localities within a Significant Urban Area weighted by the grid's population share of the Urban Centres and Localities in the Significant Urban Area.
- Median commuter distance to work ($dist_i$) is a proxy representing network complexity. It is derived using 2021 Census data on the distance travelled (shortest path of the road network) between an individual's usual residence and place of work.
- Mean land slope ($slope_i$) represents the topography of urban centres, as measured by the average mean slope of the urban areas. The data was generated from a spatial analysis process developed by Geoscience Australia.
- The natural logarithm of passenger numbers by public transport mode ($pax_{i,HR}$ and $pax_{i,B+LR}$) is a proxy which accounts for the supply of public transport. Heavy rail passengers are considered separately from bus and light rail passengers.
- A dummy variable is included to control for the presence or absence of ferry services as a mode of transport ($ferry_i$).

54 Table A-1 shows the coefficients applied in the 2025 Review.

Table A-1 Urban centre characteristics – regression coefficients, 2025 Review

Variable	Coefficient ($ per capita)	Standard error	Significance	P value
Intercept	-197.22	41.51	<0.001	0.00001
Population-weighted density	0.16	0.03	<0.001	0.00001
Heavy rail passengers (logged)	9.08	4.82	<0.1	0.0636
Bus & light rail passengers (logged)	10.74	8.03		0.1852
Median distance to work	2.08	3.67		0.5733
Average slope	12.51	5.98	<0.05	0.0400
Ferry dummy variable	40.45	46.76		0.3898

Note: The level of significance is only shown for variables which have a p-value less than 0.1 (they are statistically different from zero).

[16] Jacobs and Synergies Economic Consulting, *Urban Transport Consultancy Stage 2*, Commonwealth Grants Commission, 2019.

[17] The method recommended by the consultants to calculate population-weighted density was revised by the Commission in the 2025 Review.

Measure of urban areas

55 The ABS definition of an urban centre, Urban Centres and Localities contained within Significant Urban Areas, is used to define urban areas for the purposes of the transport assessment.

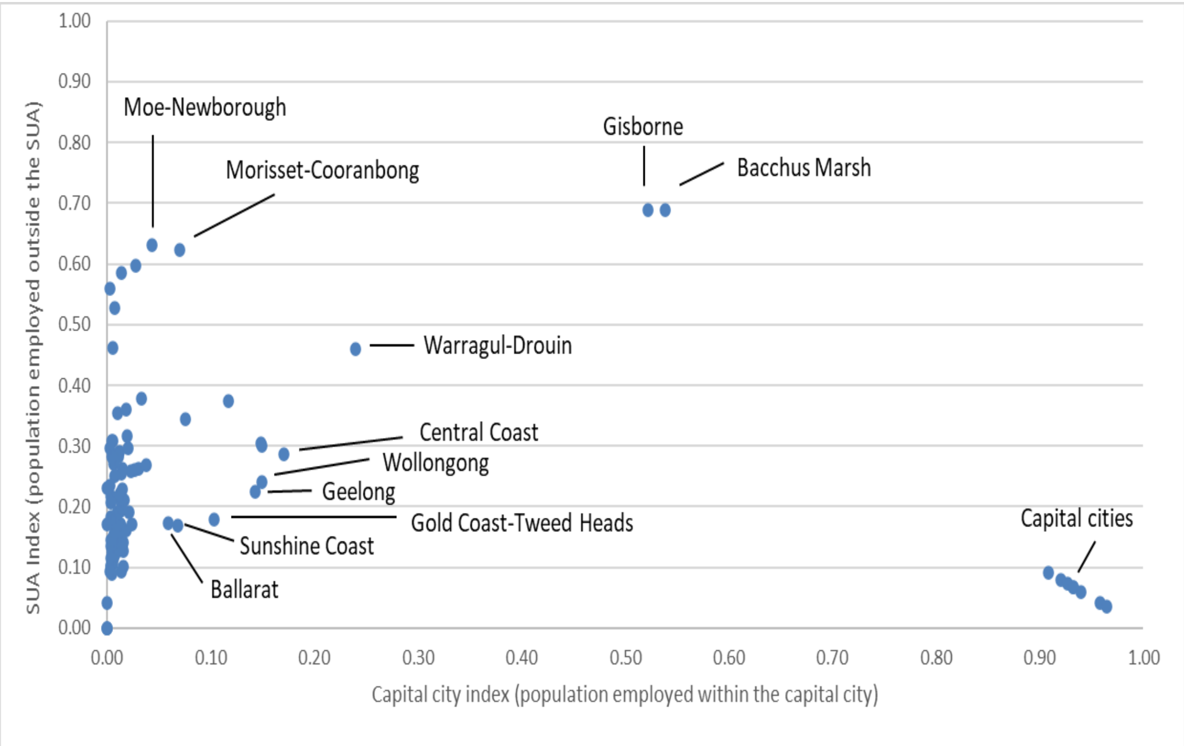
56 The Commission defines urban areas that have a highly integrated labour market with a neighbouring capital city as satellite cities. These cities are included as a part of the larger urban area in our calculations.

57 A Significant Urban Area is considered a satellite to a capital city if:

- it has a relatively high outside dependency index value (that is, a high proportion of people working outside the Significant Urban Area)
- it has a relatively high dependency to the capital city index value (that is, a high proportion of people working within the capital city Significant Urban Area).

58 To calculate these indices the Commission uses ABS journey to work data. A matrix is constructed detailing where people reside and work in each Significant Urban Area. The proportion of total people which work outside of the urban area, and the proportion of people in the urban area which work in the capital city are calculated. Figure A-1 shows the relevant indices for each Significant Urban Area.

Figure A-1 Satellite cities, 2021 Census



59 In the 2021 Census Bacchus Marsh and Gisborne meet the criteria for satellite cities. They have been amalgamated with Melbourne.

Population-weighted density

60 To calculate population-weighted density the Commission uses the ABS population grid and boundary files. While the square kilometre grid is fixed and both the Significant Urban Area and Urban Centre and Locality boundaries do not change between census years, the population files are updated annually.[18]

61 The square kilometres and associated populations are included in the measure if over 50 percent of the square kilometre is within the Urban Centre and Locality. This approach avoids issues of double counting as square kilometres are only allocated to a single Urban Centre and Locality.[19] Urban Centres and Localities are used instead of Significant Urban Area boundaries to ensure that sparsely populated areas on the fringes of Significant Urban Areas did not distort the density measure.

62 The density of each square kilometre area is then weighted by its relative share of the total Urban Centre and Locality population. The weighted densities of the square kilometres are then aggregated to obtain the population-weighted density of the entire Significant Urban Area.

Passenger numbers

63 To obtain the passenger numbers used in the regression the 2016 Census actual passenger number data are adjusted by an index based on Bureau of Infrastructure and Transport Research Economics data to obtain 2022–23 equivalents. Bureau of Infrastructure and Transport Research Economics data on passenger kilometres travelled is available for each state capital city, which is used to obtain indices for each Significant Urban Area in a state. 2021 Census passenger numbers are not appropriate for use because they are impacted by the COVID-19 pandemic. Passenger data used in the regression will remain fixed until the next review.[20]

64 The passenger numbers applied to the regression coefficients are modelled to remove policy influences. A regression model is used to account for the changing nature of public transport use as cities grow in size. The regression model can be specified as:

$$ln(pax_i) = \beta_0 + \beta_1 ln(pop_i) + \beta_2 train_i$$

65 Use rates for trains and bus/light rail passengers are then applied to the estimated total public transport passengers to obtain modelled passenger numbers for each Significant Urban Area.

[18] Population-weighted density used in the regression is fixed at 2022–23 levels. Population-weighted density applied to the regression is updated yearly with a lag of one year.

[19] Alternative approaches, including allocating square kilometres to urban areas based on where the centre of the square kilometre is placed resulted in implausibly high population-weighted density for some smaller Significant Urban Areas.

[20] The regression will be updated in the 2026 Update to incorporate 2023–24 net expense data. After the 2026 Update, the coefficients will remain fixed until the next review.

66 Once fit-for-purpose 2026 Census data are available, likely for the 2028 Update, the Bureau of Infrastructure and Transport Research Economics adjustment will be removed. Passenger numbers will continue to be modelled using a regression.

Distance to work

67 The ABS calculates distance to work by taking the shortest distance by road between a persons reported home address and usual work address. During the 2021 Census, the ABS released guidance advising people working at home due to COVID-19 restrictions to write the address they would normally work at. Therefore, the Commission considers the 2021 data are suitable for use in the 2025 Review.