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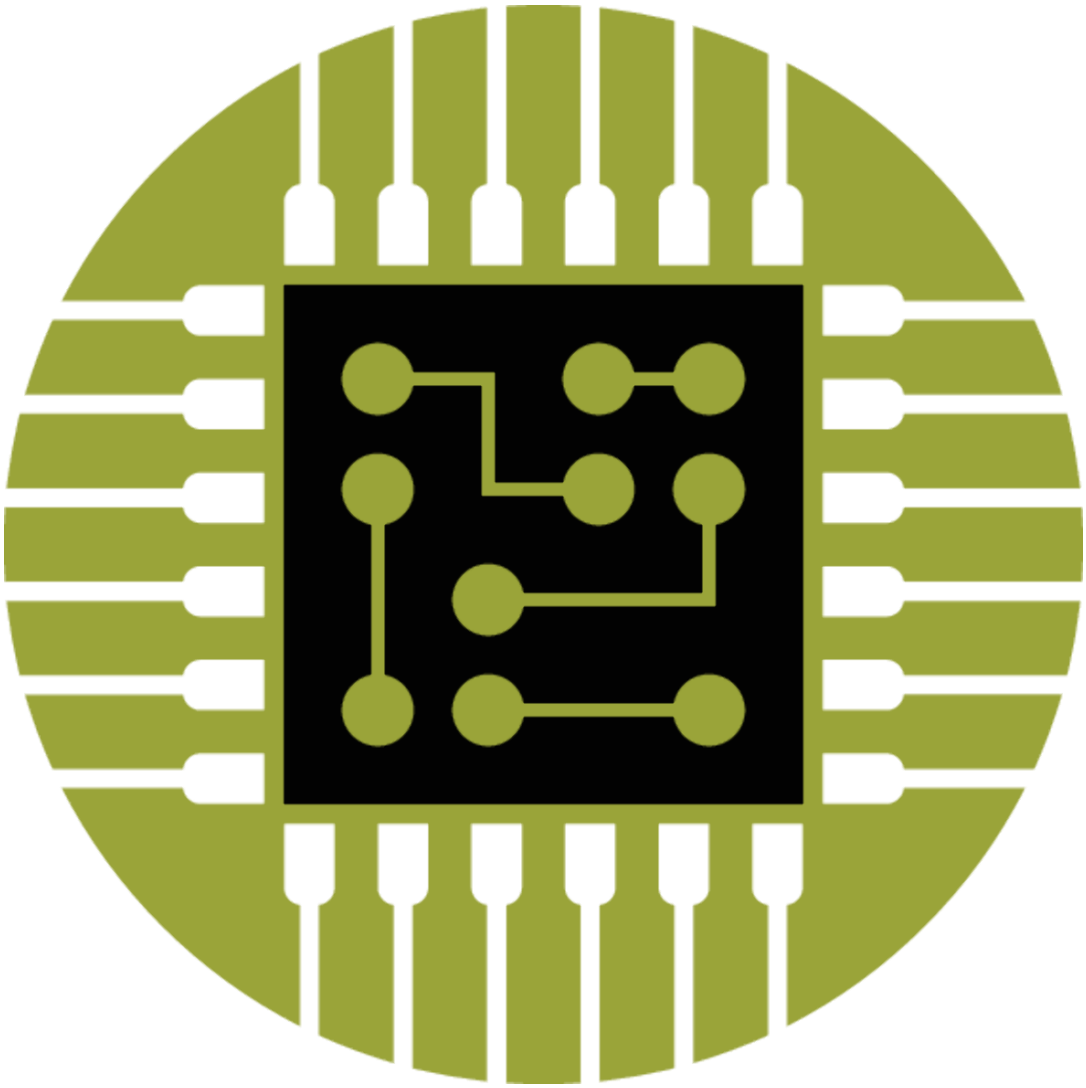

Foundations for the future

Economic baseline and growth potential of Australia's semiconductor sector: Technical Appendix

September 2026

Deloitte Access Economics

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1 Economic contribution method

1.1 Purpose

Deloitte Access Economics was engaged by the Semiconductor Sector Service Bureau (S3B) to develop a data-driven baseline of Australia's semiconductor ecosystem and assess Australia's long-term position within the global semiconductor landscape. This analysis has supported the development of S3B's National Semiconductor Roadmap, a 15-year strategic plan to establish a shared national direction and support growth across Australia's semiconductor industry and broader ecosystem.

This section outlines the methodology used to estimate the economic contribution of Australia's current semiconductor ecosystem. It sets out the framework for the analysis including which organisations were included, the estimation methodology (including attribution approach), data sources, key assumptions and limitations. It is intended to help readers interpret the economic contribution analysis, rather than to provide a detailed technical modelling manual. The modelled inputs and results rely on desktop analysis and publicly available information to estimate the approximate revenue and employment sizes of organisations in the semiconductor value chain. Deloitte has not engaged with organisations in the semiconductor industry in the preparation of this analysis.

1.2 Economic contribution modelling

This analysis estimates the economic contribution of Australia's semiconductor ecosystem using an input-output approach, consistent with standard economic contribution methodologies. Simply, this approach uses national economic data which detail how industries are connected through supply chains. It estimates the value that semiconductor-related organisations directly add to the Australian economy, as well as the additional Australian economic activity supported through their purchases from local suppliers. The analysis has been designed to provide a baseline, economy-wide view of the scale and composition of semiconductor-related activity across Australia's value chain. The analysis reports both:

- direct contribution, representing the value added and employment generated by semiconductor-related organisations themselves; and
- indirect contribution, representing the upstream economic activity supported through supply chain purchases by semiconductor-related organisations.

The indirect contribution was estimated using Australian Bureau of Statistics (ABS) Input-Output tables, which describe the flow of goods and services between industries in the Australian economy. This framework enables estimation of the supplier activity supported by semiconductor-related expenditure, including impacts across professional services, utilities and other upstream industries.

Two measures of economic activity are reported:

- value added
- full-time equivalent (FTE) employment.

Value added measures the new economic value generated by an organisation's labour and capital after removing intermediate inputs. It includes labour income, gross operating surplus and production taxes less subsidies. In simple terms, it is value created by an organisation after removing the cost of goods and services purchased from other businesses. Value added is the preferred measure of economic contribution because it avoids double counting and provides a clear indication of the contribution made to Australia's Gross Domestic Product (GDP).

Employment is measured in FTE terms. This converts different working arrangements, such as full-time, part-time and casual work, into a consistent employment measure to enable comparison across organisations and value chain segments with differing employment structures.

As the analysis looks across the semiconductor value chain, there is a risk of counting the same activity twice. For example, one semiconductor organisation may buy services from another organisation that is also included in the ecosystem. To reduce this risk, value added is used as the main measure, and transactions already

counted as direct activity were removed from the indirect modelling where appropriate. When results are shown for individual segments, these relationships were retained so that each segment reflects the activity occurring within it.

1.3 Carving out the ecosystem and its coverage

As Australia does not have a single industry classification (in the input-output tables) which captures the full semiconductor ecosystem, estimating the economic contribution of Australia's semiconductor ecosystem required defining the sector. This step required the determination of activities for inclusion which are specialised to semiconductor production or provide semiconductor-specific services.

The distinction (between semiconductor specific services) was based on whether an activity or input was general-purpose or semiconductor-specific. For example, equipment used in manufacturing was attributed based on the following rule:

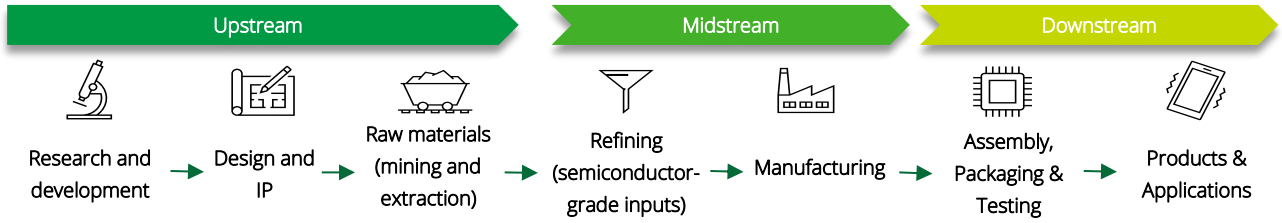
- Excluded: general-purpose manufacturing equipment that could be used across a variety of non-semiconductor processes
- Included: equipment produced specifically for semiconductor manufacturing.

Organisations were then mapped by ANZSIC classification and assessed against the semiconductor value chain.

Scope of Activities Included

The modelling covers research and development; design and intellectual property (IP); extraction of semiconductor-related raw materials; refining of semiconductor-grade inputs; manufacturing of semiconductors; assembly, packaging and testing; and product and applications (see Figure 1.1). It should be noted that the products and applications segment do not include the full value of downstream products that use semiconductors, such as consumer electronics or broader digital technologies. It does, however, seek to estimate the value derived from in-house semiconductor capabilities where products rely heavily on complex or customised semiconductor components, including activities such as specification and non-trivial integration.

Figure 1.1 Defining the semiconductor value chain



Research and development	All work undertaken to improve or innovate new approaches to the design, production and/or application of semiconductors
Design and IP	All work associated with the functional design of semiconductors (including power and performance characteristics) and their licensing
Raw materials (mining and extraction)	Extraction and initial processing of semiconductor-relevant minerals
Refining (semiconductor-grade inputs)	Refining of processed minerals into semiconductor-grade inputs
Manufacturing	Refined semiconductor-grade inputs are processed into wafers and later fabricated into functional semiconductors
Assembly, Packaging & Testing	Semiconductors are packaged for integration into products and tested to ensure quality standards are met
Products & Applications	Integration of finished semiconductor devices into electronic systems and end-use products

Source: Deloitte Access Economics (2026), based on advice provided by the Semiconductor Sector Service Bureau (2026) as well as the definitions outlined in Government of Ireland's National Semiconductor Strategy (2025) and the OECD's *Mapping the Semiconductor Value Chain: Working Towards Identifying Dependencies and Vulnerabilities* Policy Paper (2025).

This boundary was drawn for two reasons: First, including all downstream users would overstate the direct size of the semiconductor ecosystem and make the industry boundary unclear. While semiconductors enable activity in many other sectors, available data does not allow the share of downstream revenue attributable to semiconductors to be measured robustly. Second, this approach is consistent with economic contribution studies in other sectors. For example, mining studies do not usually include the full value of every downstream product that uses mined materials.

Characteristics of the Ecosystem

Australia's semiconductor ecosystem includes a mix of industries, organisations and technologies. Many parts of the ecosystem are still developing, and as such organisational boundaries are not always clear. Some organisations operate across research, government and commercial activities, or across more than one part of the value chain. As this study relied exclusively on desktop analysis, there was insufficient detail (i.e., primary data from organisations) to determine with precision the appropriate proportion of each organisation's activity across multiple segments. To overcome this, each organisation was therefore assigned (based on publicly available information) to the segment that accounted for the largest share of its value.

Building the Organisation Database

To support the analysis, a database of semiconductor-related organisations was developed collaboratively with S3B. This drew on S3B's membership database and was supplemented by desktop research. Organisations were mapped by value chain segment and organisation type. In total, 181 organisations were identified for inclusion, including commercial businesses, government entities, universities and research organisations.

Table 1.1 Summary of Australia's semiconductor ecosystem value chain

Value chain segment	Commercial entity	University/Research Organisation	Government
Research & development	0	27	2
Design and IP	30	0	0
Raw materials	5	0	0
Refining (Semiconductor-grade inputs)	3	0	1
Manufacturing	4	0	0
Assembly, Packaging & Testing[1]	0	0	0
Products & Applications	94	0	0
Equipment Suppliers[2]	15	0	0

Source: S3B, Deloitte Access Economics (2026)

Note: Each organisation was mapped to semiconductor value chain segments based on S3B's subject matter expertise and technical guidance. Where organisations operated across multiple segments, they were mapped (where data made possible) to the segment representing the largest proportion of their semiconductor-related activity. For example, in some cases, organisations mapped to downstream products and applications segments also undertake semiconductor-related design, assembly or packaging activities.

[1] 'Assembly Packaging & Testing' segment does not have any organisations mapped directly as no organisation has been identified as this activity representing the largest proportion of their respective semi-conductor-related activity. However, some organisations may undertake this activity, as a secondary business activity, but due to data limitations, this cannot be captured.

[2] 'Equipment suppliers' are not defined as a standalone value chain segment but are reported separately in the economic contribution analysis, reflecting their cross-cutting role across multiple stages rather than a single stage.

1.4 Estimating economic contribution

Each organisation was mapped to relevant Australian industry classification (e.g. ABS Input-Output Industry Groups and the Australian and New Zealand Standard Industrial Classification). These classifications were then used to apply industry-average ratios from ABS Input-Output tables and Labour Force Survey data. This enabled estimation of:

- direct value added through application of industry-average value added shares to revenue
- intermediate expenditure profiles used to estimate indirect supply chain impacts
- FTE employment using industry employment ratios and organisation-level employment data where available.

This approach assumes semiconductor-related organisations exhibit similar expenditure and operating structures to the wider industries to which they are mapped. It is acknowledged that this creates some uncertainty, primarily as many semiconductor-related firms are highly specialised or still emerging. However, it provides a consistent and practical method where detailed organisation-level financial data is not available.

Additional assumptions were required for universities, research institutions and early-stage firms that operate on a non-profit or pre-commercial basis. Where these organisations were included, their gross operating surplus (GOS) was assumed to be zero to reflect their non-commercial operating structure. Instead, the GOS share of output was assumed to be allocated equally between labour and other expenses.

Where sufficiently reliable financial or employment data was not available, organisations were excluded from the quantified estimates to maintain the consistency and reliability of the results.

1.5 Data collection and attribution

Revenue and employment data were primarily sourced from D&B Hoovers, supplemented by desktop research, stakeholder material and publicly available financial information where available. D&B Hoovers provides modelled estimates of company revenue rather than audited financial results. The estimates in this analysis should therefore be interpreted as indicative, rough-order-of-magnitude estimates rather than precise measures of 2025 economic activity.

Several additional limitations associated with the underlying data should also be noted:

- financial information was unavailable for a proportion of identified organisations
- many firms within the ecosystem are privately held, early-stage or pre-revenue
- available public financial information was not always aligned to a consistent reporting period.

Because of these limitations, it was not possible to build a detailed bottom-up estimate for every organisation. Instead, revenue and employment data were combined with an attribution factor. This factor estimated the share of each organisation's activity that related to the semiconductor industry (as defined in Section 1.3). This meant the estimates captured only relevant semiconductor-related activity, rather than treating all revenue or employment from a diversified organisation as semiconductor-related.

The attribution process involved:

- identifying relevant organisations through S3B's member dataset, large datasets obtained through web searches,[3] and a manual desktop review of company activities and websites
- mapping organisations to semiconductor value chain segments and relevant ANZSIC classifications.[4]
- collaboratively developing the attribution framework between Deloitte and S3B (see Table 1.2).
- S3B providing attribution suggestions based on industry and technical knowledge and experience, to classify each organisation's semiconductor-related activity
- using bespoke revenue shares where sufficient evidence was available to support a specific attribution factor
- using nominated attribution ranges where evidence was more limited, with final attribution factors determined by S3B based on its knowledge of the Australian semiconductor landscape.

[3] Note: Deloitte Access Economics used artificial intelligence to assist with managing large datasets.
[4] Where an organisation operated across multiple segments, it was mapped, where the data allowed, to the segment that represented the largest share of its semiconductor-related activity.

The attribution framework separated core semiconductor value chain activity from raw materials and products and applications (see Figure 1.2). Core value chain activity was defined as including all segments apart from raw materials and products and applications (see Figure 1.3). Organisations classified as "pure play" semiconductor businesses were attributed at 100%, as their main activity was directly related to semiconductor design, production or enabling inputs (see Table 1.2)

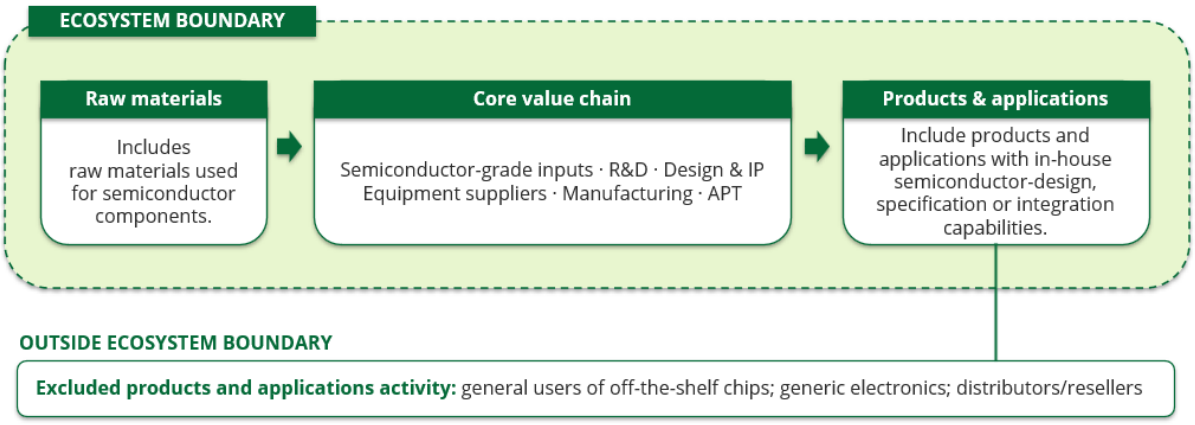
For products and applications companies, attribution was applied more selectively. These organisations were included only where semiconductor capability formed a material part of their activity. This included cases where a company had in-house capability to customise, specify or design semiconductor components, or undertook meaningful systems integration. Comparatively, organisations which used off-the-shelf semiconductors in broader products were excluded from direct semiconductor activity. Distributors of semiconductor products were also excluded as their activity was not considered to add significant value to final semiconductor products.

Where organisations in the core value chain or raw materials suppliers had a diversified product range, only the estimated share of revenue related to semiconductor activity was included, where public information allowed this to be reasonably separated.

Using this framework, 64 of the 181 organisations in the database were identified as pure play semiconductor organisations. This means that all of their activity was attributed to the semiconductor industry. Of the 181 organisations identified, 141 had publicly available data that could be used to estimate revenue.

For organisations that appeared to have semiconductor-related activity but did not have available revenue data, the largest data gaps were in Products and Applications and Design and IP. In Products and Applications, 22 organisations lacked revenue data, representing 23% of identified organisations with semiconductor capability revenue in that segment. In Design and IP, 8 organisations lacked revenue data, representing 27% of identified businesses with semiconductor capability revenue. These gaps reflect the early-stage maturity of some companies in these segments, where revenue may be limited, not publicly disclosed, or not the most relevant measure of activity, particularly for private, pre-commercial or non-commercial entities.

Figure 1.2 Defining the semiconductor value chain: Attribution framework



Source: Deloitte Access Economics (2026)

Table 1.2 Attribution Framework

Category	Revenue attribution (%)	Definition	Value chain segment
Pure play	100%	Organisations whose main activity is semiconductor R&D; design and IP; manufacturing; assembly, packaging and testing; equipment supplier (of specialised equipment); or refiner of semiconductor-grade inputs.	Core value chain
Dedicated business unit	Option 1: Revenue share Option 2: 10% – 20%	Diversified organisations with a clearly identifiable semiconductor division or service line	Core value chain
Semiconductor materials	Option 1: Revenue share Option 2: 5% – 10%	Raw materials or inputs produced specifically for semiconductor use	Raw materials
General materials	0%	General inputs to product that are not unique to semiconductor production	Raw materials
Insufficient information[5]	0% - 5%	The organisation's semiconductor relationship / dependency / activity was identified or is known, however there is a lack of evidence to properly define the value chain segment or revenue share that should be applied.	All
Semiconductor customisation	Option 1: Bespoke revenue attribution[6] (capped 40%) Option 2: 10-30%.	The organisation designs and/or specifies custom chips or semiconductor devices in-house, around which the product is built.	Products and applications
Semiconductor integration	Option 1: Bespoke revenue attribution (capped 30%) Option 2: 10-20%.	The organisation specifies which semiconductors go into their product and performs non-trivial integration (e.g. FPGA), but does not design custom chips.	Products and applications
PCB Manufacturer / Electronics	Option 1: Semiconductor-related share of revenue	The organisation manufactures or assembles semiconductor-bearing boards or systems for others. This only includes semiconductor-	Products and applications

[5] Several defence primes were included in this category but assigned very small attribution factors. While these companies are connected to Defence supply chains and have links to firms with semiconductor-related capabilities, the nature of defence activities means that these sorts of capabilities cannot be readily disclosed in great detail. However, it is understood that several primes are engaged in semiconductor related activity. This does however outline whether they undertake semiconductor-related activities in-house or where they sit in the semiconductor value chain. To overcome this knowledge gap, S3B's engagement with industry and technical knowledge surrounding the activities of these defence primes, provided guidance on reasonable attribute for their activity in the semiconductor ecosystem.

[6] Bespoke revenue attribution was applied where sufficient information was available to estimate the proportion of an organisation's segment revenue that relied on semiconductors involving in-house design, customisation or integration capabilities. This also required a defensible estimate or proxy for the share of end-product value attributable to those capabilities, such as the proportion of total business employment associated with those semiconductor capabilities.

Category	Revenue attribution (%)	Definition	Value chain segment
	Option 2: 10-30%.	centric process work, as distinguished from generic board assembly.	
Plug and play integrator	0%	The organisation buys "off the shelf" semiconductors and inserts them into a product, meaning suppliers are freely swappable and there is no specific design or integration capabilities in-house.	Products and applications
Distribution/resale	0%	The organisation resells semiconductor components with no value-add.	Products and applications

Source: S3B & Deloitte Access Economics (2026)

2 Economic impact method

2.1 Purpose and overview

This appendix outlines the methodology and assumptions used to estimate the economy-wide impacts associated with alternative development pathways for Australia's semiconductor ecosystem. The appendix describes the computable general equilibrium modelling used to estimate how alternative pathways for Australia's semiconductor ecosystem could affect the wider economy between 2027 and 2040. The analysis compares each scenario with an economic baseline representing the economy under status quo settings. The reported economic impact is the difference between a scenario and that baseline.

2.2 Computable general equilibrium modelling framework

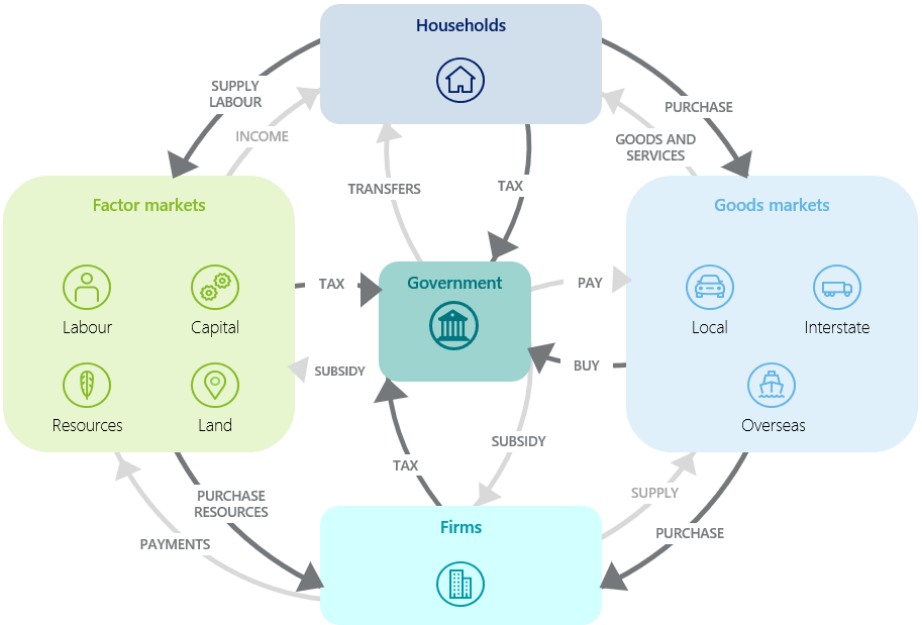
Computable general equilibrium (CGE) modelling is suited to analysing projects, policies and structural changes that affect multiple industries and markets. Unlike an economic contribution model, a CGE model represents resource constraints, opportunity costs, changes in prices and the behavioural responses of households, firms, investors and governments.

The analysis uses the Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM), a large-scale, dynamic, multi-region and multi-commodity model of the Australian and world economy. The model represents production, consumption, employment, taxation, investment and trade, with bottom-up representation of Australian regions. Results are expressed as incremental changes from a baseline, not as forecasts of the total future size of the economy.

The circular flow of income and spending that occurs in DAE-RGEM is captured in a stylised form in Figure A.1. To meet demand for products, firms purchase inputs from other producers and hire factors of production (labour and capital). Producers pay wages and rent (factor income) which accrue to households. Households spend their income on goods and services, pay taxes and put some away for savings.

DAE-RGEM is a dynamic model, which means it can show how the Australian economy may change over time in response to a change. It is also customisable, allowing for specific industries and networks to be represented across the economy.

Figure A.1 Stylised diagram of DAE-RGEM



Source: Deloitte Access Economics (2026)

2.3 Representing the semiconductor ecosystem

For this analysis, DAE-RGEM was customised to distinguish semiconductor-related activity and the broader industrial ecosystem that enables it to commercialise, scale and diffuse benefits across the economy. Australian industry classifications were mapped to the model's underlying industry database, with additional reporting groups created to support interpretation.

The semiconductor ecosystem comprises semiconductor-related manufacturing, relevant professional and technical services, and education. The industrial ecosystem comprises light manufacturing, industrial manufacturing and critical mineral refining. The remaining industries are reported as the broader economy.

Table 2.1 Public reporting structure used in the economic impact model

Ecosystem	Reporting industry	Coverage
Semiconductor ecosystem	Semiconductor-related manufacturing	Semiconductors and electronic components, including relevant finished and semi-finished dice and wafers.
	Professional services	Relevant professional, scientific, technical, administrative and support activities.
	Education	Education activities, including higher education and research-related capability.
Industrial ecosystem	Light manufacturing	Consumer-oriented and processed manufactured products.
	Industrial manufacturing	Chemicals, metals, machinery, transport equipment, fabricated products and electronic and computer manufacturing outside the semiconductor-specific group.
	Critical mineral refining	Relevant mineral processing and refining, including alumina and critical mineral activities.
Broader economy	Other industries	Agriculture, mining and energy, energy transmission and utilities, construction, trade, transport, professional services, public administration and defence, and government services.

Source: Deloitte Access Economics (2026).

2.4 Baseline and scenario framework

Two scenarios were modelled to demonstrate the potential economic impact of growth in the ecosystem, and to show what is at stake if the ecosystem is not supported. These scenarios are compared to an economic baseline, which shows the growth of the Australian economy in 'status quo'. The difference between this economic baseline and the scenario is the economic impact of the different scenarios.

The scenarios are illustrative and are designed to test the economic consequences of materially different pathways. They do not represent forecasts, commitments or estimates of the effect of any single policy measure.

Table 2.2 Scenario framework

Scenario	Purpose	Core modelling treatment
Growth	Tests the value associated with a larger, more productive and better-connected semiconductor ecosystem.	Progressive growth in semiconductor output, an initial uplift in research-related labour productivity, subsequent ecosystem productivity gains and productivity spillovers to connected industrial activities.

Scenario	Purpose	Core modelling treatment
Constraint	Tests the value at risk if domestic capability is unable to scale and contracts relative to the baseline.	A progressive reduction in semiconductor ecosystem output over an initial five-year period, with associated productivity benefits curtailed and the lower capability level maintained thereafter.

Source: Deloitte Access Economics (2026).

2.5 Growth scenario

The growth scenario represents a pathway in which Australia expands semiconductor capability through coordinated investment in research and development, commercialisation, workforce capability, infrastructure and industry growth. Semiconductor ecosystem output is assumed to triple by 2040, equivalent to average annual growth of approximately 7.5% from 2027.

The growth rate is a top-down benchmark for a plausible high-growth pathway. It was informed by observed or projected growth across selected international semiconductor ecosystems with strengths in design, intellectual property, research, advanced materials, specialist manufacturing or packaging. Because available international estimates use different definitions, time periods and data sources, the benchmarking is directional rather than a precise like-for-like comparison.

Table 2.3 International benchmarks informing the growth scenario

Country	Benchmark relevance	Reported growth benchmark	Source
Israel	Design and IP-led ecosystem supported by multinational research and development activity, without a large domestic fabrication base.	6.83% CAGR, 2025 to 2030	Mordor Intelligence
United Kingdom	Design, IP and compound-semiconductor-led strategy focused on areas of existing strength rather than full-stack fabrication.	2.23% CAGR for a narrow market definition, 2025 to 2030; other estimates cited in the final report range from 6% to 7%, depending on scope.	Mordor Intelligence
Singapore	Large manufacturing, packaging and testing hub developed through sustained state investment and foreign direct investment incentives. It provides an upper-bound comparator rather than a direct structural match for Australia.	6.90% CAGR, 2025 to 2030; approximately 11% over the preceding decade.	Mordor Intelligence
Spain	Newer ecosystem expanding from a smaller base, supported by the European Chips Act and focused on automotive and power electronics.	3.5% to 5.5% CAGR, 2026 to 2035; 4% to 6% over 2023 to 2026.	Index Box
Canada	Closest structural comparator to Australia, with a relatively flat core manufacturing base and faster growth in design, IP and specialised niches.	11.7% CAGR for the design and IP niche, 2026 to 2031; 1.3% for core manufacturing, 2020 to 2025.	Markets and Markets

Source: Deloitte Access Economics (2026), based on the publicly available market sources listed. Note: the cited estimates are drawn from different providers, time periods and market definitions. Some measure domestic industry revenue, while others cover broader value-chain activity or consumption. They are therefore used as directional benchmarks rather than precise like-for-like comparisons. The modelled 7.5% annual growth rate sits within the range observed across faster-growing specialised ecosystems and produces the assumed tripling of Australian semiconductor ecosystem output by 2040.

The scenario applies the following changes progressively:

- Semiconductor ecosystem growth, 2027 to 2040: output expands along the pathway required to reach approximately three times its initial size by 2040.
- Research-related labour productivity, 2027 to 2031: productivity within the identified research workforce increases as capability and investment build.
- Semiconductor ecosystem productivity, 2032 to 2040: further productivity gains reflect accumulated innovation, scale and commercialisation.
- Industrial ecosystem spillovers, 2032 to 2040: smaller total factor productivity gains are applied to connected industries, reflecting adoption of semiconductor-enabled technologies and diffusion of knowledge and capability.

The sequencing recognises that research investment and ecosystem growth do not translate immediately into economy-wide productivity. Benefits emerge with a lag as capability accumulates, technologies are commercialised and adoption spreads.[7] The implied research intensity reaches approximately 9.8% by 2040. This is a modelling calibration that supports the specified output pathway.

2.6 Constraint scenario

This scenario assumes that Australia's specialised semiconductor ecosystem and workforce contracts and is essentially non-existent by 2040. This scenario is intended to represent a severe but plausible loss of domestic capability under a "no co-ordination" future where policy support, industry investment, and workforce-development initiatives fail to keep pace with international competitors.

This assumption is deliberately strong. Its purpose is to isolate the economic value placed at risk where a small and concentrated ecosystem loses firms, specialised workers, facilities and investment. It should not be interpreted as a forecast that all domestic semiconductor activity will disappear.

The contraction pathway is informed by historical examples that small and concentrated capabilities can decline quickly when ownership, policy settings or investment conditions change. The benchmarks do not establish a forecast (see Table 2.4). They support the plausibility of modelling a loss of capability over a five-year period.

Table 2.4 Benchmarks informing the constraint scenario

Benchmark	Relevance to the scenario
Radiata acquisition by Cisco Systems, 2000	Illustrates how a concentrated Australian semiconductor design capability can be absorbed into a multinational organisation through a single corporate transaction, shifting ownership and future investment decisions offshore.
Contraction of Australian semiconductor manufacturing following the removal of industry protection in the 1970s	Demonstrates that domestic manufacturing capability can contract rapidly when policy and commercial conditions change, particularly where the ecosystem is small and lacks scale.
Current ecosystem concentration	Australia's semiconductor capability remains concentrated in a limited number of firms, research organisations, specialist facilities and workers. This increases exposure to firm relocation, offshore investment decisions, loss of key facilities and workforce mobility.

Source: Deloitte Access Economics (2026). Note: these examples support the assumed speed and concentration risk underpinning the scenario. They do not imply that the same events will recur or that all domestic activity would cease.

The scenario incorporates:

[7] The productivity variable of 0.038 (multi factor productivity coefficient) is used to translate changes in R&D intensity into productivity effects. This is informed by Shanks, Sid and Zheng, Simon (2006) and their econometric modelling of R&D and Australia's Productivity for the Productivity Commission.

- Semiconductor ecosystem output decline, 2027 to 2031: output is progressively reduced over five years and the resulting lower level is held thereafter.
- Productivity effects, 2027 to 2040: productivity gains that would otherwise arise from growth, research investment, clustering and technology diffusion are curtailed in line with the contraction in capability.[8]

The scenario reflects the vulnerability of a relatively small ecosystem to firm relocation, offshore investment decisions, loss of critical facilities and workforce movement. It provides an estimate of opportunity cost relative to the baseline, rather than a prediction of a specific sequence of events.

2.7 Interpreting the results

Economic impacts are reported as the difference between each scenario and the baseline. A positive result indicates that the scenario produces a higher level of activity than the baseline; a negative result indicates a lower level.

Gross domestic product (GDP) measures the total value added generated across the economy. Gross value added measures the value of goods and services produced by an industry after deducting intermediate inputs. Employment is reported in full-time equivalent terms. Annual results describe the impact in a particular year, while average annual results describe the mean impact across 2027 to 2040.

Cumulative economic impacts are presented in present value terms over 2027 to 2040 using a 7% real discount rate. Present value results convert impacts occurring in different years into a common value at the start of the appraisal period. They should not be added to average annual impacts, which are reported on a different basis.

Industry results include both gains and offsets. Expanding sectors attract labour and capital, exchange rates and relative prices adjust, and some industries may contract relative to the baseline even when the overall economy expands. These effects are a central feature of general equilibrium modelling and mean that modelled impacts should not be interpreted as simple expenditure multipliers.

2.8 DAE-RGEM technical detail

The Deloitte Access Economics regional general equilibrium model (DAE-RGEM) is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium model of the world economy with bottom-up modelling of Australian regions. The model allows policy analysis in a single, robust, integrated economic framework. This model projects changes in macroeconomic aggregates such as GDP, employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

The model is based upon a set of key underlying relationships between the various components of the model, each of which represent a different group of agents in the economy. These relationships are solved simultaneously, and so there is no logical start or end point for describing how the model actually works. However, they can be viewed as a system of interconnected markets with appropriate specifications of demand, supply and the market clearing conditions that determine the equilibrium prices and quantity produced, consumed and traded.

DAE-RGEM is based on a substantial body of accepted microeconomic theory. Key assumptions underpinning the model are:

- The model contains a 'regional consumer' that receives all income from factor payments (labour, capital, land and natural resources), taxes and net foreign income from borrowing (lending).
- Income is allocated across household consumption, government consumption and savings so as to maximise a Cobb-Douglas (C-D) utility function.
- Household consumption for composite goods is determined by minimising expenditure via a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In the Australian regions, households can also source

[8] The productivity variable of 0.038 (multi factor productivity coefficient) is used to translate changes in R&D intensity into productivity effects. This is informed by Shanks, Sid and Zheng, Simon (2006) and their econometric modelling of R&D and Australia's Productivity for the Productivity Commission.

goods from interstate. In all cases, the choice of commodities by source is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.

- Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a C-D utility function.
- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.
- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a CES production function.
- Producers are cost minimisers, and in doing so, choose between domestic, imported and interstate intermediate inputs via a CRESH production function.
- The supply of labour is positively influenced by movements in the real wage rate governed by an elasticity of supply.
- Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return. Once the aggregate investment has been determined for Australia, aggregate investment in each Australian sub-region is determined by an Australian investor based on: Australian investment and rates of return in a given sub-region compared with the national rate of return.
- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.
- Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).
- For internationally traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But, in relative terms, imported goods from different regions are treated as closer substitutes than domestically produced goods and imported composites.
- Goods traded interstate within the Australian regions are assumed to be closer substitutes again

Limitation of our work

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