

**VHM Limited**

Economic impact of the Goschen Project

**October 2022**

# VHM Limited's Goschen Project

VHM Limited is seeking to develop and operate the Goschen Project - a rare earth elements, mineral sands, and zircon mine and related processing facility.

The Goschen deposit contains an estimated **199 million tonnes** of ore.

High concentration of rare earth elements are expected to enable VHM to meet up to **10%** of global rare earth demand.



The mine and processing facility will be located within the Gannawarra Shire, in the Loddon-Mallee Region of Victoria.



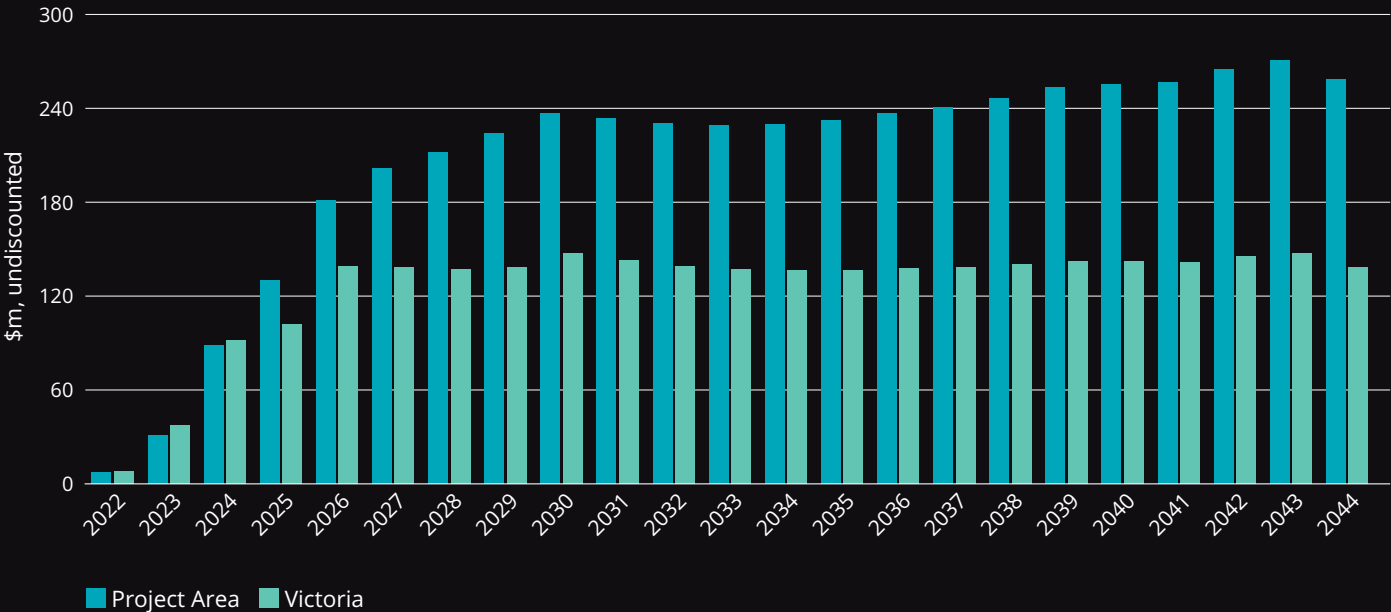
VHM Limited is forecast to invest a substantial amount of capital and operating expenditure in the mine and processing facility over the evaluation period.

Between 2022 and 2044, VHM Limited is estimated to invest a total of approximately **\$626 million** in development capital expenditure in the mine and processing facility (undiscounted).

Between 2022 and 2044, VHM Limited is estimated to invest a total of approximately **\$2.8 billion** in operating expenditure and sustaining capital expenditure in the mine and processing facility (undiscounted).



The Goschen Project is estimated to generate significant economic impacts in the Loddon-Mallee region and beyond.



**\$2.0 billion**  
Net increase in gross regional product (GRP) in the Loddon-Mallee region, between **2022** and **2044** (present value terms).



**480 FTE**  
Average annual increase in FTE in the Loddon-Mallee region, between **2022** and **2044**.





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# Executive summary

## The Goschen Project

VHM Limited (VHM) is an Australian-owned public unlisted company. VHM is seeking to develop and operate the Goschen Project<sup>1</sup> - a rare earth elements, mineral sands, and zircon mine and related processing facility in the Loddon-Mallee region in northwest Victoria.

The Goschen deposit contains an estimated 199 million tonnes of ore and the proposed project is expected to produce zircon and rutile concentrates, as well as rare earth elements neodymium, praseodymium, and dysprosium. Rare earth elements have applications in a wide variety of modern technologies including smartphones, batteries for hybrid and electric vehicles, and next-generation light bulbs.

The projected rare earth mineral concentrate (REMC) is estimated to contain 61% rare earth oxide, making it of superior purity to similar deposits.<sup>2</sup> The high concentration of rare earth elements in the Goschen deposit is expected to enable VHM to meet more than 4 per cent of global rare earth demand initially, with potential for further development.<sup>3</sup>

The development of the Goschen Project meets many key Commonwealth Government priorities. For example, the Commonwealth's Critical Minerals Strategy<sup>4</sup> highlights the opportunity for Australia in the development of its critical mineral deposits. In particular, the strategy highlights impending market tightness for critical minerals, with rapid growth in global demand for rare earth elements in future set to be combined with likely supply constraints due to market, technical and commercial risks surrounding known supply sources around the world. These issues are overlaid with geopolitical tensions around access to such materials due to their importance to key technology product markets and growth sectors.

As well as supporting the development of critical mineral deposits in Australia, the Commonwealth Government's \$1.3bn Modern Manufacturing Initiative aims to bolster Australian manufacturing technology and capability – including critical minerals processing. The Goschen Project also accords with this policy imperative, with processing of the minerals extracted at Goschen proposed to take place at an adjacent site titled the Australian Rare Earths and Minerals (AREM) processing facility.

AREM is poised to be one of the first of processing sites of its kind in Australia,<sup>5</sup> and strengthens Australia's downstream processing capability while enabling the large-scale export of refined rare earths products. It also creates an opportunity to establish further onshore manufacturing capability for which processed rare earths are key inputs.

As part of an approvals process to develop the Goschen Project, VHM Limited is required to prepare an Environment Effects Statement (EES). An EES assesses the environmental impact of a proposed development in the state of Victoria. It also assesses the potential for significant effects on the economic well-being of local areas, the regional and national economies, as well as key industry sectors.<sup>6</sup>

Deloitte Access Economics (DAE) has been engaged to undertake a study to estimate the economic impact of the Goschen Project to the local and state economies.

## Modelling the economic impact of the Goschen Project

DAE has employed its in-house computable general equilibrium (CGE) model to estimate the economic impact of the Goschen Project. CGE modelling is the best-practice methodology for estimating the economic impact of a project, or policy, across the economy. It is the preferred method for most major Commonwealth and State government agencies (for more detail on CGE models and Deloitte Access Economics' in-house model, see Appendix A).

The economic impact of the Goschen Project has been estimated for a defined Project Area around the Loddon-Mallee region.<sup>7</sup> The results suggest that the Goschen Project has the potential to deliver large increases to economic activity and provide additional employment opportunities for the residents of the Project Area and in broader Victoria.

<sup>1</sup> The Goschen Mineral Sands and Rare Earths mine, and the Australian Rare Earths and Minerals (AREM) processing facility are concurrent ventures which, together, are hereafter referred to as the Goschen Project. The AREM processing facility does not form part of the EES currently being prepared by VHM.

<sup>2</sup> VHM Limited, 2021, *VHM Shareholder Briefing*.

<sup>3</sup> Current output is currently forecast to be 12ktpa, while current global production is approximately 280ktpa

<sup>4</sup> Australian Government Department of Industry, Science, Energy, and Resources, 2022, *2022 Critical Minerals Strategy*.

<sup>5</sup> Prime Minister of Australia, 2022, *Media Release 04 April 2022*.

<sup>6</sup> Department of Environment, Land, Water, and Planning, 2019, *Scoping requirements for Goschen Mineral Sands Project Environment Effects Statement*

<sup>7</sup> The Project Area is defined as the (ABS Statistical Area 3) regions of Bendigo; Heathcote - Castlemaine – Kyneton; Loddon-Elmore; Macedon Ranges; Mildura; Murray River-Swan Hill; and Campaspe



The Goschen Project is estimated to generate significant economic impact in the region and beyond

The economy-wide modelling undertaken estimates the net impact of the additional investment in the local economy (to develop and maintain the Goschen Project) and the resultant reallocation of labour and capital from other regions and sectors of the economy to the local area.

Estimates of the forecast capital and operating expenditure required to develop the Goschen mine and AREM facility have been provided by VHM and reflect the size and scale of the project at the Detailed Feasibility Study (DFS) stage. The total development capital expenditure, is estimated to be \$626 million (in nominal undiscounted terms), while the on-going operational and sustaining capital expenditure is forecast to total \$2.8 billion over the evaluation period (FY 2022 to FY 2044) (in nominal undiscounted terms).

The Goschen Project is estimated to generate \$2.0 billion in additional Gross Regional Product (GRP) for the Loddon-Mallee region (in present-value terms, discounted at 7 per cent) which equates to an average impact to output of \$206 million (undiscounted) per annum. This equates to an average annual increase in economic activity for the Loddon-Mallee region of around 0.5%, relative to the base case.

Locally, the Goschen Project is estimated to sustain an additional 478 full-time equivalent (FTE) positions on average per annum over the evaluation period. This is relative to the current local labour force totalling 160,283.<sup>8</sup>

Due to the size of the Goschen Project relative to the local economy, development and operational activity at the site is expected to draw labour and capital from other regions and sectors of the Victorian economy. These movements of labour and capital are termed ‘crowding-out effects’. The estimation of crowding-out effects is a key advantage of CGE modelling, as it more accurately reflects the actual effects of major project investment across an economy.

As a result of the movement of capital and labour to the project region, the economic impact of the Goschen Project to the state of Victoria is expected to be lower than to the Project Area.

Across Victoria, the Goschen Project is estimated to deliver \$1.3 billion (in present-value terms, discounted at 7 per cent) in additional Gross State Product (GSP), which equates to an average output impact of \$126 million (undiscounted) per annum. The Goschen Project is estimated to sustain an additional 226 FTE positions on average per year in Victoria.

The economic impact of the development and operation of the Goschen Project over the evaluation period are summarised in Table A, below.

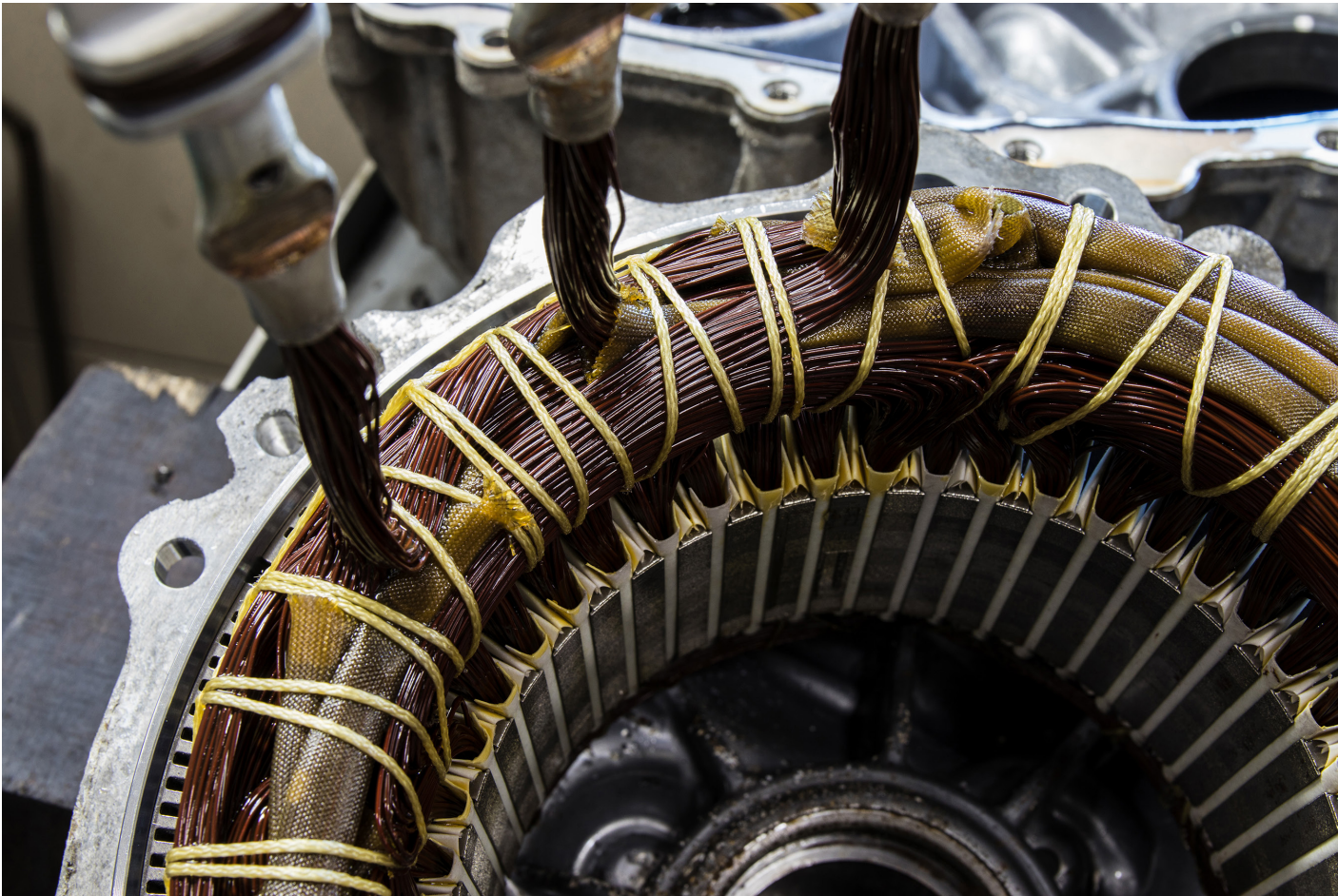
Importantly, the Goschen Project is expected to create both positive and negative spillovers on the local economy. Positive economic spill-overs are generated across the broader economy, predominately in the service sector, which experiences an average uplift to economic output of \$61 million (undiscounted) per year.<sup>9</sup> This is as a result of real incomes rising, leading to additional spending in service industries.

Negative spill-overs (i.e. crowding out) are expected to be most prominent in capital intensive industries that employ specialised labour such as heavy manufacturing, agriculture, and mining industries. Overall however, while crowding out effects are expected, these are small in scale relative to the larger spillover benefits projected for other sectors as a result of the development of the Goschen Project.

A CGE analysis estimates economic benefits associated with increased economic outputs and employment, as well as costs relating to crowding out. However, CGE analysis does not quantify all economic benefits resulting from the development of a project. For example, other benefits may also be realised from the Goschen Project through planned upgrades to infrastructure such as roads, electricity connection, and water pipelines, while negative externalities such as increased emissions, also detract from economic benefits.

Table 1.1: Economic impact generated by the Goschen Project

Region	Total change in GSP/GRP relative to base case (present value, 7% discount rate)	Average change in GSP/GRP per annum relative to base case (undiscounted)	Average change in FTEs per annum relative to base case
Project Area	\$2.0b	\$206.5m	478
Victoria	\$1.3b	\$126.3m	226



<sup>8</sup> Labour Market Information Portal, SALM Estimates, 2022

<sup>9</sup> See section 4.4



## 2. Background

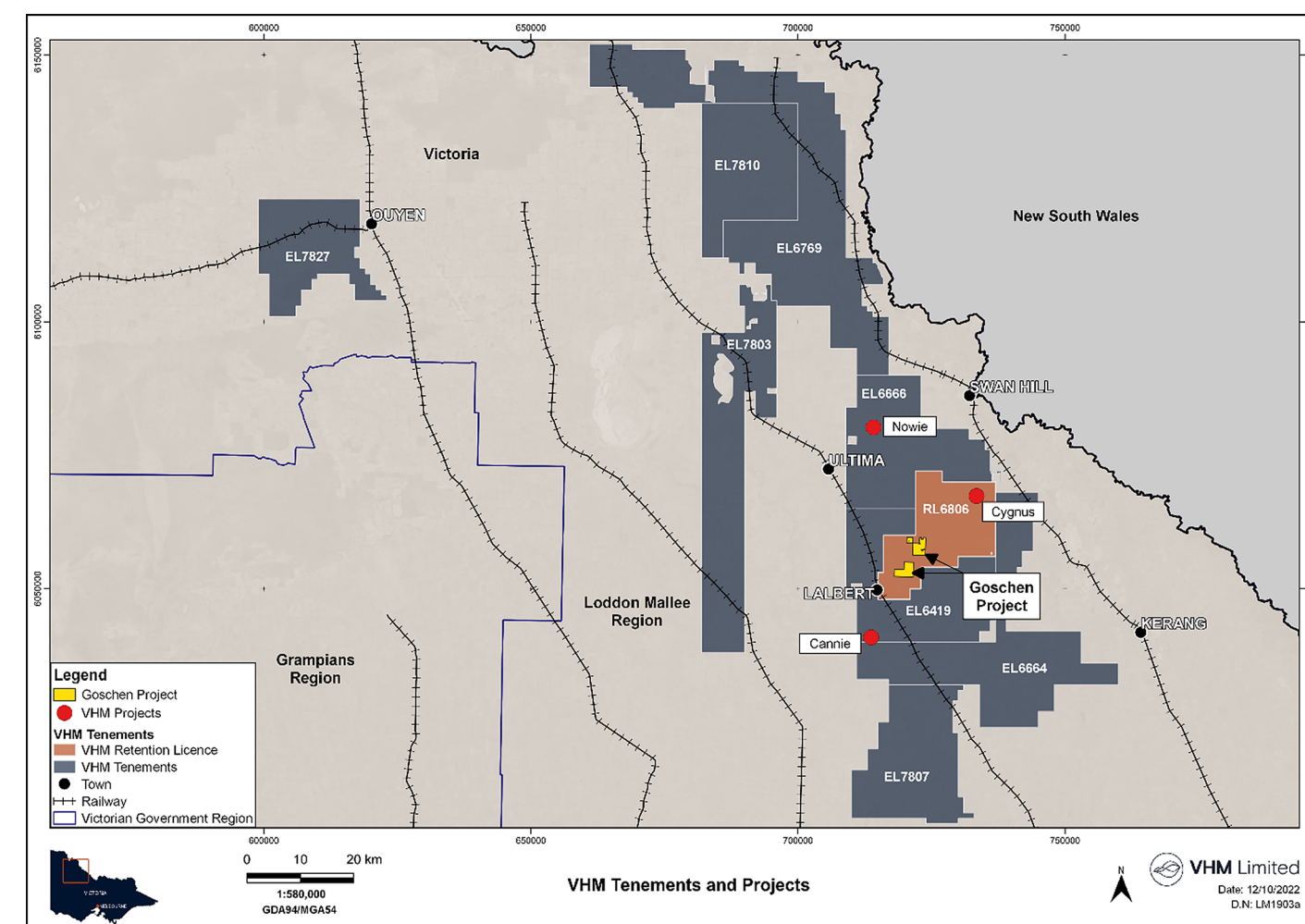
### 2.1 VHM Limited

VHM Limited is an Australian owned and operated, unlisted public company. VHM was established in 2014 and seeks to be a sustainable and reliable producer of high-quality critical minerals including rare earths, mineral sands and zircon. The company owns several exploration tenements within the Loddon-Mallee Region of Victoria, where it undertakes environmental and metallurgical assessments.<sup>10</sup>

### 2.1.1 Goschen Project overview

VHM is currently developing the Goschen Project (the 'Project'), which comprises both a mineral sands and rare earths mine, and a rare earths and minerals processing facility. The mine and processing facility will be located within the Gannawarra Shire in the Loddon-Mallee Region of Victoria. Some ancillary components of the Project, such as transport, will be based in the rural city of Swan Hill. The Project is within VHM's Retention Licence area RL 6806 (Figure 2.1).

Figure 2.1: Goschen Project area



Source: VHM Limited

<sup>10</sup> VHM Limited, 2019, *Project Overview*.



Resource definition activities have confirmed that the area comprises numerous high-grade zones of heavy mineral sands – including zircon, rutile, titanium and rare earth elements including high concentrations of neodymium and praseodymium, as well as significant levels of dysprosium and terbium.<sup>11</sup> The deposit is estimated to contain 199 million tonnes of ore which is projected to translate to mine throughput of five million tonnes per annum (see Section 3.2.4).<sup>12</sup> The rare earth mineral concentrate (REMC) recovered from the Goschen project is estimated to contain 61% rare earth oxide content, and is of superior quality to REMC recovered from similar deposits.<sup>13</sup>

The processing facility – known as Australian Rare Earths and Minerals (AREM) - will be a downstream processing facility for a REMC product. AREM will be the first of its kind in Australia, although a small number of other downstream processing facilities are at stages of early planning.<sup>14</sup>

2.1.2 Developing the Goschen Project

The Goschen Project will be developed through a phased approach. Phase 1 will consist of the ‘base project’, which will

include the necessary infrastructure to produce a zircon/titania heavy mineral concentrate and rare earth mineral concentrate products. This phase is expected to commence in the first half of 2025.

Phase 1A will commence 18 months after the first production recorded in Phase 1, and includes the installation of a Hydromet Circuit downstream of the rare earth processing chain, and will enable VHM to produce a beneficiated carbonate form of rare earth minerals. This is projected to be a significant revenue driver for VHM.

Phase 2 will commence 24 months post-production and consist of an additional mineral separation plant, hot acid leach, and chrome removal circuit. This will enable VHM to produce additional products such as premium zircon, zircon concentrate, high titanium (HiTi) rutile, leucoxene, and low chromium ilmenite.

NOTE: The phased schedule of development for the Goschen Project was completed after the economic impact assessment was completed by Deloitte (see Chapter 4 for details of this assessment). While this report has been updated to reflect

the latest development profile, the final phased schedule of development is not reflected in the modelling results. However, given the development schedule and value of capital and operational expenditures have not changed significantly relative to the modelled data, it is anticipated that the results presented in Chapter 4 are still relevant in terms of the magnitude of the economic impacts estimated.

2.2 Rare earth elements and critical minerals

The Goschen deposit contains a significant proportion of rare earth metals which have unique chemical properties, making them critical for a variety of future growth industries including renewable energy generation, aerospace, defence, electric vehicle manufacturing, telecommunications, and technology sectors.

For example, the rare earth elements neodymium, praseodymium, and dysprosium are critical in the production of ‘permanent magnets’. Permanent magnets are key inputs to the manufacture of goods ranging from mobile phones and laptops to the motors used in electric vehicles and wind turbines, and are the greatest driver of rare earth metals (refer Figure 2.2).

Demand for rare earths will rise in future as industries decarbonise, fuelling greater electrification of the energy mix. The Department of Industry, Science, Energy, and Resources estimates that the overall consumption of rare earth elements will increase by approximately 45 per cent to 2030, with supply shortfalls in neodymium and praseodymium expected to emerge during this period.<sup>15</sup>

Other critical minerals also present at Goschen - zircon, rutile, and titanium – also serve a variety of industrial applications, including the manufacture of high-performance alloys, aircraft, ceramics, and computer components. Demand for these minerals is also expected to remain strong. For example, global demand for Zircon is expected to grow by 2.4 per cent per annum over the long term, while supply is forecast to contract by 4.3 per cent at a compounded annual rate to 2030 due to some mines reaching end-of-life during this period.<sup>16</sup> Forecasts of global demand for titanium suggest growth of 4.4 per cent per annum through to 2030.<sup>17</sup>

Growing global demand for rare earth elements and critical minerals creates a significant opportunity for Australia, as it possesses the world’s sixth largest reserves of rare earth elements<sup>18</sup> and the world’s largest resources of rutile, zirconium, and tantalum.<sup>19</sup> The Australian *Critical Minerals Strategy*<sup>20</sup> outlines a vision to turn Australia into a ‘critical minerals powerhouse’ by 2030, with an aim to create stable supply of rare earths from Australia to the world, develop sovereign capabilities in downstream processing of rare earths and critical minerals, and promote regional jobs and growth through this industry.

VHM’s Goschen Project presents clear opportunities to develop Australian capability in the rare earths and critical minerals sector in alignment with the Critical Minerals Strategy outlined by the Commonwealth government. While it is of strategic relevance, the mine also includes minerals with high-growth potential like neodymium, praseodymium, and dysprosium. The high concentration of these minerals will enable VHM to produce up to 10 per cent of global rare earth demand.<sup>21</sup>

Furthermore, proposed downstream processing capabilities in the AREM facility provide a complementary asset to the mine and could enhance Australia’s critical minerals capability.

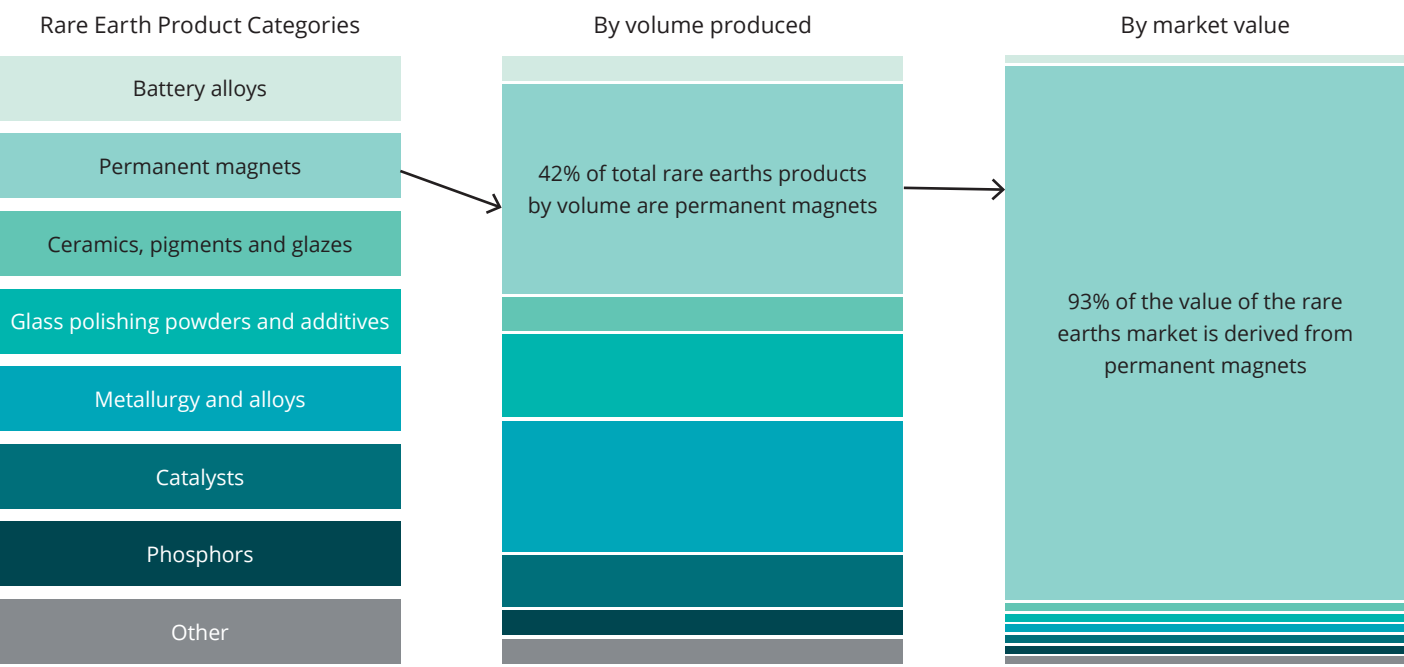
Finally, the Goschen Project will be developed in regional Victoria, in the Loddon-Mallee region and contribute to increased economic activity within the Project Area, which is discussed in greater detail through the rest of this report.

2.3 Purpose

As part of the approvals process to develop the Goschen Project, an Environment Effects Statement (EES) is currently being prepared under the Environment Effects Act 1978. An EES assesses the environmental impact of a proposed development in the state of Victoria. It also assesses the potential for significant effects on the economic well-being of local areas, the regional and national economies, as well as key industry sectors.<sup>22</sup>

As part of the impact assessment required for the EES, Deloitte Access Economics was engaged to estimate the economic impact of the Goschen Project using computable general equilibrium (CGE) modelling. The findings are presented in this report.

Figure 2.2: Permanent magnets are the greatest rare earth demand driver



Source: Adamas Intelligence

<sup>11</sup> VHM Limited, 2019, Project Overview.

<sup>12</sup> VHM Limited, 2021, VHM Shareholder Briefing

<sup>13</sup> VHM Limited, 2021, VHM Shareholder Briefing

<sup>14</sup> Prime Minister of Australia, 2022, Media Release 04 April 2022

<sup>15</sup> Department of Industry, Science, Energy and Resources, Office of the Chief Economist, 2021, *Outlook for Selected Critical Minerals*

<sup>16</sup> Adamas Intelligence, 2021, *Rare Earth Market Outlook*

<sup>17</sup> TZMI, 2021, *Market Study Update: VHM Limited*

<sup>18</sup> United States Geological Survey, 2021, *Mineral Commodity Summaries*

<sup>19</sup> Department of Industry, Science, Energy and Resources, 2022, *Investing in critical minerals in Australia*

<sup>20</sup> Australian Government Department of Industry, Science, Energy, and Resources, 2022, *2022 Critical Minerals Strategy*

<sup>21</sup> VHM Limited, 2022, *Rare Earths* [accessed from: <https://www.vhmltd.com.au/products/rare-earths/>]

<sup>22</sup> Department of Environment, Land, Water, and Planning, 2019, *Scoping requirements for Goschen Mineral Sands Project Environment Effects Statement*



## 3. Methodology

### 3.1 Estimating economic impact using a CGE framework

Deloitte Access Economics was engaged by VHM Limited to estimate the economic impact of the Project to the region and to the Victorian economy. The impact has been estimated using CGE modelling.

CGE modelling is the best-practice methodology for estimating the economic impact of changes in any one part of the economy. It is the preferred method for most major Commonwealth and State government agencies in estimating the economic impact of a project or program (for more detail on CGE models and Deloitte Access Economics' in-house CGE model see Appendix A).

CGE frameworks are preferred because they can explicitly account for a range of impacts that are otherwise omitted in alternative approaches. For example, CGE analysis incorporates:

- resource constraints (the use of labour or capital by one activity or industry comes at the expense of its use elsewhere)
- the possibility of changes in the mix of inputs used in production due to changes in relative prices or technology
- responsiveness of prices and other variables to policy changes affecting – for example - tariffs on imported goods, budgetary support to industry, industry productivity and workforce participation.

These assumptions allow for second-round impacts to be gauged — where 'agents' in the economy respond to changes in price signals — and enable CGE models to account for impacts of a policy change or program across the entire economy. Other economic modelling techniques (such as input-output modelling) are unable to address the 'dynamic' changes in the economy outlined above.

### 3.2 Modelling the economic impact of the Goschen Project

The economic impact of the Goschen Project on the local economy has been estimated using Deloitte Access Economics' in-house CGE model, DAE-RGEM. DAE-RGEM is Deloitte's in-house CGE model that estimates the impact of significant changes to the Australian economy (see Appendix A).

General equilibrium models require the development of counterfactual scenarios – a base and project case. The project case represents a 'shock' on the economy relative to the base case, which leads to the reallocation of capital and labour and other intermediate inputs in the economy through time. The 'shock' can take the form of an expected change in government policy, a possible increase in labour productivity, or a planned increase in private sector investment. The Goschen Project was modelled as a shock to private sector investment across relevant industries.

The economic impact of the Goschen Project has been estimated over the period FY 2022 to FY 2044 (the 'evaluation period').

#### 3.2.1 Base case

The base case reflects a scenario in which the Goschen Project is not developed nor operated over the evaluation period.

To define the base case, macroeconomic variables are assumed to grow in line with Deloitte Access Economics' current long-term forecasts for the state, national and global economies. That is, in the absence of the Goschen Project, the economic outlook for the Project Area (see Section 4.2 below) is assumed to change in line with future expectations of the broader Victorian economy over the period to 2044.

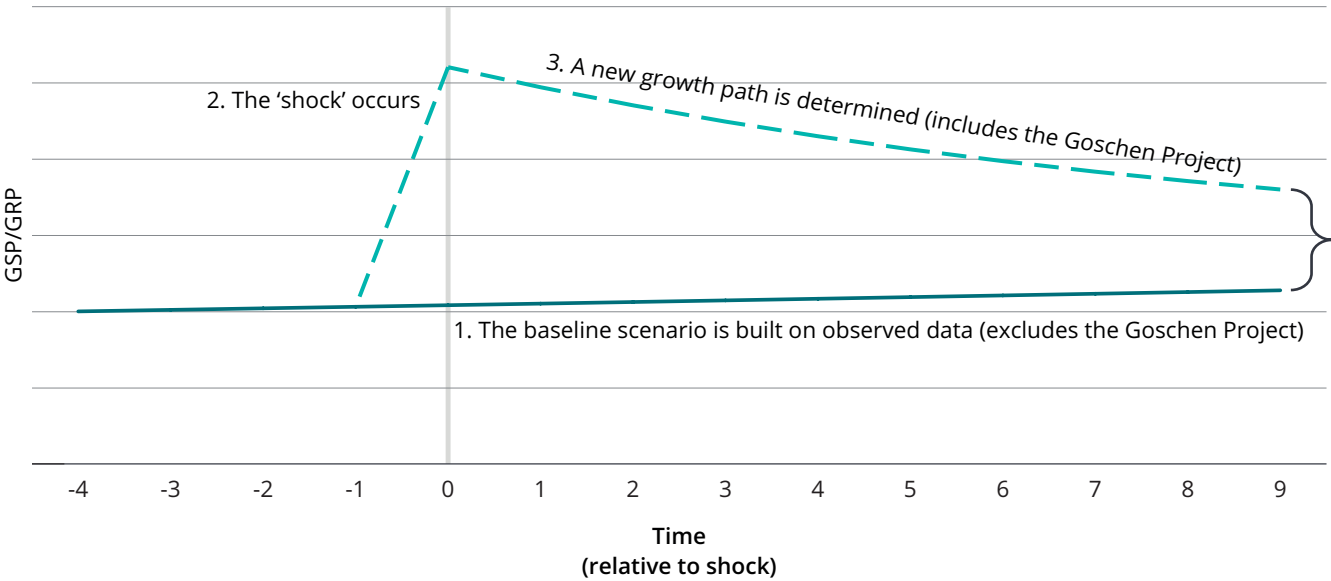


3.2.2 Project case scenarios

The project case is developed in the CGE model by introducing data specific to the Goschen Project as a 'shock' to the base case scenario. The 'shock' for this project is measured by the capital and operational expenditure associated with the development and ongoing operations of the Goschen Project (over the evaluation period). This economic shock is outlined in Section 3.2.4.

After the shock is introduced, the CGE model solves for the market-clearing (equilibrium) levels of demand and supply across all specified goods and factor markets in the economy. This effectively creates a new path for the economy over time as a result of the shock. Comparing this new path for the economy to that of the base case (where the shock does not occur) provides a gauge of the net economic impact of the Goschen Project.

Figure 3.1: Stylised representation of economic impact modelling using a CGE framework



Source: Deloitte Access Economics

3.2.3 Project Area

The economic impact of the Goschen Project has been measured to the economy of Victoria, and the local region, termed the 'Project Area'. For modelling purposes, the Project Area was defined as the broader Loddon-Mallee region consisting of the following (ABS Statistical Area 3 – SA3)<sup>23</sup> regions (refer Figure 3.2, overleaf):

- Bendigo
- Heathcote - Castlemaine – Kyneton
- Loddon-Elmore

- Macedon Ranges
- Mildura
- Murray River-Swan Hill
- Campaspe.

This aggregation of SA3s has been selected to align with Regional Development Victoria's economic development region of Loddon-Mallee.<sup>24</sup>

<sup>23</sup> SA3s are designed to provide a regional breakdown of Australia. They generally have a population of between 30,000 and 130,000 people. In regional areas, SA3s represent the area serviced by regional cities that have a population over 20,000 people. In the major cities, SA3s represent the area serviced by a major transport and commercial hub. They often closely align to large urban Local Government Areas (e.g. Gladstone, Geelong). In outer regional and remote areas, SA3s represent areas which are widely recognised as having a distinct identity and similar social and economic characteristics (Australian Bureau of Statistics)

<sup>24</sup> Regional Development Victoria, 2021, *Victoria's Regions*, <https://www.rdv.vic.gov.au/victorias-regions>

Figure 3.2: Project area used in CGE model



Source: Deloitte Access Economics

\*Gold icon represents the location of the Goschen Project

3.2.4 Defining the economic shock

VHM's projected capital and operational expenditure over the evaluation period, were coded into DAE-RGEM to formulate the shock associated with the Project.

Capital expenditure is defined as the value of investment required to develop the mine and associated AREM facility. This expenditure reflects investments in plant and equipment, infrastructure or mine development. Operating expenditure represents the value of outlays required to run the mine and AREM facility over the course of the evaluation period, and includes maintenance and sustaining capital.

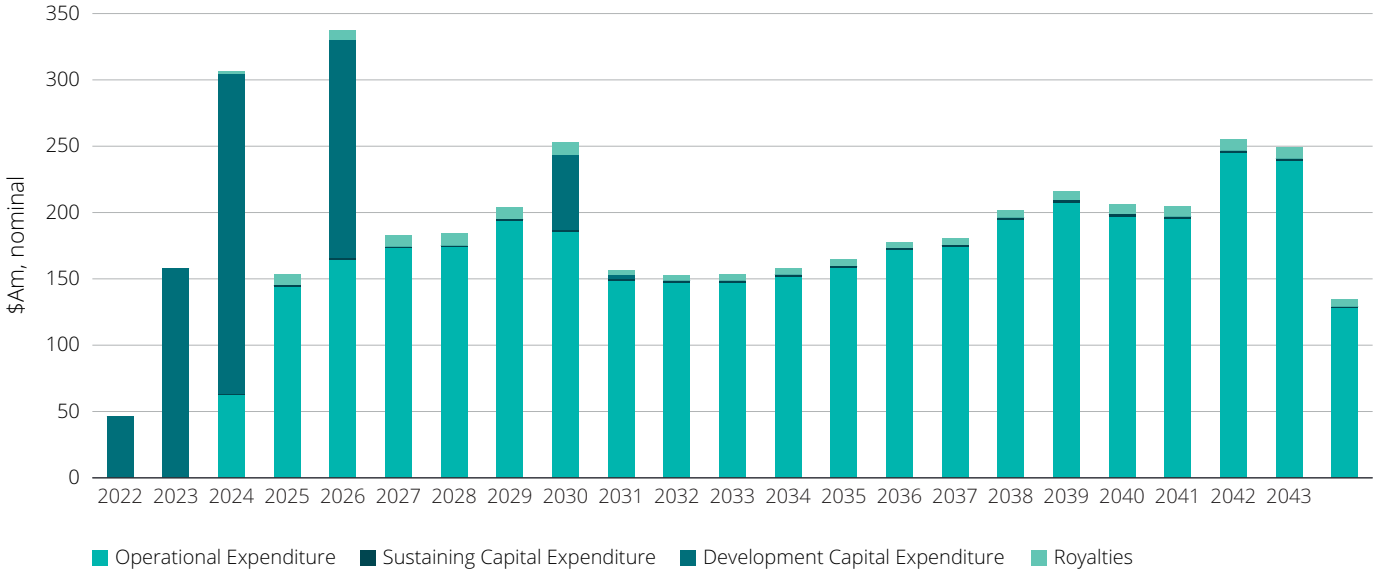
Capital and operating expenditure is forecast to total \$3.4 billion (undiscounted) over the evaluation period. This expenditure comprises \$626 million in development capital expenditure and \$2.8 billion in operational and sustaining capital expenditure (see Chart 3.1).

The CGE framework is structured such that the output of a given sector is proportional to the value of inputs required to supply its output. As such, only payments made to productive inputs, including factors (such as payments to capital or labour) or intermediate inputs (such as machinery or financial services) are included in the economic 'shock'. This value of inputs forms a subset of the operating costs of the Project provided by VHM, with royalties paid to Government excluded from the analysis (approximately \$140 million in royalties are expected to be paid over the evaluation period). Royalties are implicitly captured in the modelling framework through components of tax, with changes to mining sector output resulting in changes to government revenues.

Operational expenditure includes various steps in the production processes including mining, processing, refining, transportation as well as several ancillary services such as engineering, maintenance, geology and administration. Sustaining capital expenditure refers to investments in mobile equipment, general projects, surface and processing, haulage etc.

Chart 3.1 illustrates the forecast expenditure profile of the Project over the evaluation period.

Chart 3.1: Expenditure profiles for the Goschen Project, FY 2022 to FY 2044



Source: Deloitte Access Economics



The expenditure profile for the Goschen Project grows rapidly in the early part of the evaluation period reflecting the large scale of investment required in developing, constructing, and establishing the Goschen mine and AREM facility. Development capital expenditure subsides after five years, and operational and sustaining capital expenditures remain relatively constant between \$150 million and \$200 million per annum – reflecting a steady production profile.

Forecast expenditure only represents known and accessible deposits at the Goschen Mine and reflects the data provided at the Definitive Feasibility Study (DFS) stage.

This distinction between the nature of future capital and operating expenditure at the mine is important as operating outlays and spending on sustaining capital are treated differently to development capital spending for modelling purposes.

The latter is modelled as a shock to demand for capital goods, while operating and sustaining capital outlays are modelled as a shock to intermediate goods. This is a key differentiator, as higher expenditure on capital goods relative to the base case tends to have a greater positive impact through the economy, which is reflective of an increasing availability of capital to be accessed for productive purposes.







# 4. Economic impact

This chapter outlines the results of the CGE modelling exercise for the evaluation period between FY 2022 to FY 2044. Over the evaluation period, the development of the mine and AREM facility is estimated to generate positive economic impact to the Project Area and the Victorian economy more broadly.

A summary of the headline impacts in terms of both economic activity and employment, by region, are outlined in Table 4.1.

**Table 4.1:** Summary of economic impact from the Goschen Project, Project Area and Victoria, FY 2022 to FY 2044, real 2021\$

Region	Total change in Gross State Product (GSP)/ Gross Regional Product (GRP) relative to base case (present value, 7% discount rate)	Average change in GSP/GRP per annum relative to base case (undiscounted)	Average change in FTEs per annum relative to base case
Project Area	\$2.0b	\$206.5m	480
Victoria	\$1.3b	\$126.3m	230

Source: DAE-RGEM. Note: Victorian economic impacts are lower than the Project Area region due to ‘crowding out’, which is explored in greater detail in the following sections.

## 4.1.2 Project Area

The estimated economic impact is a measure of net economic benefit to the region as it accounts for ‘crowding out’ associated with the reallocation of productive inputs (such as capital and labour) from other industries and regions to support the economic activity associated with construction and operation of the Project.

For the mining sector located in the Loddon-Mallee region, the Goschen Project represents an increase of over 20 per cent in output. The structure of the local economy is such that many inputs required by the project (such as capital or labour) must be drawn from the surrounding regions, including the broader

Victorian and Australian economies. This reflects a transfer of skilled labour from the broader Victorian economy to the Loddon-Mallee region to support the Project’s development and operations, as well as a flow of capital from Victoria into the Loddon-Mallee region to support the additional economic activity associated with the Project. This phenomenon is reflected in the results of the economic impact analysis presented in this report.



4.2 Output impacts

4.2.1 Project Area

The economic impact of the Goschen Project are expected to be largely concentrated in the Project Area, reflecting the location of mining and processing operations.

The Goschen Project is estimated to increase economic activity in the Project Area by \$2.0 billion (present value terms, discounted at 7 per cent) relative to the base case. This equates to an average annual economic impact of \$206 million (undiscounted) in additional output in the Project Area (refer Chart 4.1), or a 0.5% increase in GRP relative to the base case.

These estimates reflect a net economic impact to the Project Area and incorporate crowding out effects associated with the reallocation of productive inputs (refer Section 4.4 for sectoral impacts).

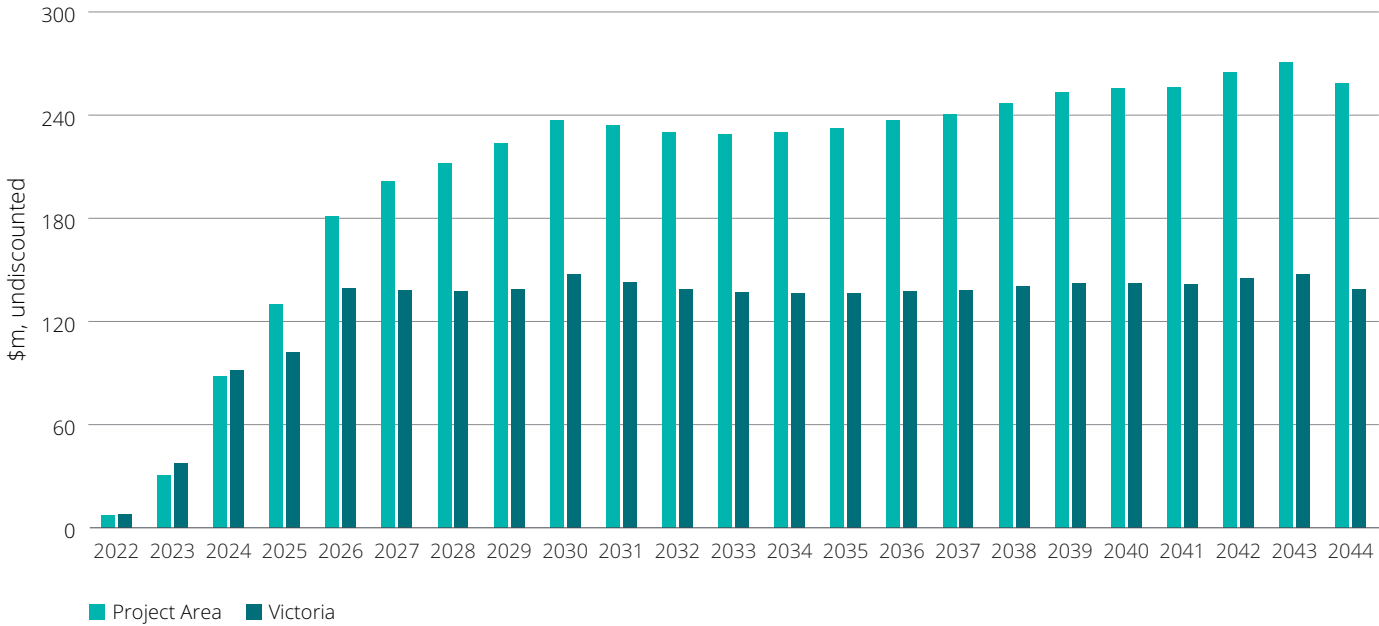
4.2.2 Victoria

Over the evaluation period, the development and operations of the Goschen project are estimated to generate a net uplift of \$1.3 billion (present value terms, discounted at 7 per cent) to the Victorian economy. This equates to an average annual impact of \$126 million (undiscounted) in additional GSP to the State.

There is a gradual increase in the positive economic impact generated by the Goschen Project across Victoria corresponding to the uplift in operational and sustaining capital expenditure from FY 2024 onwards (refer Chart 4.1). However, the net economic impact of the Project to Victoria is lower than that of the Project Area.

This reflects the large-scale nature of the Goschen Project and the associated capital and labour requirements required to establish and sustain ongoing operations in the Project Area, and is a product of subsequent crowding out effects experienced throughout broader Victoria.

Chart 4.1: Economic output impacts to the economies of the Project Area and broader Victoria



Source: DAE-RGEM

4.3 Employment impacts

The Goschen Project is also expected to create new jobs in the Project Area and across Victoria. These employment impacts, as measured by additional full-time equivalent (FTE) jobs, represent both the direct employment associated with the development and operations of the Project, but also the indirect employment opportunities generated in other sectors. The employment impacts calculated in the modelling reflect net job creation, which account for job losses across industries that experience crowding out in the labour market as a result of the Project.

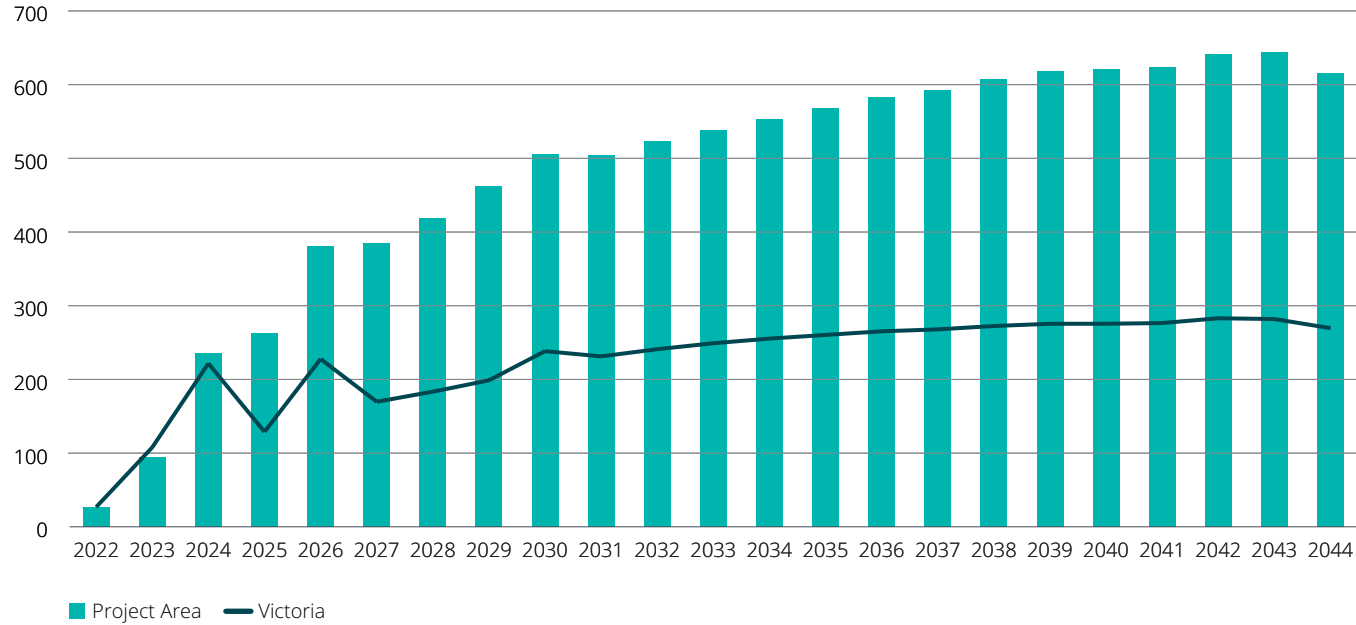
Over the evaluation period, the Goschen Project is estimated to sustain net employment gains in the Project Area of around 480 FTE jobs per annum on average. This estimate represents the average net number of jobs sustained each year as opposed to new, annual job creation. Peak employment is expected to be generated at the end of the evaluation period, with 640 additional FTE jobs in the Project Area. This is relative to an estimated total workforce size in the Project area of 160,283.<sup>25</sup>

As noted above, the net jobs created due to the Goschen Project are a combination of direct and indirect employment across sectors of the economy. The modelling indicates that outside of mining, additional jobs are expected to emerge in a range of industries but are concentrated in adjacent sectors such as construction, services, and trade.

Across the evaluation period, positive net employment impacts are also expected for the broader Victorian economy (including the Project Area). The Goschen Project is estimated to sustain an additional 230 FTE jobs per annum on average across the State, relative to the base case. Job creation in Victoria also peaks at the end of the evaluation period, reflecting the cumulative activity of the Project, with an additional 280 FTE jobs estimated in the final year.

These lower employment impacts to the State reflect both the labour requirements of the Project itself as well as crowding out across various industries that experience positive spillovers in the Project Area as a result of the Goschen Project (explored further in the following section). This is reflected in Chart 4.2, with the overall employment impact smaller across the Victorian region (including the Project Area) than in the Project Area itself.

Chart 4.2: Employment impacts in FTE, financial years, Project Area and broader State impacts



Source: DAE-RGEM

<sup>25</sup> Labour Market Information Portal, SALM Estimates, 2022



4.4 Sectoral impacts

The Goschen Project is expected to generate both positive economic spillovers and some crowding out effects (see Section 4.1.2) across industries. While positive economic spillovers are concentrated in the Project Area, crowding out occurs in other parts of Victoria. The economic impact on adjacent sectors reflects the additional economic activity associated with the Project, including increases in real incomes and associated rises in consumption of local services.

Chart 3.3 shows the flow-on economic impact (measured by value-added) of the Project to various sectors both within the Project Area and the broader Victorian economy. Relative to the base case, the mining sector within the Project Area is unsurprisingly the largest beneficiary of the development. For the mining sector located in the Project Area, the Goschen Project represents an increase of over 20 per cent in output.

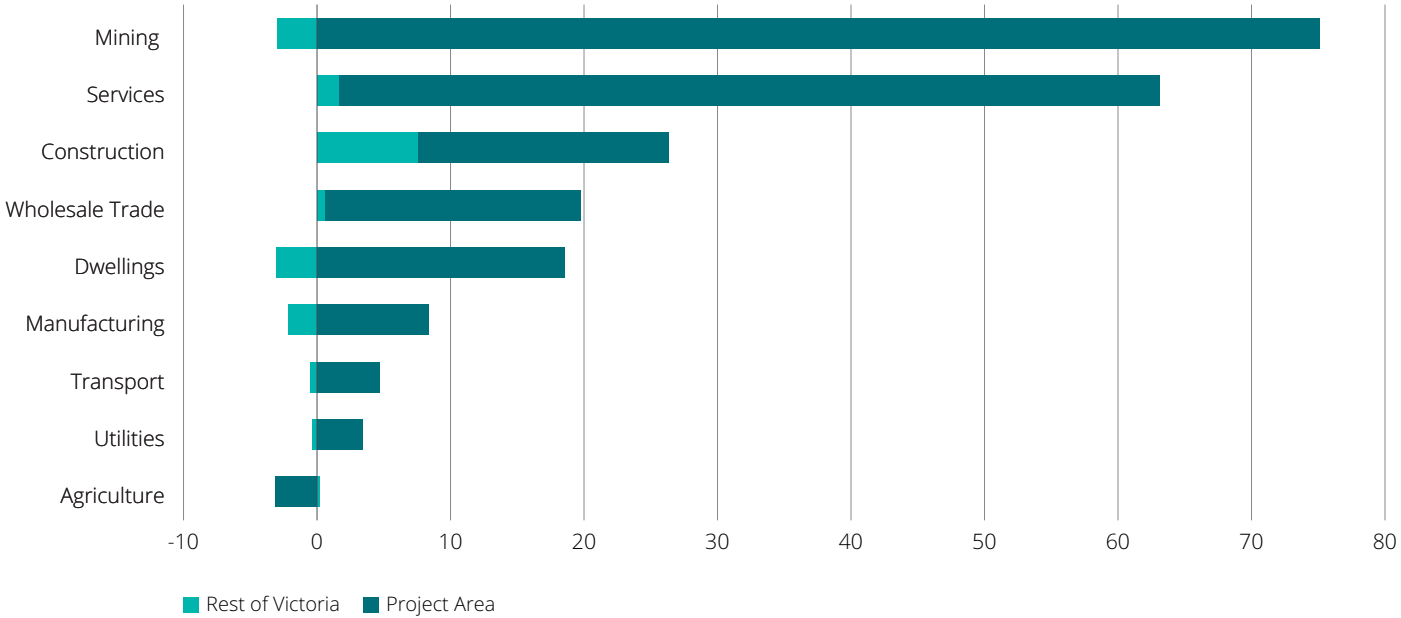
The services sector is the next largest beneficiary, which reflects the needs of the Goschen Project across the operations phase drawing on various ancillary services such as professional, financial and food and accommodation services.

The services sector within the Project Area is estimated to experience positive spillovers worth \$61 million (average annual net increase in sector output). This is followed by wholesale trade, and construction, which experience \$19 million in additional average annual output, respectively. The dwellings sector experiences positive economic spillovers within the Project area as well, with an estimated additional \$18 million per annum in economic output relative to the base case.

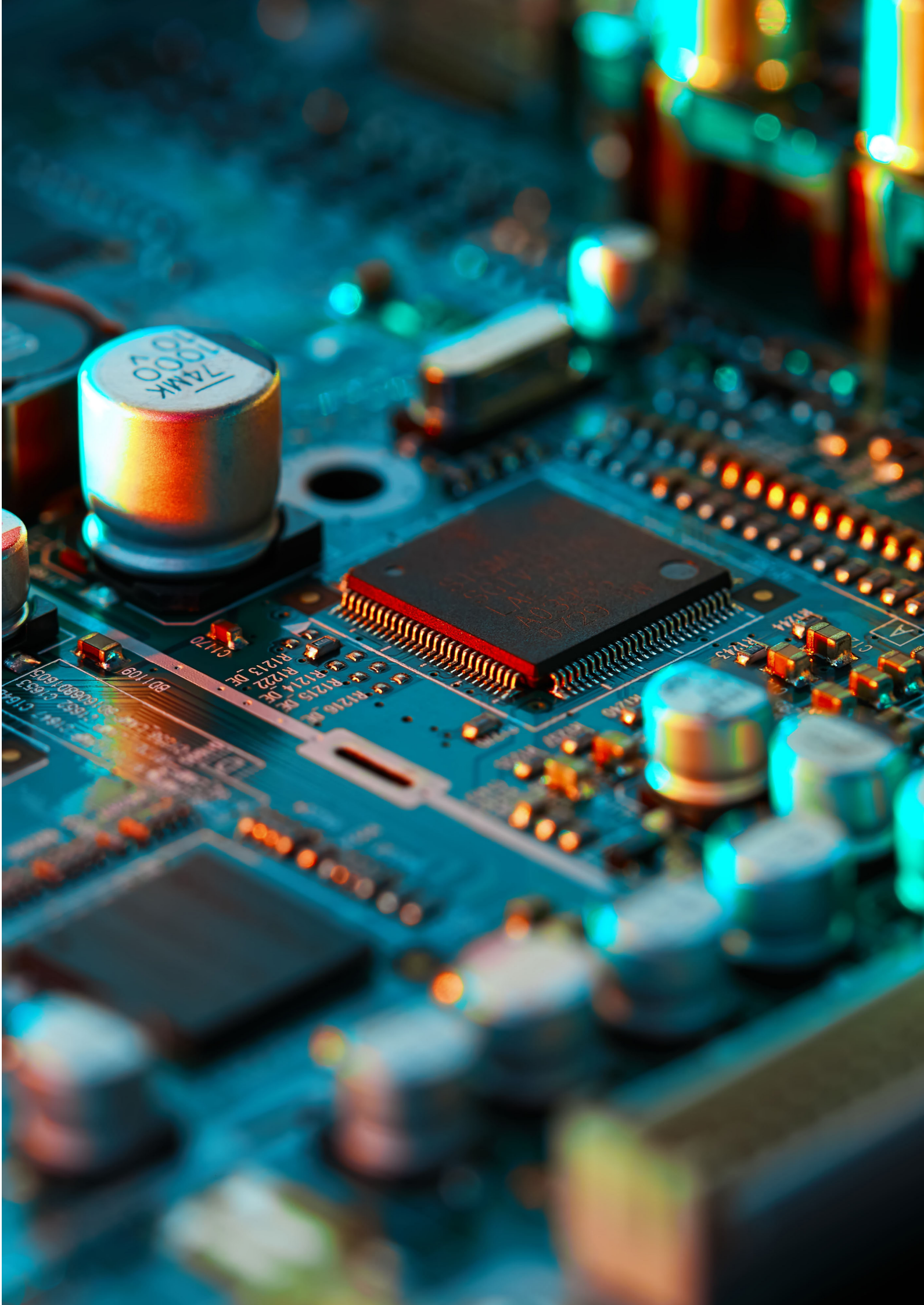
The Goschen Project is also expected to crowd out some economic activity across the rest of the Victorian economy (see Section 4.1.2). This crowding out is observed across the manufacturing, mining and dwellings sectors in Victoria (of approximately \$2-\$3 million per annum each, undiscounted, on average) while crowding out is also observed in the agricultural sector within the Project Area (of approximately \$3 million per annum, undiscounted, on average).

These net negative outcomes reflect the resource demands of the Goschen Project and the redistribution of capital and labour inputs from the broader Victorian region to support the additional economic activity occurring in the Project Area (refer Chart 4.3). The crowding out in these three sectors also reflects the capital intensive and specialist nature of labour associated with a mining project of this scale. Overall however, while crowding out effects are expected, these are small in scale relative to larger spillover benefits projected for other sectors as a result of the development of the Project.

Chart 4.3: Sectoral impacts in the Project Area and the rest of Victoria in annual average value added terms



Source: DAE-RGEM





## 5. Other benefits and costs

### 5.1 Qualitative benefits

The CGE analysis presented in Chapter 4 captures the economic impact of the Project's capital and operating expenditure on the local and Victorian economies, including resultant movements in capital and labour across regions and industries. However, there are a range of qualitative costs and benefits that cannot be quantified through this method. Relevant considerations of this nature for the Goschen Project are outlined below.

#### 5.1.1 Road upgrades

The majority of the local Project area in Loddon-Mallee is rural agricultural farmland, dedicated to broadacre farming applications. The existing local traffic is minimal, and generally comprises of local farming-related light vehicles, trucks, and mobile farming equipment. However, there are seasonal transportation peaks during harvesting and crop transport to rail loading centres.

A traffic impact assessment has been prepared as part of the EES with input from the Department of Transport, the local shire, and local residents in the Project Area, and VHM intends to perform upgrades of roads around and within the perimeter of the project areas in accordance with the findings of this assessment. Road upgrades may include widening, re-surfacing, developing acceleration, deceleration and turning lanes, and expanding intersections to account for larger vehicles with turning radii. Appropriate signage, road and lane marking, and similar measures will also be implemented.

Improved roads are likely to create benefits for all users through greater connectivity and agglomeration benefits.<sup>26</sup> For example, the agricultural industry may realise cost savings through wider roads enabling the transit of larger vehicles, which in turn enable the transport of products in bulk during the harvest season. There may also be improved safety benefits from capacity improvements, and clearer and enhanced road markings.<sup>27</sup>

### 5.2 Qualitative costs

The CGE analysis captures costs to the economy via the measurement of crowding out impacts across sectors and regions. However, other negative externalities generated by project activities – such as incremental carbon emissions – are not captured in the modelling, but are important to consider.

As this study is submitted in conjunction with other environmental assessments required for the EES process, the costs of expected environmental externalities associated with the Goschen project are not quantified or monetised here. As such, this section only provides a brief overview of environmental costs associated with the project.

#### 5.2.1 Project carbon emissions and other externalities

The development of the Goschen Project involves significant capital outlays and related construction activity, ranging from civil works such as pipeline construction, to mine site development and industrial processing plants. In operation, the Goschen mine will also possess a mining transport fleet, typically running on fossil fuels, and the mine will be powered, at least in part, using fossil fuel generators. Both these phases of the mine will generate carbon emissions.

The mining fleet required to service the Project through development and operations will also generate noise and light emissions, while mine excavation and haulage activities will generate dust.<sup>28</sup> VHM Limited has outlined management plans to mitigate the aforementioned costs, which will be included in other components of the EES.

<sup>26</sup> Gerritse, 2018, Concrete Agglomeration Benefits: do roads improve urban connections or just attract more people?

<sup>27</sup> Horberry, Anderson, & Reagan, 2006, The possible safety benefits of enhanced road markings: A driving simulator evaluation

<sup>28</sup> VHM Limited, 2022, Goschen 5Mtpa Project Description Rev 3.1



## 6. Conclusion

It is estimated that the future operations of the Goschen Project will have significant positive economic impact in the Project area, and more broadly across the state of Victoria. Over the evaluation period, the project is estimated to increase GSP in Victoria by \$1.3 billion (present value, 7 per cent discount rate), compared to the base case, where it is assumed the Goschen Project never enters development. This equates to an average annual economic impact of \$126 million (undiscounted) in additional GSP to the State.

These net positive impacts largely accrue to the Project area, with the demand for productive inputs in the region drawing on the rest of Victoria. The estimates provided include crowding out effects in the form of reallocation of capital and labour from other regions and industries to support economic activity in the Project Area.

Over the evaluation period, the Goschen Project is estimated to support an average of 226 FTE positions per annum across the State through both direct and indirect employment. The employment gains largely occur in the Project Area itself and incorporate the movement of workers from neighbouring industries and regions and accordingly reflect total job creation.

While the economic impact presented in this report indicate the scale of impacts from the Goschen Project, they do not include quantified net economic and social costs such as environmental impacts and greenhouse emissions or quantified estimates of benefits such as infrastructure upgrades that occur as a result of developing the Goschen mine. Qualitative benefits to be considered include the upgrade of roads, power lines, and water pipelines in the Project Area.



# Appendix A DAE-RGEM

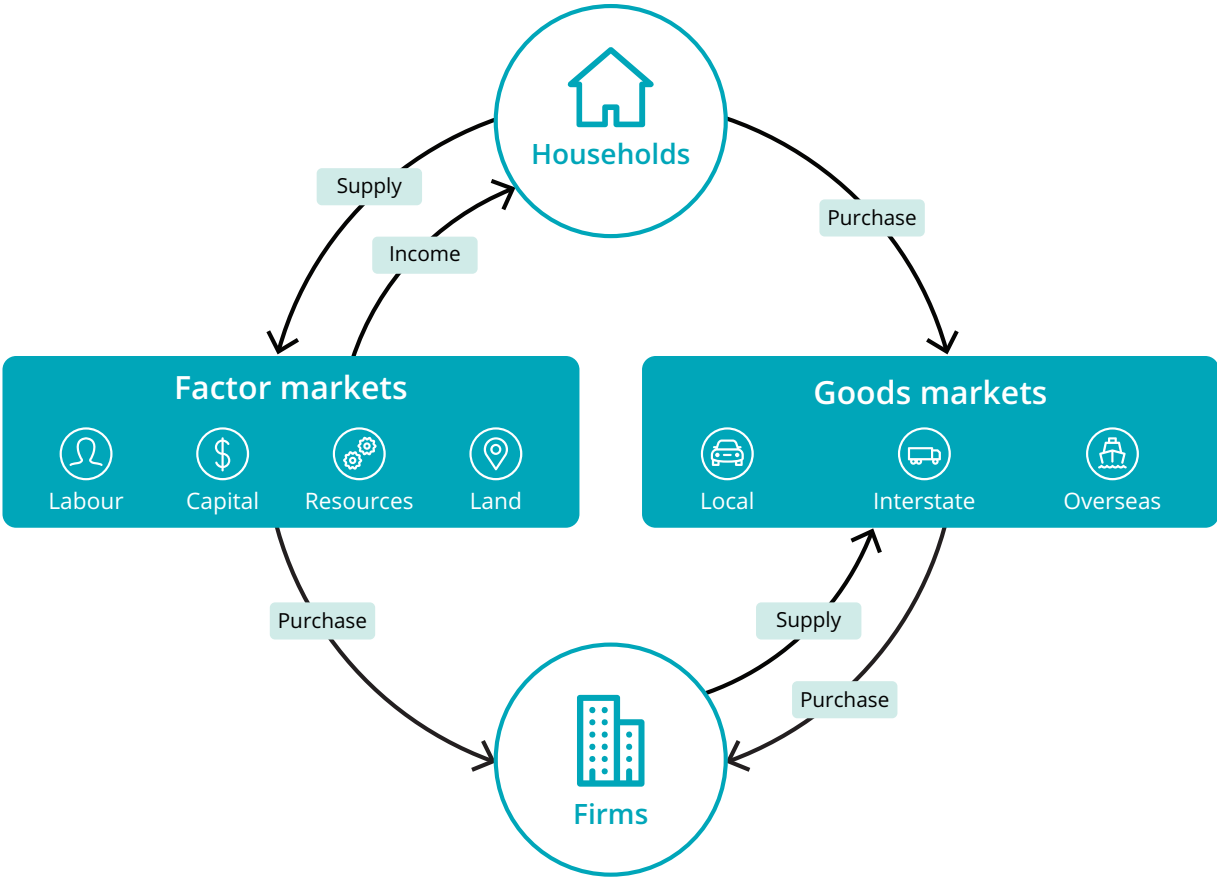
## A.1. Deloitte Access Economics’ in-house model (DAE-RGEM)

The Goschen Project utilises DAE-RGEM. DAE-RGEM is a large scale, dynamic, multi-region, multi-commodity CGE model of the world economy with bottom up modelling of Australian regions. DAE-RGEM encompasses all economic activity in an economy – including production, consumption, employment, taxes and trade – and the inter-linkages between them.

For this analysis, the model has been customised to explicitly identify core sectors of the Australian and global economy and has split each jurisdiction into greater city and rest of jurisdiction regions.

Figure A.1 is a stylised diagram showing the circular flow of income and spending that occurs in DAE-RGEM. 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. The government uses tax revenue to purchase goods and services, while savings are used by investors to buy capital goods to facilitate future consumption. As DAE-RGEM is an open economy model, it also includes trade flows with other regions, interstate and foreign countries.

Figure A.1: The components of DAE-RGEM and their relationships



Source: Deloitte Access Economics

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 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 constant elasticity of substitution production function.
- Producers are cost minimisers, and in doing so, choose between domestic, imported and interstate intermediate inputs via a CRESH production function.
- The model contains a more detailed treatment of the electricity sector that is based on the ‘technology bundle’ approach for general equilibrium modelling developed by ABARE (1996).
- 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.
- The model accounts for greenhouse gas emissions from fossil fuel combustion. Taxes can be applied to emissions, which are converted to good-specific sales taxes that impact on demand. Emission quotas can be set by region and these can be traded, at a value equal to the carbon tax avoided, where a region’s emissions fall below or exceed their quota.



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# Notes



# Notes





Deloitte Access Economics  
Brookfield Place, Tower 2  
123 St Georges Terrace  
Perth, WA, 6000  
Australia

Phone: +61 8 9365 7000  
[www.deloitte.com.au](http://www.deloitte.com.au)

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