

4. Future levels of economic activity

4.1. Introduction

The level of future economic activity will be a major determinant of the future demand for energy. This section provides an estimate of the amount and composition of economic activity in the years 2013, 2020, 2040 and 2050.

No economic estimates over such a long period of time can be considered to be accurate ‘forecasts’ as the potential for unexpected technological, social and economic transformations to occur is too great. However, using a range of plausible assumptions it is possible to develop future scenarios which provide a sound foundation for current day policy making.

The long lifespan of electricity generation infrastructure makes it necessary to attempt to describe the economy so far into the future. Decisions made today about electricity generation will still have an impact on Australia’s greenhouse gas emissions in 40 years time. The need to scrap electrical generation capacity before it reaches the end of its economic life will significantly increase the cost of greenhouse gas abatement. It is therefore necessary for policy makers to be aware of the future energy needs of the Australian economy, and the capacity to meet those needs from alternative sources, if they are to facilitate a low cost transition to the sustainable emissions of greenhouse gases in Australia.

This chapter is organised as follows. Section 4.2 provides an overview of the methodology used to estimate future economic activity in Australia. Section 4.3 provides a discussion of the contemporary Australian economy and the factors that are likely to shape its development over the next 50 years. Section 4.4 provides the estimates of Australian economic activity for the years 2013, 2020, 2040 and 2050. Section 4.5 offers some conclusions.

4.2. Methodology

The process used to estimate future economic activity is as follows:

- 1) Determine output by sector for the base year (2001).

The sectoral data for the base year was purchased from the Australian Bureau of Statistics (ABS). For most industries data were collected at the two-digit level in the ANZSIC classification system. However, for some highly energy intensive industries such as manufacturing and mining, more disaggregated three-digit ANZSIC data were used.

- 2) Determine the growth rate(s) for individual sectors between the base year, the point estimates and the end point.

While most sectors were assumed to grow in line with the economy overall (see below) a number of sectors were assumed to grow faster or slower than average. A discussion of the more significant assumptions concerning sectoral growth patterns is provided below.

3) Forecast the output of each sector.

The sectoral growth rates were applied to the base year estimates of sectoral output to determine the first estimate of sectoral output. Refinements to these estimates, however, are necessary to ensure that the combined output of each sector does not exceed the forecast potential output for the economy as a whole. Steps 4-6 outline the process for estimating future output for the economy as a whole.

4) Determine the total output of the economy in the base year.

ABS output data were purchased as described above.

5) Estimate the potential growth rate.

Long run economic growth is constrained by the available resources and technology. The two factors that are most important in determining the long run rate of economic growth are labour force growth and labour productivity (which is assumed to capture technological change). The rates of employment growth and labour productivity used in the *Intergenerational Report* (Costello 2002) were used in estimating the overall level of economic activity. These forecasts however, end in 2040. The employment and productivity growth rates used in the *Intergenerational Report* for 2040 were therefore assumed to hold until the end of the current analysis in 2050. The forecasts from the *Intergenerational Report* are provided in Table 4.1.

Table 4.1: Growth in labour productivity, employment and GDP

| Decade | Labour productivity growth (% p.a.) | Employment growth (% p.a.) | Real GDP growth (% p.a.) |
|---------------|--|-----------------------------------|---------------------------------|
| 2000s | 1.7 | 1.5 | 3.1 |
| 2010s | 1.75 | 0.6 | 2.3 |
| 2020s | 1.75 | 0.2 | 2.0 |
| 2030s | 1.75 | 0.1 | 1.9 |

Source: Costello (2002) p. 30.

6) Estimate output for the end point.

The sectoral growth and overall growth then need to be reconciled. If all sectors were assumed to grow at the forecast average rate of growth then such reconciliation would not be necessary. However, given that differential sectoral growth rates were assumed to exist the sectors for which differential growth were assumed to occur were estimated first and then the average rate of growth for the remaining sectors was estimated subject to the constraint that the sum of sectoral outputs must equal the estimated size of the economy as a whole.

4.3. The contemporary Australian economy

The Australian economy, like that of all developed economies, has been shaped by a wide range of historical, technological, cultural and political forces. The nature and extent of the impact of individual factors on Australia's economic development has been highly contestable in the past (see for example EPAC 1986; Bureau of Industry Economics 1992, Howe 1993, Dao *et al.* 1993) and will, no doubt, continue to remain that way.

That said, it is possible to identify particular trends that have occurred in recent times and, in turn, to suggest trends which may continue or are likely to emerge. As stated above, however, the following estimates can not be considered as forecasts due to the long length of the period under examination and the inevitability of new technological, social and cultural trends emerging.

Table 4.2 shows the share of GDP by industry for Australia in 2000-01. Manufacturing and property and business services are by far the largest industries accounting for 11.6% and 11.5% of GDP respectively. However, given the length of the time period being analysed in this study it is important to note that relative growth rates, rather than current industry size, will be the major determinants of the composition of economic activity in 2050.

Table 4.2: Australian industry share of GDP, 2000-01

| Industry | Share of GDP (%) |
|---------------------------------------|-------------------------|
| Agriculture forestry and fishing | 3.0 |
| Mining | 4.6 |
| Manufacturing | 11.6 |
| Electricity gas and water supply | 2.5 |
| Construction | 4.6 |
| Wholesale trade | 5.0 |
| Retail trade | 5.1 |
| Accommodation, cafes and restaurants | 2.3 |
| Transport and storage | 4.9 |
| Communication services | 3.2 |
| Finance and insurance | 6.3 |
| Property and business services | 11.5 |
| Government administration and defence | 3.9 |
| Education | 4.3 |
| Health and community services | 5.5 |
| Cultural and recreational services | 1.9 |
| Personal and other services | 2.4 |

Source: ABS 5204.0

Table 4.3 shows the growth rates of each industry for each of the years between 1993-94 and 2000-01 as well as the simple average growth rate over that period. The highest rate of growth has been in the communication services industry, which averaged 10.37 % growth over the period. The lowest growth rate, on the other hand, was achieved in the education industry, which grew by only 1.73 % over the period, less than half the growth rate for the economy as a whole.

Table 4.3: Australian industry growth rates 1993-94 to 2000-01

| | Average (% p.a.) |
|---------------------------------------|------------------|
| Agriculture forestry and fishing | 3.13 |
| Mining | 4.75 |
| Manufacturing | 2.67 |
| Electricity gas and water supply | 2.28 |
| Construction | 2.66 |
| Wholesale trade | 5.76 |
| Retail trade | 3.89 |
| Accommodation, cafes and restaurants | 4.89 |
| Transport and storage | 4.07 |
| Communication services | 10.37 |
| Finance and insurance | 4.62 |
| Property and business services | 6.23 |
| Government administration and defence | 2.42 |
| Education | 1.73 |
| Health and community services | 3.46 |
| Cultural and recreational services | 4.06 |
| Personal and other services | 5.10 |
| Ownership of dwellings | 4.01 |
| GDP | 3.98 |

Source: ABS 5204.0

It is important to note that energy intensive industries such as manufacturing, electricity, gas and water and construction all grew at well below average over the period 1993-94 to 2000-01. Similarly, industries with low energy intensity, including property and business services and wholesale trade have expanded much more rapidly than the economy as a whole. In other words, the economy is gradually becoming less energy intensive.

Table 4.4 provides recent ABARE estimates of future economic growth and industry output for highly energy intensive manufacturing industries. It shows that, excluding direct reduced iron production, metal production is expected to grow at a substantially slower rate than the economy as a whole.

Table 4.4: ABARE estimates of growth in selected manufacturing industries

| | % change |
|---------------------------------------|-----------------|
| GDP | |
| 2000-01 to 2005-06 | 3.7 |
| 2000-01 to 2019-20 | 3.4 |
| Direct reduced iron production | |
| 2000-01 to 2005-06 | 21.0 |
| 2000-01 to 2019-20 | 11.6 |
| Steel production | |
| 2000-01 to 2005-06 | 1.7 |
| 2000-01 to 2019-20 | 2.6 |
| Aluminium production | |
| 2000-01 to 2005-06 | 2.2 |
| 2000-01 to 2019-20 | 1.4 |
| Alumina production | |
| 2000-01 to 2005-06 | 2.2 |
| 2000-01 to 2019-20 | 1.3 |

Source: Dickson, Akmal and Thorpe, 2003, p. 11.

In line with reduced shares of activity in the energy intensive manufacturing sectors the coal mining industry is expected to grow at a slower than average rate. Such shifts, combined with policy changes aimed at reducing the subsidies to coal mining relative to the cost of renewable energy, are likely to result in a substantial decline in worldwide demand for coal. The International Energy Agency, for example, forecasts a 17 % decline in coal use in the OECD by 2020 (IEA 2002, p. 336).

Another important recent trend that is likely to continue is the relative growth of the services sector, particularly communications, banking and finance and hospitality (See for example HSBC 1999; National Office for the Information Economy 2003). These sectors have demonstrated strong growth in recent years and can be expected to continue to do so.

A further note is required on the treatment of the more important of the economic sectors which are determined endogenously in our energy model. These are Oil and Gas Production, Petroleum Refining and Electricity. In the case of Oil and Gas, current expectations are for a decline in Australian production of crude oil, as reserves are depleted, but for this to be offset by a large expansion in natural gas production to supply rapidly growing domestic and international demand. The latter will be supplied by LNG, the production of which constitutes a high value added element of the Oil and Gas sector. We assume that the net effect of these changes will be that economic value added of the sector as a whole grows slightly faster than the economy as a whole, and that demand for energy services for LNG production grows at the same rate. The growth in demand for energy services in processing natural gas for domestic markets is determined endogenously within the energy system model.

In our scenario, physical demand for both electricity and petroleum products grows much more slowly than the economy. This implies that the conventional businesses supplying these commodities will also grow more slowly. However, the lower level of physical demand growth is largely brought about by significant growth in expenditure on energy efficiency – *negawatts* displacing megawatts in the terminology coined by Amory Lovins. This implies greatly increased growth in the diverse industries that supply energy efficiency services, some of which may well be undertaken by electricity supply businesses. We have modelled this change by defining growth in the Electricity and Petroleum Refining industries to be equal to the growth in demand (including demand from transport) for these fuels in the Baseline energy demand projections, i.e. energy demand without the implementation of strong energy efficiency measures.

Table 4.5 provides the relative growth rates for industries that have been assumed to grow at above or below average rates of growth. The figures in Table 4.5 are expressed relative to the assumed rate of growth for the economy as a whole (which change over time as shown in Table 4.1). That is, the figure of 0.9 for Metal Ore and Other Mining suggests that these parts of the mining industry will grow at 90% of the average rate of growth for the economy as a whole while a figure of 1.3 for Accommodation, cafes and restaurants suggests that the industry will grow at 30% above the average rate of growth.

Table 4.5: Relative growth rates for selected industries (% p.a.)

| | |
|---|-----------------------------|
| Coal Mining | 0.5 |
| Oil & Gas | 1.1 |
| Metal Ore Mining | 0.9 |
| Other Mining | 0.9 |
| Petroleum Refining | 0.9 |
| Petroleum and Coal Product Manufacturing n.e.c. | 0.4 |
| Basic Chemicals | 0.4 |
| Ceramic products | 1.1 |
| Cement, lime, plaster & concrete products | 0.9 |
| Iron & steel | 0.4 |
| Basic Non-Ferrous Metal | based on ABARE ¹ |
| Non-Ferrous Basic Metal Products | 0.7 |
| Paper & Paper Product | 0.4 |
| Accommodation, café's and restaurants | 1.3 |
| Road transport | 0.9 |
| Rail transport | 1.2 |
| Air transport | 1.1 |
| Communication services | 1.2 |
| Finance and insurance | 1.2 |
| Education | 1.1 |
| Health and Community services | 1.2 |

¹ The growth rate of aluminium production was assumed to change over time in line with Dickson, Akmal and Thorpe (2003). It is assumed to grow at 2.2% p.a. from 2001-2006 and 1.4% p.a. until 2050.

4.4. Estimates of future economic activity

Estimates of the size of individual sectors and the economy as a whole are derived from the application of the differential growth rates for each sector to the base year estimates of the size of each sector. The results of this process for the years 2013, 2020, 2040 and 2050 are shown in Table 4.6.

Table 4.6: Estimated output by industry 2013, 2020, 2040 and 2050 (\$million)

| | 2013 | 2020 | 2040 | 2050 |
|---|-------|-------|--------|--------|
| Coal mining | 6659 | 7203 | 8742 | 9609 |
| Oil & gas | 24433 | 29009 | 44300 | 54479 |
| Metal ore mining | 12987 | 14950 | 21154 | 25062 |
| Other mining | 1205 | 1387 | 1963 | 2326 |
| Petroleum refining | 1800 | 2072 | 2932 | 3474 |
| Petroleum and Coal Product Manufacturing n.e.c. | 67 | 71 | 83 | 90 |
| Basic chemical | 2503 | 2666 | 3113 | 3358 |
| Plastic product | 3225 | 3771 | 5543 | 6691 |
| Ceramic product | 829 | 984 | 1502 | 1847 |
| Cement, lime, plaster & concrete product | 2778 | 3197 | 4524 | 5360 |
| Iron & steel | 2947 | 3138 | 3665 | 3953 |
| Basic non-ferrous metal | 6338 | 6985 | 9225 | 10601 |
| Non-ferrous basic metal product | 660 | 736 | 965 | 1101 |
| Other chemical product | 4991 | 5834 | 8577 | 10353 |
| Paper & paper product | 2822 | 3005 | 3509 | 3785 |
| Accommodation, café's and rest. | 22754 | 27860 | 45906 | 58592 |
| Road | 12902 | 14852 | 21015 | 24898 |
| Rail | 5491 | 6621 | 10503 | 13159 |
| Air | 8402 | 9976 | 15234 | 18734 |
| Water | 760 | 881 | 1264 | 1506 |
| Other transport | 1222 | 1417 | 2034 | 2423 |
| Communication services | 28728 | 34638 | 54948 | 68843 |
| Finance and insurance | 67008 | 80792 | 128164 | 160573 |
| Education | 43153 | 51235 | 78242 | 96221 |
| Health and Community serv. | 57094 | 68839 | 109202 | 136817 |
| Agriculture, forestry and Fishing | 29757 | 34500 | 49519 | 58990 |
| Services to Mining | 1286 | 1491 | 2139 | 2549 |
| Food, beverage & tobacco | 20247 | 23474 | 33693 | 40137 |
| Textile, Clothing, Footwear and Leather] | 3556 | 4123 | 5918 | 7049 |
| Log sawmilling & timber dressing | 1323 | 1533 | 2201 | 2622 |
| Other wood product | 2070 | 2400 | 3444 | 4103 |
| Printing, Publishing and Recorded Media | 9084 | 10532 | 15116 | 18008 |
| Rubber product | 699 | 810 | 1163 | 1385 |
| Glass and Glass Product | 912 | 1057 | 1518 | 1808 |
| Non-Metallic Mineral Product Manufacturing n.e.c. | 436 | 506 | 726 | 865 |
| Structural metal product | 2603 | 3018 | 4331 | 5160 |
| Sheet metal product | 1699 | 1970 | 2828 | 3368 |
| Fabricated metal product | 3135 | 3634 | 5217 | 6214 |
| Machinery and Equipment Manufacturing | 18565 | 21524 | 30895 | 36804 |
| Other manufacturing | 3327 | 3857 | 5536 | 6595 |

| | | | | |
|-----------------------------|--------|--------|--------|--------|
| Electricity | 13125 | 15217 | 21841 | 26019 |
| Gas | 2194 | 2544 | 3651 | 4350 |
| Water | 5812 | 6738 | 9671 | 11521 |
| General construction | 20515 | 23784 | 34139 | 40668 |
| Construction trade services | 27563 | 31956 | 45867 | 54640 |
| Wholesale trade | 46125 | 53477 | 76758 | 91438 |
| Retail trade | 45220 | 52427 | 75250 | 89643 |
| Services | 16310 | 18910 | 27142 | 32333 |
| Storage | 1890 | 2191 | 3145 | 3747 |
| Property and bus. Services | 101251 | 117388 | 168492 | 200717 |
| Govt. admin and defence | 34665 | 40189 | 57686 | 68719 |
| Cultural and Rec. Services | 16218 | 18803 | 26989 | 32150 |
| Personal and other services | 20253 | 23480 | 33702 | 40148 |

The data presented in Table 4.6 are summarised in Table 4.7, which shows the proportionate increase in value added between 2001 and 2040 for each sector of the economy that was separately analysed in the model. Note that this sectoral breakdown was adopted in order to focus analytical attention on industries which use large amounts of energy, or have particularly distinctive and important energy use characteristics (such as the sugar industry), rather than basing breakdown solely on economic size.

This summary shows clearly that service industries as a whole (termed Commercial/institutional) grow faster than the total economy, though, within this large grouping, accounting for about half of total GDP, some sectors grow faster than others, as shown in Table 4.6. All other sectors of the economy grow at less than the average rate for GDP as a whole, but they all nevertheless show significant growth. Export coal mining, for example, is 55% larger in 2040 than in 2001, making it larger than today's total coal mining industry that supplies both export and domestic markets. There will, therefore, be no need for substantial job losses in any industries on the basis of limited growth alone.

Table 4.7: GDP and Sectoral value added growth ratios, 2001 to 2040 (%)

| Category | Output ratio |
|---|-------------------|
| GDP | 2.40 ^a |
| Domestic energy supply industries | N/A ^b |
| Coal mining for export | 1.55 |
| LNG production for export | 2.62 |
| Mining (non energy) | 2.2 |
| Iron and Steel | 1.42 |
| Food, beverages, tobacco | 2.3 |
| Sugar industry | 1.21 |
| Basic chemicals | 1.42 |
| Cement, lime, plaster and concrete | 2.2 |
| All other non metallic mineral products | 2.3 |
| Non-ferrous metals | 1.79 |
| Wood, paper and printing | 1.42 |
| All other manufacturing | 2.3 |
| Construction | 2.3 |
| Commercial/ institutional | 2.5 |
| Agriculture/ Forestry/ Fishing | 2.3 |

| | |
|-------------|-----|
| Residential | 2.3 |
|-------------|-----|

a: *Intergenerational Report* (Costello, 2002)

b: endogenously determined

4.5. Conclusions

The scenario presented above is, by design, highly conservative. That is, the nature and structure of the contemporary economy is used as the starting point for the analysis and the application of differential growth rates is such that no industries are assumed to disappear and no new industries are assumed to emerge.

As discussed above, the objective of this analysis is not to provide a forecast of the likely industry composition of the Australian economy in the future. Rather, the purpose is to highlight the fact that, using plausible increases in energy efficiency and technological change, it would be possible to meet the likely energy demands of an Australian economy which, while broadly similar to the contemporary economy, had experienced long periods of subsequent economic growth.