Building on the Western Australian Boom:

The Drivers and Shapers of China's

Economic Development in the 21st Century

February 2007

WESTERN AUSTRALIAN
TECHNOLOGY & INDUSTRY
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Executive Summary

China's surging economy, underpinned by strong demand in the USA and other developed economies, is the key factor driving the high rate of growth of the world economy at the present time. This is leading to large-scale investment in the resources sector in Western Australia and around the world. China's expansion is not, however, just another case of a rapidly growing East Asian economy, and should not be seen only in terms of growing markets for particular products, such as resources, energy and educational services. Rather it involves a fundamental reorientation of global patterns of demand and supply, of sources of innovation, and of economic and political power. China is becoming not only a richer country, but also a leader in science and technology, education and social affairs, and an important political power. By 2020, only 14 years hence, China's economy will be by far the largest in the world and its R&D spending will be higher even than in the USA (in purchasing power parity terms). China will then account for more than 15% of world merchandise trade. China is, in short, a key player in the creation of a new world order that will hold the key to Western Australia's continued prosperity in the 21st Century.

Both the speed and the scale of change towards this new world order are unprecedented, but it will not be created in a smooth and steady manner, free of crisis and upheaval. Severe strains are developing in the global economy – in terms of unsustainable growth in energy use and its impact on the climate, a chronic imbalance in financial flows between East Asia and the oil producers on one hand and the developed world on the other, and rising geopolitical tensions related to energy and trade. Imbalances are also mounting within China. Rapid growth based on exports, heavy industry and construction is leading to further pollution of the environment and widening the gap between rich and poor, leaving many dissatisfied with the limited benefits they have received from development. Adjustment to these imbalances may be gradual, or it may involve a sharp slowdown in the world economy, but it will inevitably take place. However this adjustment, when it comes, is unlikely to reverse the underlying trend to a new centre of gravity in the world economy.

Implications for Western Australia

These facts – the extent of Western Australia's current links with China, the historic nature of China's transformation and the likelihood of severe disturbances along the road – provide both major opportunities and big risks for Western Australia. In our judgment it is likely that demand for resources will continue to be strong for the next two to three years. This will drive further major investment in new resources and energy projects, although a strong supply response is already under way. China's economy is growing strongly, even as the imbalances build, and this seems likely to continue for the next few years. Western Australia's unique resource endowments, especially in terms of iron ore and offshore natural gas fields, will generate further large scale investments in such an environment. The boom, however, will come to an end, and this ending could be quite abrupt if the global and Chinese imbalances are not effectively managed. This could mean a return to the boom/bust cycle that has plagued Western Australia in the past.

There is both a real need, and a major opportunity, for Western Australia to build sustainable, long term sources of growth out of the present boom, and on the back of the close links with China that it is generating. The difficulty of this task arises from the fact that, while the economy is booming, it is hard to focus public and private resources on the longer term; but when the boom breaks, much of the opportunity has been lost. The policy challenge is to build these sustainable sources of growth now, while the opportunities abound.

Building a Global Knowledge Hub in Western Australia

Existing Foundations for a Global Knowledge Hub

The State Government has identified four pillars for Western Australia's diversification beyond the boom – biotechnology, information and communications technology, marine and defence and renewable energies. There is, in our assessment, a major opportunity to build a knowledge hub in Western Australia, significant in global terms and unique in Australia, on the basis of these four pillars and of initiatives to date, and through strong collaboration with China (and India). By a 'knowledge hub' we mean an integrated cluster of R&D activities, advanced educational programs and knowledge-based business services, of sufficient scale and excellence to be recognised as a world leader in R&D, to provide a growing level of exports of services to firms and agencies around the world and to be a world leader in the provision of education services internationally.

Both scale and excellence are vital in the creation of such a global knowledge hub. This means that the core activities must be focused in a cluster of related areas where Western Australia can claim, or can reasonably set out to achieve, world best practice and in which it can attract and maintain a high level of demand. In our assessment, the related areas in which these two criteria can be met are: engineering and technical services, especially related to resources and energy; environmental services; marine science and technologies, related both to offshore and sub-sea platforms and to coastal management; and agriculture and water.

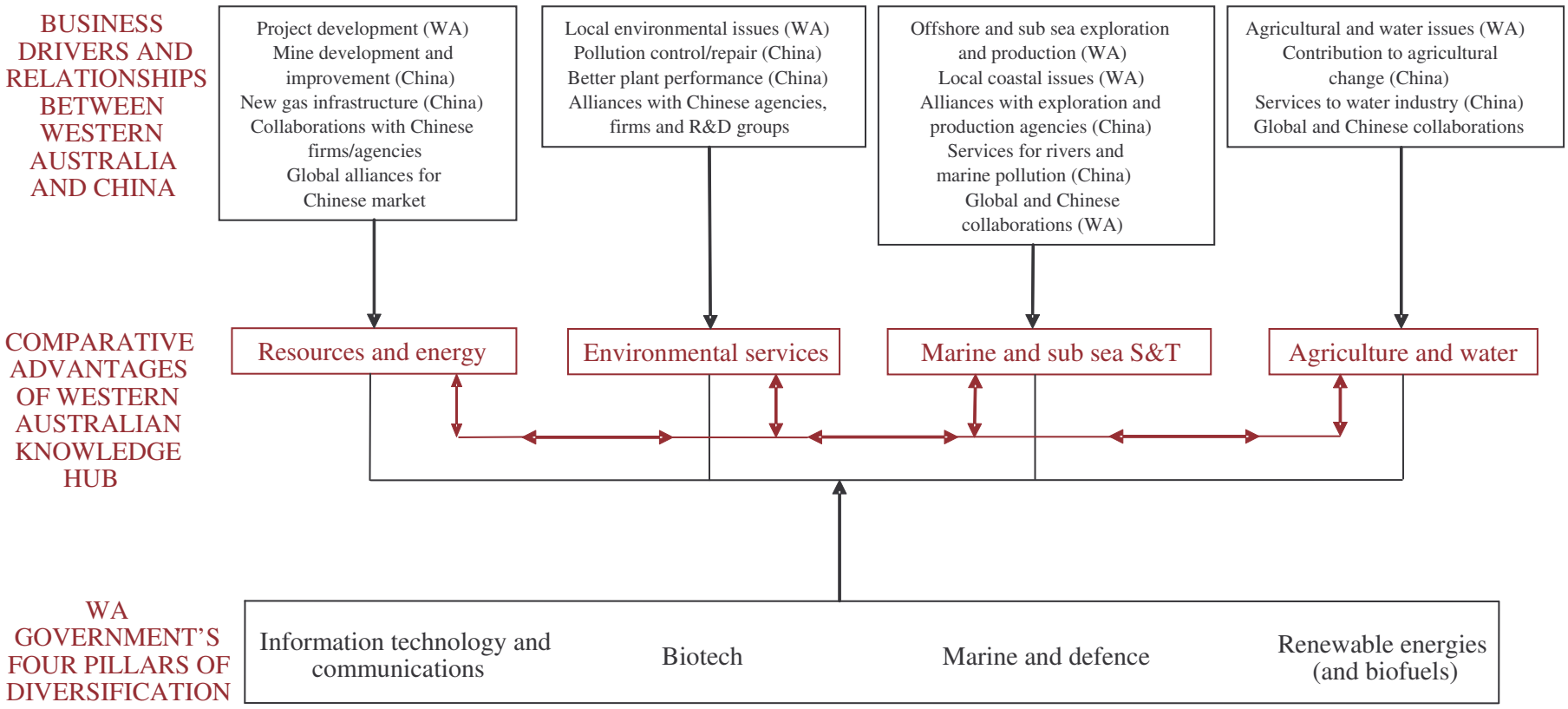
In terms of R&D there is strong evidence that both scale and excellence are being built in Western Australia. There has been a remarkable surge in business R&D in recent years, which is continuing as companies such as BHP Billiton, Chevron and others establish R&D centres in the State. Business R&D grew by only 4.6% per annum in Western Australia over 1992-93 and 2001-02, but between 2001-02 and 2004-05 it jumped by 33% per annum. Growth for the rest of Australia over the latter period was 8.8% per annum. As a share of GSP, business R&D increased from 0.56% in 2001-02 to 1.04% in 2004-05, while for the rest of Australia the increase was only from 0.88% to 0.94%. There is a real prospect that, in the context of effective programs and continued company support, the business R&D share in Western Australia could increase to over 2% within five years. This would be unprecedented within the Australian context. R&D in higher education in Western Australia also increased by 22.2% from 2002 to 2004, by comparison with 10.7% for the rest of Australia.

In terms of knowledge-based services, domestic firms provide a high level of services to resource and other projects within the State, but the level of identified exports of knowledge-based services from Western Australia remains relatively modest. Nevertheless exports of architectural, engineering and other technical services from Western Australia reached $198 million in 2005, 30% of the Australian total. However, overseas student enrolments have grown more slowly in Western Australia than in any other state over the last three years, partly because of a low share of the rapidly growing Chinese student market (4.3% share in 2005).

Building Scale and Excellence through the China Relationship

A major opportunity for building scale and excellence for a global knowledge hub in these areas lies in increased collaboration with China, as China emerges as a global power in science and technology with a growing thirst for knowledge in areas in which Western Australia has expertise. China's R&D priorities are closely aligned to the State's areas of expertise, and spending in these areas by both governments and firms in China is growing rapidly. Figure 1 spells out how a deepening relationship with China, at both commercial and government levels, could play a major role in developing the scale and excellence of the State's global knowledge hub.

Figure 1 Developing a global knowledge hub in Western Australia: China linkages



Many aspects of China's development, and of its response to the massive challenges that it faces, could be supported by expertise from Western Australia. Two of many possible examples illustrate the potential scale involved. First, China has a growing need for natural gas, as an efficient and relatively clean energy source for cities in the south of the country, far removed from China's main coal deposits. Western Australia could provide some of this gas from new fields, but the growth of the China market is constrained by technical and infrastructure issues at the Chinese end, as well as by domestic policy issues. The market for technical expertise and services in this area in China over the next decade will be very large. Second, China realises that it must address deep environmental problems in many areas arising from rapid growth. To do so, it has allocated US$175 billion of government funding over 2006-2010, and is placing great pressure on firms to improve their performance. The scale of the environmental issues to be addressed will almost certainly increase further as rapid development proceeds and the government becomes more committed to environmental audits. In both of these areas Western Australia has substantial expertise (created to meet its own needs), that could be the basis for large scale exports of knowledge-based services and technologies to China. Other areas in which stronger links with China might drive the development of a Western Australian knowledge hub are noted in Figure 5.1.

Building strong relationships with Chinese firms, government agencies and research institutions can also help to strengthen the quality and relevance of Western Australian R&D and education in these areas. China is moving rapidly from being a mere recipient of modern scientific knowledge to being a leading creator of knowledge on a very large scale. Mutual R&D collaborations, with shared R&D activities in both countries, are being recognised by many countries as highly valuable vehicles for increasing the scale, quality and relevance of local R&D. Similarly, high quality Chinese graduate students, and closer links with the institutions from which they come, could contribute greatly to academic life within Western Australia.

Policies for Building the Global Knowledge Hub

To realise the multi-billion dollar potential of this knowledge hub for Western Australia, three issues need to be addressed. There needs to be an *increased orientation* of private services firms, government agencies and universities to export markets, especially in China. Building stronger *relationships and collaboration*s, especially with Chinese firms and agencies, will be crucial. Finally, *building recognition of quality* is necessary if firms, agencies and individuals in other countries are to participate in knowledge activities in Western Australia. While this recognition is growing rapidly in some sectors, in others, such as higher education, a perception in some countries that the major knowledge centres in Australia are located in the eastern states may hinder the growth in high quality student enrolments in Western Australia.

Two specific programs could contribute greatly to achieving these objectives and to building the knowledge hub. Firstly, a program is required to support private firms embarking on knowledge-based collaborations with China, and to encourage universities and government agencies to enter into such relationships. This could provide funding, on a competitive basis, to joint R&D activities in China and Western Australia, to local companies developing products in conjunction with Chinese partners, to government agencies embarking on research or development activities with their Chinese counterparts, to shared R&D and teaching activities and so on. If such a program were of significant scale, say $80-100 million over five years, it would also signal the Government's intention to create a more export-oriented culture in knowledge-based services in Western Australia. Similar programs have been implemented in relation to China by other governments around the world, with some signs of success.

Secondly, a central part of the knowledge hub would be a growing level of internationally engaged, high quality activity in post-secondary education in Western Australia. To increase the involvement of high quality Chinese postgraduate students in the State's universities, the Government could offer a PhD program for leading graduates from China. Such a program, perhaps reaching a total stock of students of about 100 by the third year at a cost of $3-4 million per annum, would attract good students emanating from China's leading universities. If widely advertised within China it could help to build recognition of the State as a knowledge base and as a student destination. Preference could be given to students embedded in a broader collaborative relationship.

The Scale of the Knowledge Hub

In the scope of this report it has not been possible to explore fully this potential to create a global knowledge hub in Western Australia, nor to analyse in detail the policies required to develop it. But it is, in our view, a major opportunity and a realistic possibility. In quantitative terms it might involve, by 2012, outcomes such as the following: a level of business expenditure on R&D in excess of 2% of GSP; exports of knowledge intensive business services in excess of $1 billion per annum; over 5,000 Chinese students, many of the highest quality, studying in the State's universities; and a wide array of international collaborations with Chinese and other firms, agencies and research and educational institutions. Such outcomes would be unprecedented within the Australian context, and would have a major impact on Western Australia, but are achievable. For example, there is a very real prospect that, in the context of effective programs and continued company support, the objective of business R&D at 2% of GSP in Western Australia by 2012 could be achieved.

For practical purposes the report proposes a knowledge hub that can deliver to both Chinese and Indian markets by respecting their differences and unique characteristics. The proposed knowledge hub also forms a framework for any future markets that Western Australia wishes to engage.

It is recommended that the opportunity to create a knowledge hub, and the policies necessary to achieve it, be the subject of a further detailed study.

Other Opportunities for Western Australia

Our analysis in the body of the report suggests a number of other opportunities for Western Australia in the light of the continuing emergence of China. These are noted briefly below.

Tourism

In 2005, there were 31 million outbound tourists from China worldwide, an increase of 20% per annum since 1998. The World Tourism Organization forecasts that the number will rise to 100 million by 2020 (a growth rate of 10% per annum) and this may well prove conservative. The number of Chinese tourists visiting Australia, although only about 1% of the global total, has been growing more rapidly than that total, and Chinese tourists stay longer and spend more on average than other tourists to Australia. In spite of its unique and varied attractions, Western Australia received only 5% of Chinese visitor nights in 2003 and only 4.3% of all Chinese visitors in 2005-06.

There is clearly scope for the State to attract a much larger share of a large and rapidly growing number of Chinese tourists in the years ahead. For example, if 2% of China's tourists visited Australia by 2020 and 10% of those came to Western Australia, the number of Chinese tourists visiting the State would increase twelvefold by 2020, relative to the current level.

While further investment in facilities would undoubtedly be required, the major requirement would seem to be much greater recognition within China of the State and its attractions.

Renewable Energy

Given the continued growth of energy use based on fossil fuels in China and other countries, there is little doubt that global concerns about climate change and renewable energy sources will deepen in coming years. Western Australia has a number of avenues to pursue further development of renewable energy, and considerable expertise in this area. One particular matter being widely debated at the present time is the possibility of increased production and use within Australia of ethanol or biodiesel, and the tax and/or subsidy arrangements that might be appropriate for this case. Our assessment is that high energy demand from China, India and other countries is likely to mean relatively high oil prices for the long-term, although high prices will in due course both moderate demand and increase the supply of oil from both conventional and non-conventional sources. Western Australia has the potential to produce a large volume of ethanol fuel from wheat, both for domestic use and possibly for export, and some potential for biodiesel production. Our analysis suggests that under the full excise tax exemption, the production of ethanol from wheat is commercially viable even at long run oil prices below US$50 per bbl, but that viability declines markedly as the tax exemption is withdrawn. Detailed attention to this and a range of other renewable energy products and services is clearly in the State's interest in the emerging world context.

Value Added Industries

There has long been debate about why Australia, and states such as Western Australia in particular, cannot add more value to resource exports before they are shipped overseas. Some notable investments have been undertaken to this end in Western Australia, for example in the HiSmelt process and in fertilizer production on the Burrup peninsula, and a number of fertilizer and ammonia nitrate projects are on the drawing boards. However, if China is to move up the industrial value chain while getting serious about controlling energy use, there is a case to be made for more processing of resource imports before they come to China. This option will become more attractive if, as seems inevitable, there is a substantial increase over time in the value of the RMB. Whether such value adding activities could or should take place in Western Australia is another matter, but this issue is one that will demand continued policy attention as the global situation develops.

Human and Government Services

As outlined in the body of the report, strenuous efforts are being made in China to shift its development strategy to one that places much greater emphasis on the service sector, and especially on health. China currently spends a very low proportion of its budget on health services, and faces complex problems of improving health services, both in urban areas and in remote rural regions. China also has an extremely complex governance system within which to deliver these changes, and there are significant disparities within and among the four levels of sub-national governments, and the level of services varies enormously between regions, provinces, counties and townships. Over the next few decades there will be a vast and growing market within China for expert services related to these challenges. Many of them have been addressed over a long period of time in Western Australia, so that local firms and public sector institutions should be well positioned to compete for this business.

National and State Strategic Policy Issues

The centrality of China, and the new world order of which it is a key part, to the future prosperity of Australia, and especially Western Australia, raises a number of broader issues that need to be addressed at both state and national levels.

Firstly, the social and cultural prerequisites within the Australian, and the Western Australian, communities for dealing effectively with a world in which China is a dominant player need to be addressed. This covers such matters as Chinese history, language and cultural studies in schools, much more extensive programs in these areas in the universities and more general programs to share information and to create awareness.

Secondly, using the emergence of China in an effective way to promote local growth will depend above all on the development of long-term relationships, networks and linkages at many levels between Western Australia and China. Given the resource relationship, the State has a head start in this matter, but the extension and deepening of these relationships should be a high priority of the State Government.

Thirdly, attention needs to be given to some of the strategic issues in developing closer relationships with Chinese firms and agencies. These include the possible use of direct investment by Chinese agencies as a mechanism for controlling the use of resources and of curtailing the operation of markets, and of the unique and complex issues involved in doing business in a rapidly growing, increasingly market oriented economy governed by the Chinese Communist Party in a way that can be heavily bureaucratic. China is changing rapidly in many relevant respects, but these issues remain important for firms and governments dealing with China.

Finally, the initial impact of China's emergence as a global economic power on Western Australia is quite different from its impact on the south eastern states of Australia. For the former, it is driving the resources boom, leading to a strong trading surplus and an increased concentration of global knowledge resources in Western Australia. For the latter, the impact is initially felt mainly through greatly increased competition in manufacturing, as indicated by a trading deficit on elaborately transformed manufactures of $71 billion in 2005, and increased pressure on knowledge resources as the manufacturing base erodes. Both regions need to develop considered strategic responses to the challenges and opportunities that they face. However, these increasingly divergent paths mean major problems for key national institutions – those concerned with matters ranging from immigration and monetary policy to wage, price and exchange rate determination and fiscal equalisation – in producing outcomes that meet the needs of the whole of Australia.

1 The Rise of China in Global Perspective

For several millennia prior to 1700, China and India were the primary economic powers on the globe, accounting for more than 50% of global GDP between them (Maddison 2003). They were also knowledge oriented societies, fostering some of the world's great civilizations and contributing significantly to the advance of human knowledge. Europe's increasing prosperity and openness after the Renaissance allowed it to build on that inherited knowledge, and to integrate it with that of ancient Greece and Rome, to create modern science and to apply that science to shape new forms of economic activity. The resulting Industrial Revolution from the 18th Century was firmly centred in Western Europe, and quickly led to the rise of Europe as the dominant economic, military and imperial power. The United States emerged gradually over more than a century, to surpass Western Europe as the most prosperous region and to become the dominant global power over the second half of the 20th Century.

For many complex reasons, the impact of these developments on China and India was adverse, in both absolute and relative terms. After accounting for about 50% of world GDP as late as 1820, by 1973 they provided only 8% of world GDP (Maddison 2003), in spite of still being home to 37% of the world's population. This change was not simply one of relative position, but involved serious levels of poverty and deprivation for substantial parts of the population in both countries, as in many other developing countries.

It has become clear only in recent years that the sustained development of China since 1979, and the progressive emergence of India to rapid growth, is indeed likely to be the creation of a new world order, involving the return of China and India to their previous position as global economic powers, and perhaps indeed to being the major world powers. Two developments in particular have sparked this new understanding of the scale of change underway. One is the performance of China since its entry to the WTO in 2001, which has sparked a remarkable new round of growth at 10% per annum, led by exports, fixed investment and energy intensive industrial production. The other is the initiation in India, by the United Progressive Alliance Government under the leadership of Manmohan Singh, of a major new phase of reform and development, which is building the foundations for sustained growth at 7-8% per annum. However, such fundamental change will not be achieved easily or smoothly – major imbalances and contradictions need to be addressed, and the risks of the world economy being thrown off course in a major way remain significant.

1.1 The Economic Shape of the New Order

To set this report in context, it is useful to provide some quantitative definition of the emerging new global economic order which is being driven above all by China's continuing growth. Few international agencies provide long-term forecasts, say out to 2030, and the most authoritative ones available are those of the International Energy Agency, last published in November 2004 (IEA 2004). These provide our starting point, although substantial revision is necessary for key developing countries, in part to take account of recent information concerning growth in GDP in China, India and other countries. Nevertheless, in building the projections summarised below and reported in more detail in Supporting Paper 1, the values of key parameters from IEA 2004 are used except where new data or other information make this no longer appropriate. For the OECD countries except Japan, Korea, Australia and New Zealand, and for the transition economies, the IEA projections are retained in full.

These projections are on an unchanged policy basis, and assume that there is no major crisis in the world economy or in these countries over the period to 2030, and in particular that China finds a way to resolve the imbalances in its present expansion, and to achieve a sustainable growth path (see Chapter 4). They are presented in constant purchasing power parity prices.

China has grown 9.8% per annum between 2001 and 2005, following growth of nearly 10% per annum between 1980 and 2001. The available data suggest that strong growth is continuing in 2006, with exports, investment in fixed assets and increases in industrial production driving growth, and real GDP 10.9% higher in the first half of 2006 than in the same period of 2005 (http://www.stats.gov.cn). In projecting that growth forward we assume a gradual moderation of growth to 8% by 2010, a reduction of that growth rate to 7% on average through to 2020, and an annual rate of 6% per annum over 2020-30. These assumptions involve a considerable slowing of Chinese growth from its current hectic pace, but continued fairly strong growth over the longer term.

India's growth has been accelerating since the late 1970s, and reached 5.4% in the Ninth Plan period, 1997-2002. The Indian Planning Commission estimates that the outcome for the Tenth Plan period, 2002-07, will be 7% per annum, by comparison with a target of 8.1% (IPC 2005), and is using a growth rate of 8.5% as the working basis for the Eleventh Plan period, 2007-12 (PC 2006). The initial estimate of real growth for 2005-06 was 8.4% (www.mospi.nic.in). India's growth has traditionally been driven by services rather than industry, and a notable feature of recent trends has been an increase in the growth of secondary industry relative to the overall growth of GDP. Thus for the Eleventh Plan period the initial target working basis for industry is 10% per annum, and for manufacturing 12% per annum, by comparison with the GDP rate of 8.5% (PC 2006). For the projections we use lower figures than those foreshadowed by the Planning Commission, but ones that still imply strong growth out to 2030: 7% for the Eleventh Plan period, 6.5% from 2012-20 and also for 2020-30. These projections imply convergence of growth rates in the two countries, with China's long-run growth rate slowing from that of recent decades, with the underlying rate of growth in India continuing to increase for some time. The projections for both China and India are fairly conservative, in that higher figures could be justified both on the basis of recent trends and official statements.

Table 1.1 GDP, actual 1971-2002 and projected 2002-2030, in 2000 US$ PPPs

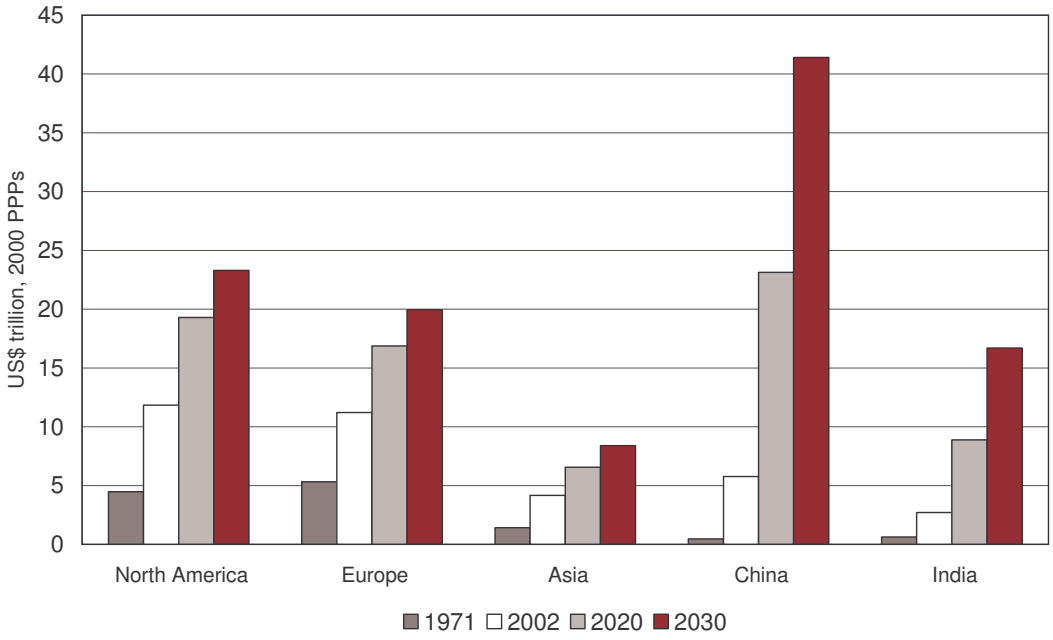
	GDP in US $2000 PPPs			Annual change (% per annum)			Share of global growth (%)
						IEA (2004)	
	1971	2002	2030	1971-2002	2002-30	2002-30	2002-30
		(US$ trillion)			(% per annum)		(%)
OECD		27.9	53.1	2.9	2.3	2.2	24.3
North America	4.5	11.8	23.3	3.2	2.4	2.4	11.1
Europe	5.3	11.2	20.0	2.4	2.1	2.1	8.5
Asia	1.4	4.2	8.4	3.5	2.5	1.9	4.0
Oceania	0.2	0.6	1.4	3.0	2.9	2.3	0.8
Transition economies	1.8	2.1	5.7	0.4	3.7	3.7	3.5
Developing countries	4.1	17.0	84.5	4.7	5.9	4.3	71.4
China	0.5	5.8	41.1	8.5	7.3	5.0	40.7
India	0.6	2.7	16.7	4.9	6.7	4.7	13.5
SE Asia	0.4	1.9	6.4	5.4	4.5	3.8	4.3
Other	2.6	6.7	20.0	3.1	4.0	3.4	12.8
Other countries	0.1	0.6	1.4	6.4	3.2	3.2	0.8
World	17.4	47.5	144.6	3.3	4.1	3.2	100.0

Source: Historical data to 2002 is from IEA website (http://data.iea.org/ieastore/statslisting.asp) with projections by the authors.

For other OECD regions (Asia and Oceania) and other developing countries projected growth rates are about 0.5 percentage points higher than in IEA (2004), reflecting factors such as the emergence of Japan from its long period of stagnation, the impact of resources and other demand from China on Australia's growth prospects and improved prospects for the developing countries generally.

The results of these projections are provided in Table 1.1 and figures 1.1 and 1.2. Global growth is expected to be 4.1% per annum over 2002-30, about 25% higher than in the IEA (2004) projection and than the actual rate for 1971-2002. Growth in OECD countries is expected to be lower than over 1971-2002 but, driven by China, developing countries as a whole are projected to grow by nearly 6% per annum. On this interpretation of unchanged policy assumptions, China will account for almost one quarter of world economic activity by 2020, and will be by far the largest national economy in the world by that time (Figure 1.1). By 2030 China's GDP in purchasing power parity terms is likely to amount to about 32% of global GDP, to be twice as large as that of Western Europe and almost double that of North America. By 2030 India's economy will be the third largest national economy in the world, twice the size of that of Japan.

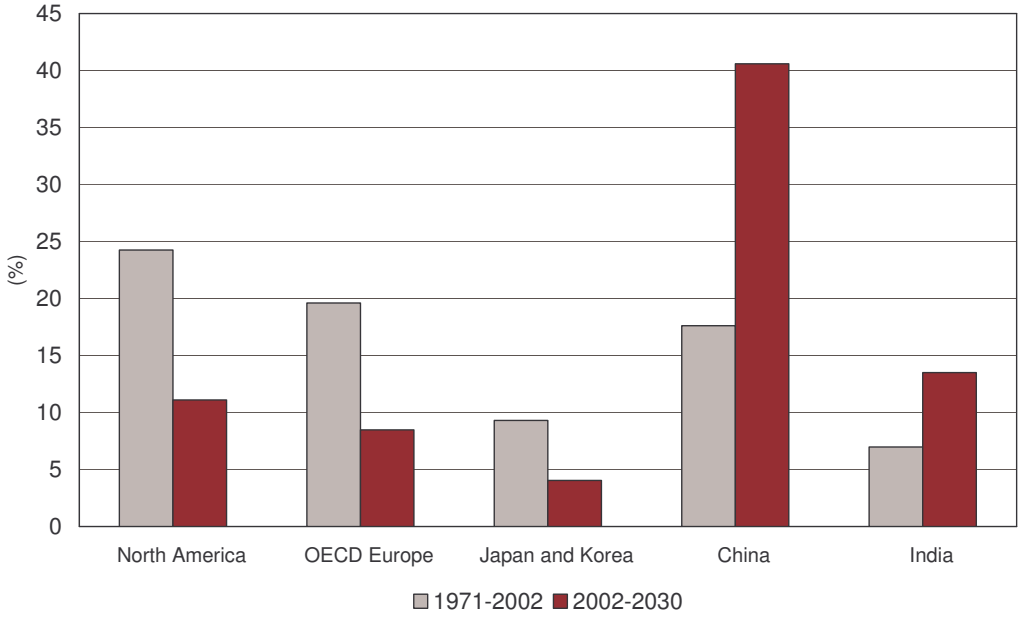
Figure 1.1 GDP, selected regions and countries, 1971-2030, US$ trillion, in 2000 US$ PPPs



Source: As for Table 1.1.

Perhaps a more important perspective for the present study concerns the sources of global growth over the period to 2030, as indicated by the regional distribution of the addition to GDP. As is evident from the right hand column of Table 1.1 and from Figure 1.2, over the period 1971-2002 the impetus for global growth was still mainly coming from the developed countries. The OECD countries of North America, Europe and East Asia provided 54.5% of global growth, with China providing only 17.6%, even though it was growing rapidly for much of this period, and China and India together accounting for 24.6%. Over the period 2002-2030 these contributions will be almost exactly reversed, with 41% of global growth occurring in China (and 54% in China and India combined) and only 24% being provided by the OECD countries. The 'centre of gravity' of global growth has shifted decisively.

Figure 1.2 Shares of the change in global GDP, selected regions and countries, 1971-2002 and 2002-30, per cent of total change



Source: As for Table 1.1.

1.1.1 Implications for Western Australia

These are indeed historic trends, and imply a fundamental reshaping of the economic order as it stood at the end of the 20th Century. Australia's proximity to the emerging powers mean that the welfare of Australians, and perhaps especially of Western Australians, will be heavily shaped by trends in China and India, and by the nature and quality of our links with them. However, the development paths and the cultural frameworks of the two countries are quite different, as are the implications of their development and the opportunities that they provide, and in this report we focus only on China. In the balance of this chapter we explore some key aspects of the emerging Chinese path, in the context of its likely global impact.

1.2 The Factory of the World

In China's rapid development since the 'opening to the market' in 1979 the central engine of Chinese growth has not always been the industrial sector, and indeed for the first decade of reform, the unleashed energy in agriculture and services was most important (see Chapter 3). But the industrial sector is certainly at the heart of the rapid expansion since 2001. Real value added of the Chinese industrial sector will be more than 70% above its 2001 level in 2006, and in many industrial products China's output constitutes a major proportion of total world output. In US$ terms China's merchandise exports will be about US$950 billion in 2006, three and a half times their 2001 level of US$266 billion, and seem set to continue to for sometime to come. There is thus much reality to the current cliché of China becoming the 'factory of the world'.

Table 1.2 Production of selected industrial products, China, 1990-2006

	Chemical fibres (m tons)	Air conditioners (m units)	Household refrigerators (m units)	Colour TV sets (m units)	Crude steel (m tons)	Cement (100m tons)	Motor vehicles (m units)	Micro-computers (m units)	Integrated circuits (100m units)
1990	1.7	0.2	4.6	10.3	66.4	2.1	0.5	0.1	1.1
1995	3.4	6.8	9.2	20.6	95.4	4.8	1.5	0.8	55.2
2000	6.9	18.3	12.8	39.4	128.5	6	2.1	6.7	58.8
2001	8.4	23.3	13.5	40.9	151.6	6.6	2.3	8.8	63.6
2002	9.9	31.4	16	51.6	182.4	7.3	3.3	14.6	96.3
2003	11.8	48.2	22.4	65.4	222.3	8.6	4.4	32.2	148.3
2004	14.2	66.5	30.3	73.3	272.8	9.7	5.1	45.1	211.5
2005	16.2	67.7	29.7	82.8	352.4	10.6	5.7	80.8	266
2006 (est.)[1]	18.9	68.6	40.1	83	416.9	12.8	7.3	108.3	387.6
				Growth rates (% per annum)					
1990-2001	15.9	51.6	10.2	13.3	7.8	11	14.8	52.9	44.8
2001-2006	17.5	24.1	24.3	15.2	22.4	14.1	25.5	65.3	43.5
				Estimated share of total world production, 2006 (%)					
	50	na	na	na	42	52	10	na	na

Note: [1] Estimate for 2006 based on application of the year on year growth rate for the first half of 2006 for the full year.
Source: NBSC (2005a, 2006a, 2006c).

Given the lack of adequate disaggregated data on Chinese industrial production in real terms, some illustration of that growth is provided in Table 1.2 in terms of selected items in physical units. Each of the nine items shown in the table has grown very rapidly both over 1990-2001 and since 2001, but for seven out of the nine items growth has been considerably more rapid over the past five years. The production of crude steel, for example, has increased nearly three-fold between 2001 and 2006 (estimated on the basis of the growth rate for the first half of the year). In 2006 China will account for over 40% of global steel production, with the increase in this year being above 20%. Production of non-ferrous metals, and particularly aluminium, is also expanding sharply. Cement production, for which China accounts for over half of world output, continues to grow strongly, to meet the demands of the construction boom. Motor vehicle production is also increasing rapidly from a strong base, with China now producing about 10% of all vehicles worldwide and production growing by some 25%. The automotive sector is likely to be an important next stage of China's export expansion, with exports of automobiles and automobile components expected to increase from US$10.9 billion in 2005 to US$70 billion by 2010.[1] While it is hard to get simple summary measures of output volumes in ICT, China is clearly now a major global producer in this area also.

One important aspect of recent developments, relevant both to energy use and to the demand for Western Australia's resources, is the increasing shift to heavy industry in China's industrial production. Data is not readily available for the heavy/light industry split in real terms, so Table 1.3 illustrates the point with current price data. In the first half of 2006 heavy industry accounted for 69.5% of industrial value added (excluding non state-owned enterprises with sales of less than 5 million yuan), by comparison with 60.8% in 1999. This ongoing shift to heavy industry is undoubtedly one of the factors contributing to rapid growth in energy use and in demand for resources such as iron ore, alumina and nickel.

[1] Xinhua Online, 19 September 2006.

Table 1.3 Value added, light and heavy industry, China, 1990-2006 (est.) (all state-owned enterprises and other enterprises above designated size)

	Light industry	Heavy industry	Total	Share of heavy industry
	(billion yuan, current prices)			(%)
1999	8448	13116	21564	60.8
2000	9514	15881	25395	62.5
2001	10517	17813	28330	62.9
2002	12352	20643	32995	62.6
2003	14353	27638	41991	65.8
2004	17762	37043	54805	67.6
2005	20585	45840	66425	69.0
2006 (first half)	23837	54320	78158	69.5
Growth rates		(per cent per annum)		
1999-2006	16.0	22.7	20.6	
1999-2002	13.5	16.3	15.2	
2002-2006	17.9	27.4	24.1	

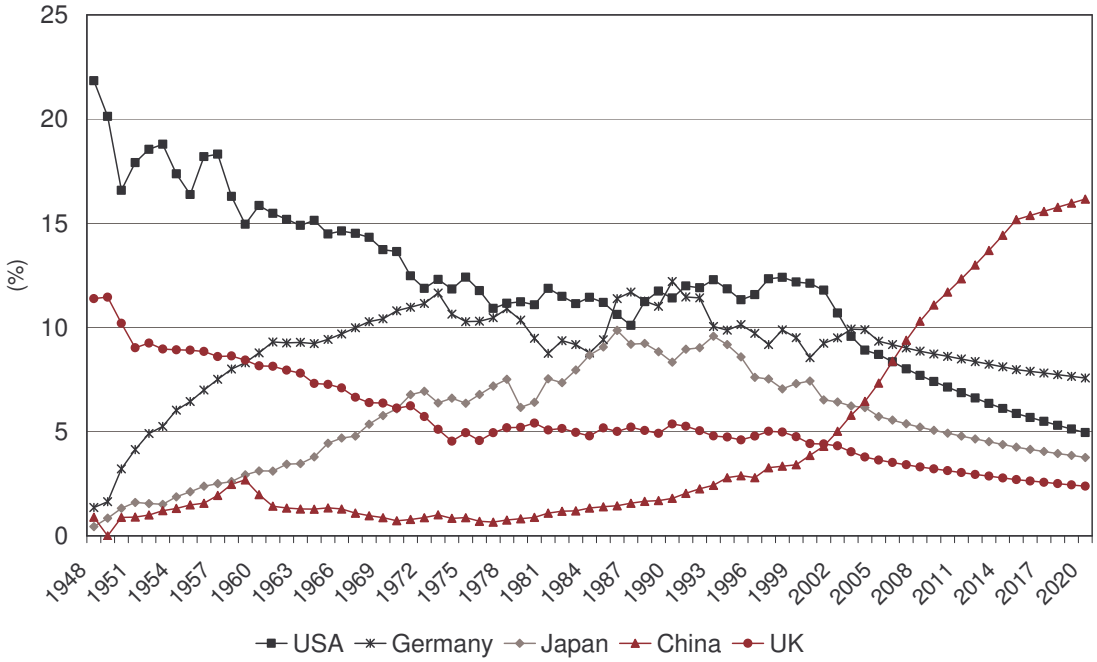
Note: In terms of non state-owned enterprises, the table includes only those with sales in excess of 5 million yuan.
Source: NBSC (2005a, 2006a, 2006d).

The emergence of China as the modern 'factory of the world' is a relatively recent phenomenon, linked above all to China's entry into the WTO in 2001. This entry not only gave China increased access to global markets, but also stimulated further interest on the part of multinational companies in basing production for world markets within China, and led to a further increase in Foreign Direct Investment. Of China's total merchandise exports of US$762 million in 2005, nearly 60% were produced by foreign companies and joint ventures, while only 22% came from state-owned enterprises and 18% from listed and private foreign companies (Ryan 2006). Much of these exports still seem to involve relatively low value added production or assembly operations, although the Government is seeking to increase the value added level through increased application of science and technology.[2]

The recent emergence of China as a major trading nation can only be fully appreciated by being placed in its historical context. Figure 1.3 shows the share of world merchandise exports for five nations (USA, Germany, Japan, China and UK) from 1948 to 2005, with indicative projections to 2020. The projections involve a continuation of existing export trends for countries other than China, and a progressive slowing in the growth rate of Chinese exports, from the rate of 25% per annum over 2000-05 to 15% per annum over 2010-15 and to 10% per annum over 2015-2020. Given the current impetus of China's exports these assumptions may understate their growth if the world economy remains relatively strong.

[2] For a discussion of this issue in the case of information technology and telecommunications products see Chapter 3; for a contrary view see Rodrik (2006).

Figure 1.3 Selected country shares of total world merchandise exports, 1948-2005, with indicative projections to 2020



Source: WTO (2006) and estimates of the authors.

Two main features are evident from the figure. First, while China's share of world merchandise trade has been increasing gradually over the whole reform period, the big jump has been since 2000. Indeed China's share increased by more from 2000 to 2005 (from 3.9% to 7.3%) than it did between 1980 and 2000 (from 0.9% to 3.9%). Secondly, on the assumptions listed above China's share of world merchandise exports will exceed 16% by 2020, a level comparable only to the dominance that the USA held over world trade in the aftermath of World War II, and a level exceeding 20% is certainly feasible. This chart thus brings out the scale and speed of this change in historical perspective, and hints at the magnitude of the adjustment that it will imply for many other countries.

1.2.1 Different Impact on Western Australia and on the Rest of Australia

There are two main types of global impact of China's current export-based expansion: a positive impact on those regions which are providing inputs – in the form of resources, components and equipment – to fuel the expansion, and a negative one for those regions whose industries face severe competition from China, in either domestic or export markets. Within Australia both of these effects are being felt, with Western Australia (and to a lesser extent Queensland) receiving great stimulus from China's demand for resources while the states in the south east of Australia feel the full impact of Chinese competitiveness in terms of the manufacturing industry.

This differential impact is illustrated in Table 1.4 and Figure 1.4, which show trade with China by major components for Western Australia, the rest of Australia and the nation as a whole. The three categories used are elaborately transformed manufactures (ETMs), simply transformed manufactures (STMs) and mining and other, which includes both agriculture and resources exports plus items not classified by commodity, mainly because of confidentiality provisions. For more details see Supporting Paper 2.

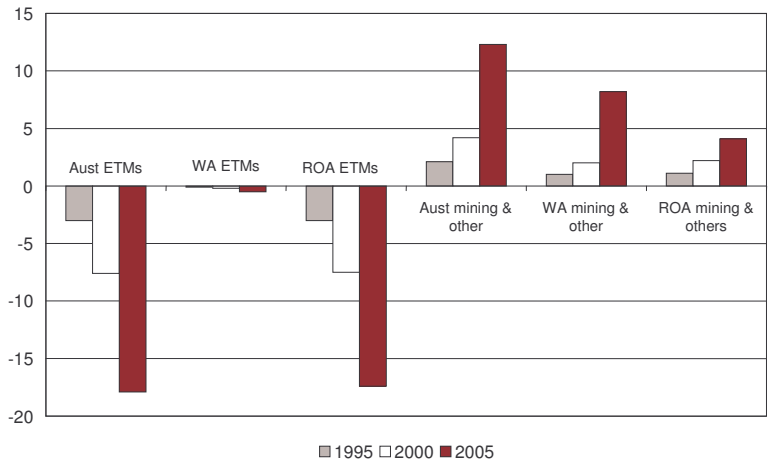
Table 1.4 Australia's goods trade with China, 1995-2005

	Australia			Western Australia			Rest of Australia		
	1995	2000	2005	1995	2000	2005	1995	2000	2005
	(A$ billion)			(A$ billion)			(A$ billion)		
Exports									
Total	3.1	5.8	16.1	1.0	2.1	8.6	2.1	3.7	7.4
ETM	0.4	0.6	1.4	0.0	0.1	0.3	0.4	0.5	1.1
STM	0.3	0.4	0.7	0.0	0.0	0.0	0.3	0.4	0.7
Mining and other	2.4	4.8	13.9	1.0	2.0	8.3	1.4	2.8	5.6
Imports									
Total	3.9	9.1	21.3	0.1	0.3	1.0	3.7	8.8	20.3
ETM	3.5	8.3	19.3	0.1	0.2	0.8	3.4	8.0	18.5
STM	0.1	0.2	0.4	0.0	0.0	0.1	0.1	0.2	0.3
Mining and other	0.2	0.6	1.6	0.0	0.0	0.1	0.2	0.6	1.5
Trade Balance									
Total	-0.7	-3.2	-5.3	0.9	1.8	7.6	-1.6	-5.0	-12.9
ETM	-3.0	-7.6	-17.9	-0.1	-0.2	-0.5	-3.0	-7.5	-17.4
STM	0.2	0.2	0.3	0.0	0.0	-0.1	0.2	0.2	0.4
Mining and other	2.1	4.2	12.3	1.0	2.0	8.2	1.1	2.2	4.1

Source: TradeData/ABS.

As is well known, Australia's exports to China have grown very rapidly since 2000, increasing from $5.8 billion to $16.1 billion. Very little of this $10.3 billion growth has been in manufactured goods, and in particular Australia's ETM exports to China remain very low. Between 2000 and 2005 China's imports of ETMs grew from US$130.3 billion to US$438.9 billion, and Australia provided only a little over US$1 billion of the 2005 figure. Most of the growth in Australia's exports to China ($9.1 billion) was in mining and other exports, and Western Australia provided two thirds of that, with most of the rest being provided by Queensland. In terms of Australia's imports from China, the picture is reversed: of the total increase in imports from China between 2000 and 2005 ($12 billion) almost all of this ($11 billion) was in ETMs, and almost all of this ($10.5 billion) went to the rest of Australia.

Figure 1.4 Australia's goods trade balance with China, 1995-2005, by region and product category



Source: TradeData/ABS.

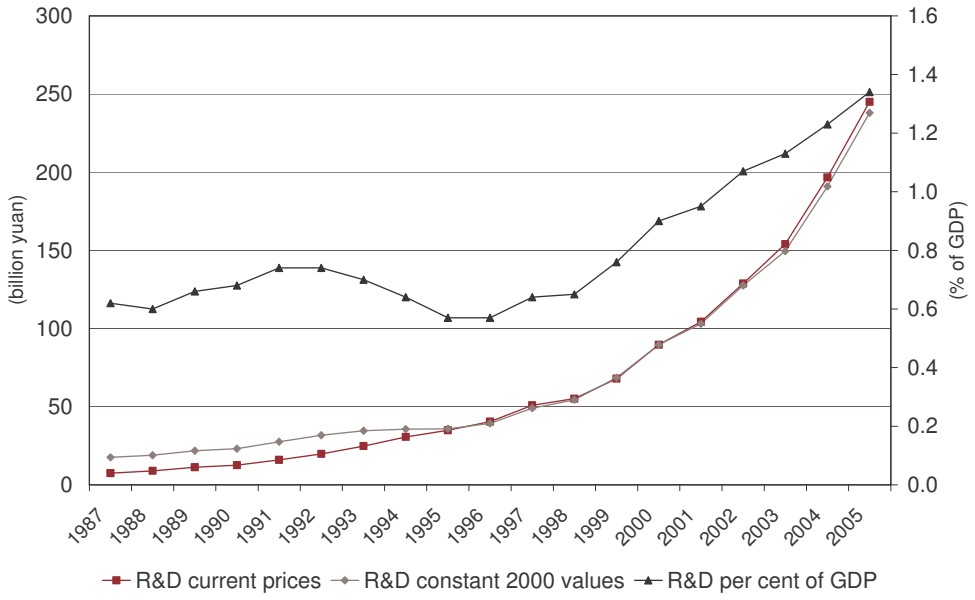
Thus while Western Australia benefits from mining and other trade surplus of $7.6 billion in 2005, the rest of Australia has a deficit of $17.4 billion on ETM trade, and increase of just on $10 billion since 2005. The expansionary effect of China is being felt in Western Australia, the deflationary effect is strong in the south eastern states.

In Western Australia, however, high levels of investment in the resource sector have flowed through to the manufacturing, energy and construction sectors. Employment in these sectors plus mining grew by 65,600 persons or 5.7% per annum in Western Australia between August 2001 and August 2006, by comparison with an increase of 46,300 or 1.5% per annum in the rest of Australia (see Chapter 5).

1.3 An Emerging Power in Science and Technology

As part of its overall development plan, China is seeking to achieve global leadership, or at least parity with the leading Western countries, in science, technology and education. To this end, investment by the Chinese Government and other Chinese parties in these areas continues to be very substantial. In the period 1991-2004, total investment in R&D in China grew thirteenfold and, in the five years to 2004, China added 395,200 personnel to its skilled researcher base, an increase of 74%.

Figure 1.5 Expenditure on R&D, China, 1987-2004



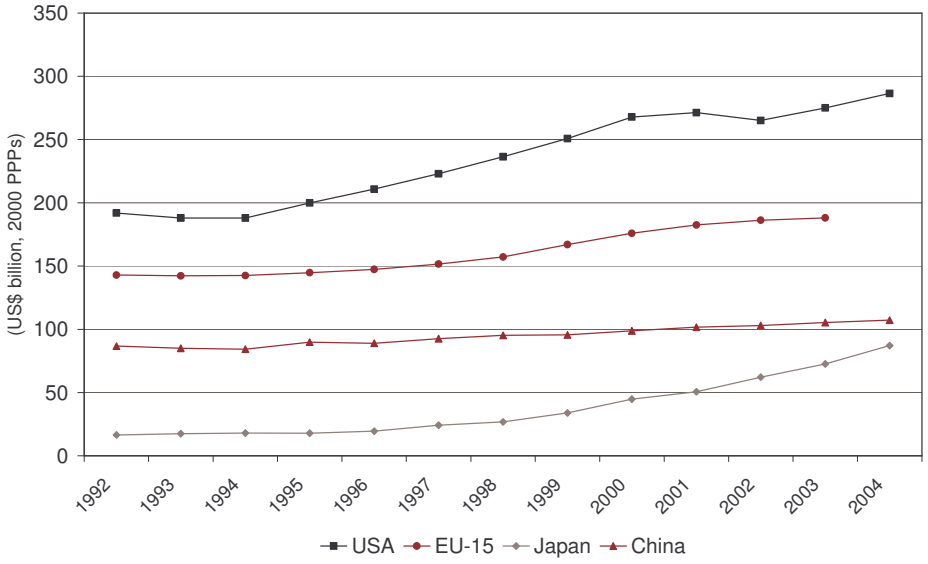
Source: Ministry of Science and Technology of China, (http://www.sts.org.cn/kjnew/maintitle/MainMod.asp?Mainq=1&Subq=2).

The path of spending on R&D in China expressed in yuan is shown in Figure 1.5, both in nominal and real terms and as a share of GDP. Given the rapid growth of GDP at about 10% per annum, even a stable GDP share implies that R&D is rising rapidly in real terms. After being relatively stable at about 0.6% of GDP between 1987 and 1998, R&D as a share of GDP more than doubled to 1.34 % by 2005. This is another remarkable aspect of the transformation currently taking place in China.

For international comparisons, there is little point in comparing a million yuan spent on R&D in China with the equivalent sum, at market exchanges rates, spent for example in USA. For example, salaries for research workers, the most important cost component of spending on R&D, are on average much lower in China than in the USA when compared using market exchange rates. To overcome this problem international comparisons are normally made on the basis of purchasing power parity prices (derived from the relative purchasing power of the currencies concerned over standard baskets of consumer goods). While this is not ideal for the case of R&D – purchasing power parities based on the components of R&D spending would be most appropriate – it is a reasonable approximation.

Figure 1.6 shows comparative spending on R&D for China, USA, EU-15 and Japan in US$ billion at 2000 purchasing power parity prices. On this basis, the USA remained the major centre of R&D spending in 2004, with a spending level about 50% greater than the EU-15. China, while increasing strongly, remained below the level of Japan in 2004.

Figure 1.6 R&D expenditure by major countries, US$ billion, in 2000 US$ PPPs



Source: OECD.

In its long-term plan for science and technology for 2006-2020, the Chinese Government has declared an intention to double the proportion of China's GDP spent on research and development from 1.23% in 2004 to 2.5% by 2020, and on current indications this is likely to be achieved.[3] Using the GDP forecasts above, Chinese R&D by 2020 will be about US$675 million in 2000 purchasing power parity prices if China achieves an R&D spending level of 2.5% of GDP, implying an average annual growth over 2004-2020 of 13.6%. Using the same GDP forecasts and assuming further modest increases in R&D spending as a share of GDP in the other countries and in the EU-15, indicative projections of R&D spending for 2020 at provided in Table 1.5. These estimates place China's R&D spending in 2020 over 45% greater than that of the USA, 60% above that of EU-15 and four times that of Japan. Perhaps more importantly, over 50% of the increase in R&D spending in these five countries/regions between 2004 and 2020 will take place in China, and just on 60% in China and India combined. Clearly any such projections must be treated with caution, and scientific leadership is about quality as well as the level of spending. But it seems beyond doubt that, if China's R&D spending continues to increase rapidly over the next 10-15 years as planned, the 'centre of gravity' of global science and technology development will also shift to China.

This rapid growth in R&D within China is not being achieved only by the activities of the Chinese Government and other Chinese agencies. As with industrial production, growth in knowledge intensive activities in China is in part being driven by large scale investment from developed countries, particularly the US, Japan, Germany, UK and France, as well as from elsewhere in Asia. Massive foreign investment is flowing into China's R&D sector, as companies seek to utilise high skill, low cost researchers, to position themselves for the China market and collaborate with Chinese individuals and institutions as they emerge on to the world stage. Of the worldwide 1,773 greenfield FDI projects involving R&D undertaken during 2002-2004, 626 were in China alone (UNCTAD 2005).

[3] In 2005 R&D spending increased to 1.34% of China's GDP (www.sts.org.cn).

Table 1.5 Indicative levels of R&D spending, 2020, in 2000 US$ PPPs

	Projected GDP Levels	Assumed rate of R&D spending	Projected R&D spending levels	Share of increase in total R&D spending, 2004-30
	(US$ billion, 2000 PPPs)	Share of GDP (%)	(US$ billion, 2000 PPPs)	(%)
USA	15,438	3.0	463	15.4
OECD Europe	16,864	2.5	422	20.3
Japan	4,599	3.5	161	4.7
China	27,009	2.0	675	51.1
India	8,897	1.5	133	8.6

Source: OECD R&D Statistics and estimates of the authors.

Given the scale of the expansion of China's R&D capabilities, it is useful to note China's national science and technology research priorities, as expressed in the national S&T plan to 2020. The top ten areas of national focus and priority are shown in Table 1.6. The notable feature of these priorities, in the context of the present study, is their alignment with the historic focus and capability of the Western Australian economy. For example, the four top priority areas – energy, water and minerals, the environment and agriculture – are key areas of focus also for Western Australia.

Table 1.6 Areas of national focus and priority (top ten), China, 2006-2020

1. Energy
2. Water and mineral resources
3. Environment
4. Agriculture
5. Manufacturing
6. Transportation
7. Information technology and modern service industries
8. Population and public health
9. Urbanisation and municipality development
10. Public security

Source: MOST (2006).

1.3.1 Implications for Western Australia

The ongoing rise of China as a major science and technology leader has important implications for Western Australia's strategy, and in particular for the implementation of its 'four pillars' policy. With nearly half of the increase in global R&D likely to take place in China over the period to 2020, integration into this expansion is seen as a key route to success by companies and governments around the world. This is likely to be the case also for Western Australia, especially given the fit between China's research priorities and the experience and expertise of Western Australia.

1.4 Energy Use and the Climate

One area where China's development path is of special global significance is in terms of energy use and the climate. Here we build on the GDP projections outlined above to develop some indicative projections for global energy use and CO2 emissions to 2030 consistent with our interpretation of the new world order, again using the IEA (2004) projections as the starting point. The rapid growth in China's appetite for energy, and the dominance of coal in its sources of fuels, is a key element in these projections. A key issue in developing projections of energy use is the value for different countries of the energy elasticity of GDP, that is the percentage increase in energy use for a one percent increase in real GDP. It is widely held that, during the development phase, the elasticity of total primary energy use with respect to GDP is equal to or greater than one, but that once societies achieve higher living standards this elasticity becomes significantly less that one, and indeed less than 0.5.

The assumptions made in relation to this variable are critical to long run projections of energy use. During the 19th Century, the elasticity of energy use was substantially greater than one for what are now the developed countries but the elasticity was 0.5 for the OECD countries as a whole over 1971-2002, with higher values only for OECD-Asia (Japan and Korea, 0.84) and for OECD-Oceania (Australia and New Zealand, 0.85). The IEA (2004) projections use a set of country specific figures that imply an overall OECD elasticity of 0.39 for 2002-2030, and our projections imply a similar figure for the OECD region (0.43).

A critical issue, however, is the value of the elasticity parameter for developing countries. The energy elasticity of GDP for the developing countries as a whole was 1.04 over 1971-2002, in spite of an elasticity for China of only 0.57. For all developing countries other than China, the elasticity over this period was 1.34. Prior to the opening up of the Chinese economy after 1979, it was both highly energy intensive and highly inefficient in its use of energy. As a result, energy use rose more slowly than GDP for the first 15 years of the new expansion, implying a fall in the energy intensity of GDP and an elasticity well below one. Interpretation of trends became more complex in the second half of the 1990s, as the official Chinese energy data became unrealistic (Sinton and Fridley 2003). Between 1996 and 2001 real Chinese GDP was reported to have increased by 46%, but total energy consumption was reported to be 3% lower in 2001 than in 1996, implying a negative value for energy elasticity.

Since 2001, energy use in China has surged, with reported energy use growing by 11.6% between 2001 and 2005, implying an elasticity of 1.2 over this period. Consistent with the discussion above, we assume an energy elasticity of one for the period 2006-2010, with a gradual subsequent decline as the economy matures and as current renewable energy and price reform measures take effect, to 0.85 over 2010-20 and to 0.75 over 2020-30. Together with the GDP profile described earlier, these assumptions imply that growth in TPES in China of 10.6% per annum over 2002-2010, but with growth slowing to less than half that rate (5.2% per annum) over 2010-2030, giving 6.7% per annum growth over 2002-2030. This projection means that China's energy use would increase more than six-fold between 2002 and 2030 and account for more than 30% of global energy use by 2030, as China takes an ever larger share of global production of energy intensive products, as well as providing higher living standards for its people. For a full discussion of these and related issues, including a discussion of other projections of China's energy use, see Supporting Paper 2.

Another important case is that of India. The energy elasticity of GDP (excluding biomass) for India was 1.15 over the period 1971-2005, although lower over 1990-2002 than in the earlier period. Energy use in India has been limited to date by a focus on service industries and by supply shortages, but industrial and household demand is increasing and sustained efforts are being made to increase electricity generation, primarily through coal-fired power stations. India has also been highly dependent on energy from biomass and waste. But with expansion possibilities limited in these traditional areas, growing demand for energy will need to be increasingly met from commercial sources. The Draft Report of the Expert Committee on Integrated Energy Policy, presented to the Indian Planning Commission in December 2005 (PC 2005a), outlines both India's growing energy needs and the programs that are being put in place to ensure that they are met. We assume that the energy elasticity of GDP in India will gradually return to an average of 1 over the 2010-2020 period, but decline after 2020. The net result is projected average annual growth in TPES in India of 6.2% over 2002-2030, with some slowing in the final decade of the projection period. This is broadly consistent with the projections of the Expert Group, who use a lower elasticity but higher growth assumptions to generate a range of projected growth rates in TPES for India of 5.1%-6.0% over the period 2006-07 to 2031-32.

Table 1.7 Energy use (Total Primary Energy Supply – TPES), actual 1971-2002 and projected 2002-2030

	Total primary energy supply			Annual change (% per annum)			
				1971-			IEA (2004)
	1971	2002	2030	2002	2002-10	2002-30	2002-30
	(mtoe)			(% per annum)			
OECD	3,309	5,177	6,857	1.5	1.4	1.0	0.9
North America	1,730	2,608	3,465	1.3	1.5	1.0	1.0
Europe	1,237	1,730	2,041	1.1	1.0	0.6	0.6
Asia	287	714	1,166	3.0	2.2	1.8	1.0
Oceania	56	124	185	2.6	2.1	1.5	1.0
Transition economies	851	1,012	1,467	0.6	1.8	1.3	1.3
Developing countries	633	2,816	12,059	4.9	6.9	5.3	3.0
China	241	1,030	6,386	4.8	10.6	6.7	2.9
India	61	330	1,771	5.6	6.2	6.2	3.1
SE Asia	39	311	935	6.9	5.0	4.0	3.2
Other	292	1,145	2,966	4.5	3.6	3.5	3.0
Other countries	17	114	175	6.4	2.0	1.6	1.6
Bunkers	106	146	193	1.0	1.0	1.0	--
World	4,916	9,264	20,752	2.1	3.4	2.9	1.7

Source: Historical data to 2002 is from IEA website (http://data.iea.org/ieastore/statslisting.asp) with projections by the authors.

The upshot is projected growth in global CO2 emissions of 3.1% per annum to 2030, by comparison with the IEA (2004) figure of 1.7%, and with growth over 1971-2002 of 1.8%. The main factor generating much faster growth in the projection than over 1971-2002 is not increased growth in emissions in either developing countries (5.4% over 2002-30 compared with 4.8% over 1971-2002) or in the OECD countries (1.0% compared with 0.9%), but the much increased weight of the developing countries in world aggregates. IEA (2004) project the same growth rate over 2002-30 as over 1971-2002 only as a result of a projected sharp slowing of the growth of CO2 emissions from developing countries, from 4.6% over 1971-2002 to 2.9% over 2002-30. This is not likely to occur, on present trends. The revised treatment of China and India accounts for over 90% of the variation between the projected value of emissions in 2030 in Table 1.8 and in the IEA projections of 2004.

Table 1.8 CO_2 emissions from fuel combustion and cement production, actual 1971-2002, projected to 2030, GtC

	1971	2002	2030	1971-2002	2002-30
	(Gigatonnes of carbon)			(% per annum)	
OECD	2.6	3.5	4.6	0.9	1.0
North America	1.3	1.8	2.4	1.0	1.0
Europe	1.0	1.1	1.3	0.2	0.7
Asia	0.2	0.5	0.7	2.3	1.4
Oceania	0.0	0.1	0.1	2.8	1.2
Transition economies	0.6	0.7	1.0	0.2	1.3
Developing countries	0.5	2.3	10.0	4.8	5.4
China	0.2	1.0	5.8	4.9	6.5
India	0.1	0.3	1.5	5.4	5.9
SE Asia	0.0	0.2	0.7	6.9	4.0
Other developing	0.2	0.8	2.1	4.0	3.4
Other countries	0.0	0.1	0.2	6.3	2.6
Bunkers	0.1	0.1	0.2	1.0	1.0
World	3.9	6.7	15.9	1.8	3.1

Source: Historical data to 2002 is from IEA website (http://data.iea.org/ieastore/statslisting.asp) with projections by the authors.

For China, total primary energy use by 2030 is projected to be 5.8 btoe, about 30% of global energy use by that time and implying an increase of 6.5% per annum over 2002-30 (Table 1.7).

With nearly 90% of energy use in 2030 still being provided from fossil fuel sources, in spite of a projected 10.5% per annum growth in energy from non-fossil fuel sources, emissions are projected to grow by 6.5% per annum and to total about 5.8 billion tonnes of carbon by 2030 (Table 1.8). For reference, total global emissions of CO2 from fuel combustion and cement in 2000 were 6.4 billion tonnes of carbon.

It is apparent that the current understanding of China's energy system remains limited, as does our ability to project future developments. Data limitations and other factors also preclude the effective use of advanced modelling techniques. Nevertheless a number of things do seem to be clear. One is that the historic era of rapid economic expansion with low growth in energy use has come to an end, and that major reductions in energy intensity will now require new policy initiatives or changes in the structure of the economy. Another is that, since 2000, a striking new phase of China's development has been under way, driven by very rapid growth in exports, investment in fixed assets and in secondary industry. Failing a sharp adjustment in the global economy, this phase of growth seems set to continue through to at least the end of this decade. Given its energy intensive, and indeed coal intensive, character this will imply growth in energy use and in CO2 emissions from fuel combustion in excess of 10% per annum over 2002-2010. Longer term projections that involve a halving of these growth rates over 2010-2030 still imply very high levels of energy use and emissions in China by 2030. Such outcomes, if they come to pass, will have major ramifications for world energy markets and for the global climate.

1.4.1 Implications for Western Australia

This brief analysis highlights several issues of direct relevance to Western Australia and its further growth path. First, leaving aside disruptive adjustment to the various imbalances developing within the world economy, a continued high rate of growth of energy use is implied by the current growth path. This is likely to impact directly on the continuing demand for Western Australia's energy resources. Secondly, however, this rapid growth in energy use, especially as it is heavily based on coal, will have serious implications for global warming, and these are likely to become increasingly apparent over the next 5-10 years. This will mean growing opposition to energy intensive growth paths, especially those using fossil fuels, but also higher demand for natural gas as the cleanest fossil fuel and for renewable energy technologies and services. Thirdly, the projection implies that, within its own boundaries, Western Australia will also have to address the consequences of accelerated global warming.

1.5 Global Financial Flows

In theory, in a free market economy the prices of financial instruments, such as interest rates and exchange rates, adjust to balance financial flows within the world economy. For a range of reasons, such an adjustment is not taking place at the present time. Major imbalances are developing, primarily between the USA (and to a lesser extent countries such as UK and Australia) on the one hand and East Asia and the oil producing nations on the other, and there is deepening concern as to how these imbalances might be reduced. There are many contributing factors to this trend: the strengthened competitive position of East Asia, and especially China, in manufactured exports; the lack of substantial adjustment in exchange rates, reflecting both the maintenance of a pegged exchange in China and the willingness of investors to continue to invest in the USA, at existing exchange and interest rates; the continued growth, facilitated by domestic and external borrowings, in the Anglo-Saxon countries and the high level of oil and other energy prices.

Some of the key elements of these imbalances are summarised in Table 1.9. In its recently released World Economic Outlook, the IMF expects that the total current account deficit for USA, UK, Australia and New Zealand will approach US$1 trillion in 2006, with the vast bulk of that deficit in the USA (IMF 2006a). This is an increase of over US$500 million on the figure for the four countries in 2000. The primary counterpart of this is an overall surplus, again approaching US$1 trillion, in the key East Asian economies (of which China now has the largest surplus) and in the oil producing countries taken together, and increase of about US$650 million since 2000. While other countries run surpluses and deficits, these are the two main poles of trade related flows at the present time.

Table 1.9 Current account position and holdings of reserve assets, selected countries and regions, 2000 and 2006 (projected)

	2000	2006
	(US$ billion)	
Current account position for year		
USA	-415	-869
UK, Australia and NZ	-56	-107
East Asia		
Japan	120	167
NIEs	39	79
China	21	184
Total	180	430
Fuel Producers	146	557
Holdings of reserve assets at year end		
China	169	1063
Fuel Producers	190	881

Source: IMF (2006a).

In addition to trade flows, net financial positions are influenced by capital and financial flows. China is currently in the position of having 'twin surpluses', that is having surpluses on both the current and capital accounts. In 2005, for example, China had a current account surplus of US$161 billion and a surplus on capital and financial account of US$63 billion, primarily due to net Foreign Direct Investment into China of US$67 billion (SAFE 2006). As a result, after accounting for errors and omissions, China's foreign exchange reserves rose by US$207 million during 2005 to reach US$823 billion by year end. The foreign exchange reserves of China and the fuel producing countries taken together increased by US$395 billion during 2005, and are projected by the IMF to increase by a further US$505 million in 2006, to a total of US$1944 billion by the end of 2006.

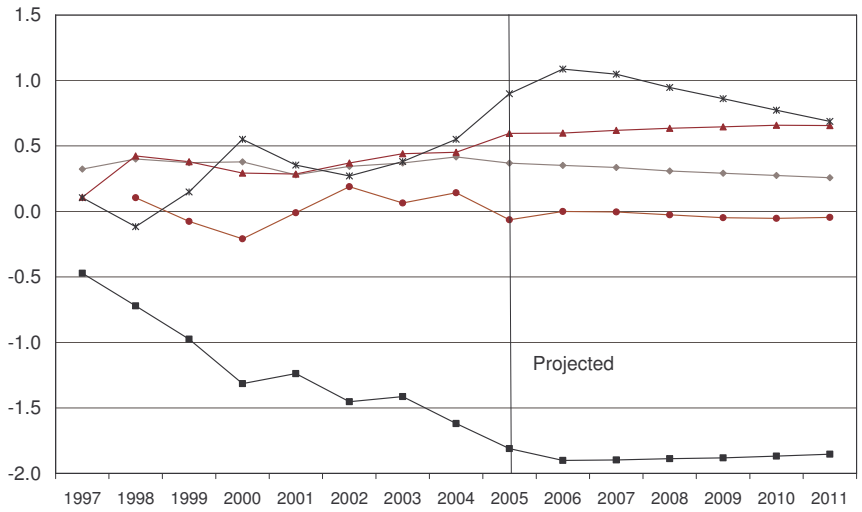
Aspects of these trends are shown in both historical and future perspective, via the IMF World Economic Outlook (2006a) projections to 2011, in Figure 1.7. The top panel shows the current account positions for the five countries or regions, expressed as a percentage of world GDP, and the lower panel shows holding of net foreign assets, also a share of global GDP. The IMF's unchanged policy projections imply that the US current account deficit stabilises after 2006, but they imply that the key East Asian countries and the fuel producers will continue to fund a US deficit of almost 2% of world GDP through to 2011. This implies a net holding of foreign assets – in good part in holdings of US Treasury bonds issued to finance the US budget deficit – on the part of these countries of about 15% of world GDP by 2011, with corresponding deficiency in net foreign assets held in the USA.

The imbalances may well continue to rise after 2006 and, even if they stabilise, the situation remains inherently unstable. There is no guarantee that US assets will continue to provide an attractive home for such massive foreign funds at current interest rates, and there is a risk of severe disruption to financial markets if an abrupt adjustment process is triggered.

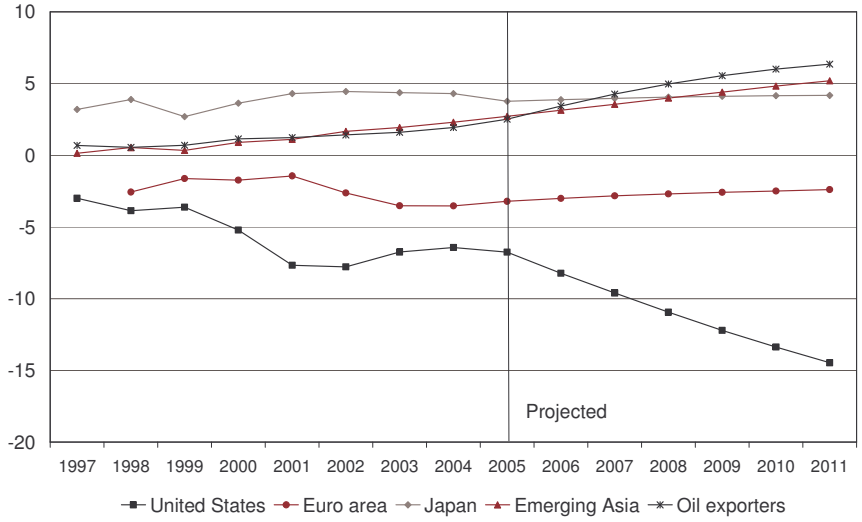
In its September report the IMF has discussed a number of different scenarios for the adjustment process. The 'no policies' scenario involves a reasonably orderly adjustment process through market forces and assumes a continued willingness of key countries to hold increasing quantities of US assets. There is a depreciation of the US dollar of about 15 % and US growth retreats to about 3% per annum, with corresponding adjustments in East Asia. By contrast with this fortunate 'muddling through scenario', and a 'strengthened policies' scenarios in which active policies by all parties achieves better outcomes, the Fund also considers a 'disruptive adjustment' scenario. In the specific case modelled an abrupt and disorderly adjustment, arising from a worldwide reduction in appetite for US assets and an increased premium for risk, leads to rapid changes in exchange rate, increased interest rates, a slowing of US growth and a sharp slowing of growth in East Asia. They also comment that 'there are clear risks of even worse outcomes than shown in the disruptive adjustment case' (IMF 2006a, p. 26) if there is severe disruption in financial markets and if rising unemployment triggers a new wave of protectionism. While all these scenarios, and others, are possible, we just do not know how this situation will evolve.

Figure 1.7 Current account balances and net foreign assets, per cent of world GDP

Panel A. Current account balance



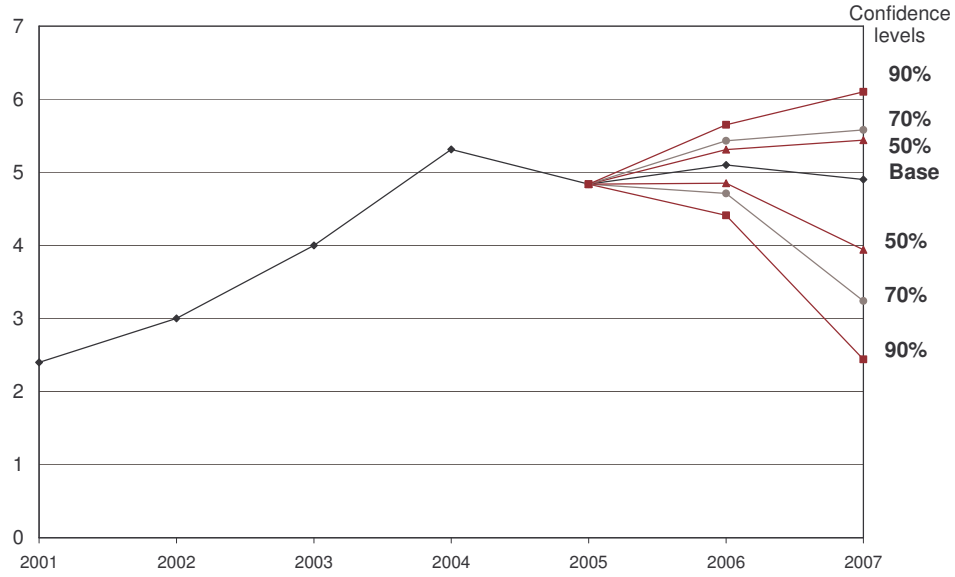
Panel B. Net foreign assets



Source: IMF (2006a).

Figure 1.8 summarises the IMF's risk profile around its core forecast for growth in the world economy of about 5% in 2007. Mainly on the basis of risks associated with the adjustment of the imbalances, they see a 50% chance that global growth will be below 4% in 2007 and one chance in ten that it will be below 2.5%. A sharp slowing of growth would, of course, impact strongly on financial and commodity markets, and sharply curtailed investment activity in the resource sector.

Figure 1.8 Prospects for world GDP growth in 2006 and 2007, per cent



Source: IMF (2006a).

1.5.1 Implications for Western Australia

This discussion highlights another dimension of the fragility of the global economic boom on which current growth in Western Australian so heavily depends. The world economy is moving deeper into uncharted waters, in terms of the scale and persistence of financial imbalances between major regions. While these imbalances are being successfully managed at the present time and there is no reason for immediate concern, the more they increase the greater the risk of an abrupt and costly adjustment at some point in the future. They thus provide another reason for building on the current boom to diversify the Western Australian economy and to broaden its base, in the ways discussed later in this report.

1.6 Geopolitical Dimensions

1.6.1 'Great Power' Relations

International Politics

International politics in the 21st Century is characterised by a multipolar world. For approximately 45 years international politics had been bipolar, with the Soviet Union and its allies confronting the United States and its allies. Since the end of the Cold War, global politics has slowly evolved into a degree of multipolarity.

How stable will the emerging world order be? The conventional wisdom of political scientists is that multipolarity leads to global instability. This is exemplified by the relationship between the great European powers and the outbreak of World War I, and the relationship between Germany, Japan, Britain, Russia and the United States between 1918 and 1945.

In the 21st Century, the major 'Great Powers' are likely to be the United States, China, and India, and possibly Europe and Russia. For a country to become a 'Great Power', its economy has to be sufficiently advanced to facilitate the acquisition of military power that can be used far afield, and not just around its borders. Secondly, the country in question needs to have a government capable of running a vigorous foreign policy. Third, there needs to be public support for the conduct of a vigorous foreign policy, and fourth, there needs to be some solid practical reason for taking an interest in international affairs.

The United States is the dominant world power, with the size of its economy and the technological power of its military dwarfing any other single power. But it is only capable of resourcing two major military actions and perhaps one minor action at any point of time. And while its dominance is evident in conventional military terms, its reach is much less effective when faced with guerrilla activities and terrorism. In order to deal with the latter threats, it needs to obtain support from the wider global community.

For China, continuing rapid economic growth on top of its current military base equals a major military presence in the coming decades second only to the United States. China is beginning to develop a more sophisticated foreign policy framework to handle some significant challenges in regional politics. While previously staying clear of multilateral diplomacy, China is now at the centre of multilateral efforts to persuade North Korea to abandon its nuclear-weapons programs. Its dramatic growth as an internationalised economy has led to wider material interests abroad, and this is reflected in its membership of the World Trade Organization (WTO). China easily qualifies as the second 'Great Power' in 21st Century politics.

India will surely qualify as a 'Great Power' during the coming decades. It has a booming economy that is rapidly advancing towards the requisite size for a major power, and efficient armed forces. It may be temporarily held back by the preponderance of regional political issues in such hot spots as Pakistan, Sri Lanka and Nepal, but its trading interests and resource requirements will encourage it to seek a wider involvement in global affairs.

Europe appears to lack the economic capacity to maintain a status as a 'Great Power'. While it is theoretically rich enough to finance the necessary military resources, fiscal pressures and slow rates of economic growth have led to a real contraction in its military capacity. Moreover, Europe appears to lack the organisational unity to pursue an effective foreign policy. Europe's economic size guarantees it a presence in multilateral forums, but in practical terms, individual European countries with their varying views on international politics exercise more influence than does Europe as a whole.

The arrangements put in place by the great European powers after the Napoleonic wars may offer a clue to the possibilities for international 'Great Power' relations in the 21st Century. Russia, the Hapsburg Monarchy, Britain, and later France and Prussia worked closely together for more than 30 years to manage international relations and ensure a successful and enduring peace. These arrangements involved the powerful Foreign Ministers of each power and were supported by a small secretariat. In the present context, it is possible that the G8 could be extended to a G10 by including China and India and facilitating a managed dialogue between the Foreign Ministers and, where necessary, the heads of government on key international problems.

China and 'Great Power' Relations

The relationship of China to the other major powers will be dominated by the China-U.S. relationship. China and Europe have few points of direct interest other than on trade (although trade in strategic high-technology goods and services may expose mutual interests between China and Europe that run counter to American policy). Past strains in the relationship between China and the Soviet Union have dissipated with the collapse of the USSR, with the Chinese having a strong interest in the supply of hydrocarbons from Siberia and Central Asia. Tensions between China and India have also eased over recent times. The relationship between China and Japan remains prickly, with issues such as the historic legacy of the Japanese invasion of China in the 1930s and 1940s and current territorial disputes leading to frosty relations. Nevertheless trade between the two countries has boomed over recent years.

The relationship between China and the United States is the most important of the 'Great Power' relationships, and is framed by their mutual nuclear deterrence. It is unthinkable that they should engage in direct conflict while nuclear arsenals remain. Conflict through proxies, a feature of the Cold War between the USSR and the USA, is theoretically possible. However, the example of the Soviet Union indicates that Cold War competition creates huge economic burdens on the smaller (in economic terms) of the protagonists. This is a burden that China, with its unsolved social pressures, could ill afford. Nevertheless, the major differences in politically ideology and the stresses of economic competition make it unlikely that China and the United States would ever become close allies,[4] even if they do not become points of outright conflict.

Managing Asian Hotspots

The real test of any concert between China and the United States will lie in how potential foreign policy challenges in Asia are managed. There are three such hotspots: Taiwan, North Korea, and Central Asia.

Over the past decade the Taiwanese economy has become deeply enmeshed in the economy of mainland China as the predominant trading and investment partner. At the same time movements in and out of mainland China have increased. Taiwan can now no longer afford to challenge the principle of Chinese sovereignty without totally sacrificing its economy. Both the United States and China have vested interests in calming the political situation in Taiwan. *The Economist* (2006) quotes a source suggesting that President Hu Jintao has decided that unification with Taiwan is not feasible during his term of office.

North Korea raises concerns for international political stability because of its threat to become a nuclear power and its record of dealing in illegal armament exports. Regional neighbours are also concerned that a sudden collapse of the regime might lead to large destabilising migrations. The United States has been repeatedly checkmated by the North Korean regime. China appears to be the one country that can exercise some real influence over North Korea. It has an incentive to do so because a nuclear North Korea could provoke Japan into becoming a nuclear power. The Chinese influence on North Korea is welcomed by the United States.

[4] Among the many points of tension of between China and the United States are international trade matters, access to natural resources, and China's relationship with pariah third world countries.

China's political relationships with some third world countries are a source of tension with the United States. This is particularly the case with Iran.[5] China, along with India, France, Japan and other countries, is involved in importing gas from Iran and assisting in the development of the gas supply in Iran. China has also transferred weapons technology to Iran in the past. The United States continues to seek cooperation with China on stemming Iran's nuclear ambitions, and is keen to gain support for the imposition of trade sanctions against Iran. This may be contrary to Chinese interests, although China now considers implementation of its non-proliferation commitments a priority.

Energy and Global Politics

The security of energy supplies raises important issues for international politics. The traditional argument is that the threat of energy shortages may provoke a competition between the major powers to obtain control over energy resources. China, India and the United States could become fierce competitors for political dominance over resources.

Resource security becomes a problem if major reserves of energy resources are located in areas where they may be prone to disruptions in supply. This is a particular problem for the location of crude oil reserves and a lesser, but not insignificant, problem for natural gas.

It is becoming widely recognised that oil scarcity as a problem is best approached by a combination of discouraging demand (the introduction of new technologies that shift energy consumption away from oil or reduce total energy consumption) and increase supply (investing in the technologies that enable enhanced oil recovery and investing in the infrastructure that enables new oil reserves to be brought into commercial production). IEA (2004) suggests that there are sufficient oil resources in place for the period up to 2030 provided that sufficient investments are made in infrastructure and improved oil recovery technologies. Absent these conditions, and oil scarcity could become a problem much sooner.

Oil security problems are most likely to arise as a result of: (i) terrorist-inflicted damage to infrastructure; (ii) supply disruptions associated with internal conflicts in oil producing countries; and (iii) failure of some oil producers to maintain infrastructure and manage the development of their oil assets.

The Chinese Government is encouraging foreign acquisitions of assets in the oil industry through low interest loans to SOEs. It is seeking to obtain access to relevant technology (as in the failed bid to takeover US oil company Unocal). It also has a vital interest in the development of pipeline connections to the oil and gas resources of Central Asia and Siberia through the acquisition of PetroKazakhstan and financial connections to the Russian oil company Yukos (Antkiewicz and Whalley 2004). In March 2006, China and Russia signed an agreement to cooperate in the construction of two pipelines, one to deliver gas from western Siberia into western China, and the other from Russia's Far East to north-eastern China.

Trade

Growth in the volume of world trade accelerated from 3.7% per annum between 1979 and 1989 to 6.0% per annum from 1989 to 1999 (based on IMF data). After a brief easing in trade growth at the turn of the century, the OECD calculates that world trade growth was 10.3% in 2004 and 7.3% in 2005 and is likely to be in excess of 9.0% per annum in the following two years.

[5] China also imports energy and other resources from Venezuela, Sudan and Zimbabwe under special agreements with those states.

Recent statistics and projections present a hopeful picture for trends in world trade volumes. There are four aspects of this more hopeful view of trade trends:

1. The rate of increased engagement of developing and Economies in Transition (EIT) in world trade is still continuing.

2. Shipping shortages may have been resolved for now, and if fuel costs are a problem for international transport costs, efficiencies in logistics are a helpful offset.

3. More broadly, globalisation forces appear to be irresistible in many industries.

4. Setbacks in world trade liberalisation may have been cushioned by these other influences.

5. World trade liberalisation has been struggling to maintain momentum as a result of the complete lack of any progress in the Doha Round of international trade negotiations.

Serious problems remain, however, regarding world trade liberalisation in the areas of agriculture, textiles and regional trade agreements. Miniscule progress has been made in reducing the protection of agriculture in implementing the Uruguay Round, and no progress at all under the Doha Round.

China has gained considerably from its entry into the WTO because protection in the advanced economies of manufacturing (other than textiles) has almost ceased. This has permitted a surge in the high-technology exports that have had the most widespread benefits to the Chinese economy. It would appear that this has more than made up for the losses associated with the reimposition of quotas on Chinese textile exports. China has also been active in negotiating regional trade arrangements with the agreement with Australia being the first such arrangement.

1.6.2 Social Pressures within China

Aggregate Employment Opportunities

The growth in China's economic capacity, stimulated by the huge productivity increases associated with increasing capital-intensity and strong growth in total factor productivity, has been accompanied by rapid growth in the demand for goods and services associated with big increases in China's share of world exports and internal fiscal expansion. This has enabled the growth in employment opportunities to broadly match the increase in labour supply of between 1.0 and 1.5% per annum. Can the economy continue to support increasing employment to meet the needs of the work force? Growth rates need to remain very high to maintain this increase in aggregate employment, and working conditions remain very poor for many migrants form the countryside (*The Economist* 2006).

One important development in the coming years will be an eventual reduction in the size of the labour force. This is likely to start after 2015, with the growth of the labour force moderating in the preceding years. Problems would arise if the growth of demand eases significantly (which could happen if the rate of export growth tapers off and if there are tightening constraints on domestic pump priming) while domestic supply capabilities continue to grow.

Regional Inequalities

Even if the aggregate growth in employment is adequate, the regional distribution of employment opportunities may give rise to social pressures, as might poor income-earning opportunities for the self-employed, such as farmers. The regional areas at risk include the Northeast, the Midwest, and remote rural areas. Such regional divergences create problems for the viability of the regional areas at risk, local environmental pressures that are associated with inadequate earnings from agriculture, and migration into both regional urban centres and the urban centres where growth is strongest.

The latter trend gives rise to other social pressures because of the absence of a broad social safety net in China. The social security fund administered by the central government is very small and appears to be contracting in scope. While there are plans to broaden its scope by payment of pensions form individual accounts that the government invests in, China needs a more mature bond and equity market to make such a policy workable (*The Economist* 2006). The much larger provincial pension funds have been grossly under-funded. Farmers and migrant workers tend to be almost entirely excluded from social security, which impacts adversely on already struggling rural populations and migrants that have been driven into the cities by poor economic conditions at home. Big problems will present themselves in future as a result of the rapidly ageing population.

Demographics

China also faces further problems related to demographic trends. These challenges are the rapid ageing of China's population and the emerging gender imbalance. A key influence on these demographic trends has been China's one-child policy. Introduced more than a quarter of a century ago, the policy has encouraged couples to have no more than one child and punished those that have not complied. Some exceptions have been allowed to this policy, and it has been more completely enforced in urban, rather than rural, areas. Nevertheless, the fertility rate in China has fallen from 2.29 children per woman in 1980 to 1.69 in 2004.

The reduction in fertility since 1980 has led to a contraction in the proportion of the young (aged 0-14) in the population of China that is expected to intensify over the next 30 years. This trend will carry through, with a lag, to the proportion of the population of working age (15-64) that, after peaking in 2010-2015, will then decline by 10 percentage points. In economic terms, this means that the dependency ratio in the population (one minus the proportion aged 15-64) will rise significantly. The proportion of the elderly (65 plus) in the population is already rising and will increase at an accelerating rate over the coming decades.

At the same time, China will also experience a decline in the population of working age expected after 2015, rapid growth in the aged population expected, particularly between 2010 and 2035, and a fall in the size of its total population after 2025. Each of these aspects of the population projections has implications for China's economic development. The decline in the work force expected within 10 years represents a considerable change from the recent growth of more than 1% per annum. Along with the possibility of somewhat less dramatic growth in output per worker, they imply a slower rate of potential economic growth than in the past. They also raise the possibility of widespread labour shortages. On the other hand, these trends, along with a decline in the population in education, would make it less costly to increase human capital per worker in the future.

The rapid growth in the aged population will increase the strains on social security and health care policies that are already inadequate. The fall in the total population will reduce the need for population-sensitive infrastructure and thereby reduce the need for some types of investment. As the case of Japan shows, some economies have had difficulties managing these demographic trends.

1.6.3 Internal Politics and Regime Stability

Threats to Political Stability

There are three main categories of threats to regime stability in China (excluding the challenges related to economic prosperity and development). They are economic, social and geopolitical.

The economic threat that could be politically destabilising is a significant reduction in the rate of economic growth. This is important because economic development appears to be the key objective of Chinese policy. An economic slowdown could occur as a result of three separate influences:

- slowing export growth associated with either slower world trade growth or increasing barriers against Chinese exports;
- a significant reduction in the pace of productivity growth in China as difficulties emerge in the transition to a higher level of economic development; and
- demographic trends which result in an eventual decline in labour force numbers and a higher burden associated with a rapidly ageing population.

Social conditions represent a very major political threat to China. The marked growth in inequalities previously discussed is already leading to violent disputes. Ethnic fractionalisation in the western regions of China represents a further political threat.

Geopolitical threats could divert resources from economic development and lead to internal political tensions. Of critical importance in the world geopolitical scene is the relationship between China and the United States. While the most likely political scenario is that of a managed China/USA relationship in which Cold War-type competition is avoided. However, Taiwan represents a significant challenge to 'Great Power' relationships.

Consequences

There is a wide range of factors that could challenge the stability of the current political regime in China. There are the outright threats associated with social stresses and economic slowdown. There are also the problems that might occur as a consequence of further economic success – the pressures for the further development of economic institutions and its compatibility with continuing rule by the Communist Party.

The consequences of these politically destabilising influences range from: (i) political collapse and fragmentation through to; (ii) regime change; and (iii) reformation within the current political system.

Starting with the last of these possibilities, there are two major issues confronting the current political system: (i) how to maintain economic development by progressively strengthening economic institutions; and (ii) how to reduce social threats to the existing political regime.

The principal threat to the current political regime in China is related to the broad range of social inequities. The strategies to deal with social problems are economic (dealing with regional disparities in economic growth) social security (spreading the net), and education and health care (improving access). These are all about the funding and delivery of policies. In addition there is the question of rural land disputes that are essentially about inadequate property rights in many regional areas.

The Government is aware of China's vulnerability to the sort of sudden political crisis that caused the collapse of communist governments in Russia and Eastern Europe at the beginning of the 1990s. A fashionable topic for discussion in the official media is the potential 'Latin Americanisation' of China. This refers to the possibility that growing income inequalities and the rush to privatisation could precipitate economic and political upheaval (*The Economist* 2006).

Unquestionably political change in the direction of fundamental democratisation would make it easier to achieve the further development of economic institutions. But there are other influences at work that could facilitate improvements in China's economic institutions. Globalisation and the rise of the knowledge economy has become a major influence on the development of the Chinese economy. The increased interaction between China's business sector and businesses in the most advanced economies in the rest of the world is creating an important political platform for changes in China's economic institutions. This trend mirrors the rising influence of the private business sector in China.

However, these influences are the strongest in the rapidly growing regions of China most oriented towards the global economy. Property rights and social conditions in the less developed regions of China remain more fragile.

In a recent announcement the Chinese Communist Party has pledged 'unlimited funds' to the cause of 'reviving' Marxism in China, in an attempt to turn the country into the global centre for Marxism studies. Major investments are contemplated in the human and financial resources to build more research institutes, train more theorists and produce academic papers and more than 100 new Marxism textbooks. The aim is to 'modernise' Marxism by building a theoretical system with 'Chinese characteristics' (Hilton 2006).

If sufficient changes cannot be made within the current political system to facilitate an easing of social, tensions and a further development of economic institutions, major political stresses are likely. In what follows, two different possibilities are analysed:

1. Political collapse and disunity.
2. Regime change, with the Communist One Party State replaced by another national political system.

Long term political scenarios often include an assumption that China will break up as a unified polity. In the longer-run of history, a breakdown of central political authority in China was generally accompanied by a split into separate warring states. However China always reunited after such periods. In the period since the Second World War, political instability around the world has usually led to regime change rather than state collapse and break-up. If the experience of the past half-century is taken as a guide, destructive political collapses of states have tended to occur only in the following circumstances:

- ethnic fractionalisation;
- economic stagnation and an associated failure to reward key political stakeholders; and
- sub-national bids for key resources.

For China, ethnic fractionalisation is predominantly an issue confined to regional areas, specifically Xinjiang and Tibet. Political collapse can be associated with very major economic and social stresses, but these are rarely a sufficient condition for such an occurrence. Sub-national regional bids for the economic returns from resource endowments have been a factor in political collapses in some other countries, but resource endowments do not seem to be a key issue in Chinese politics. The key issue for China is one of managing political dissent (which is much more of a problem than a destructive political collapse).

Regime change could become a likely consequence of the various destabilising factors bearing down on China if it is assumed that reformation of the current system does not occur. As has been previously noted, social inequities are the cause of widespread disturbances. If these *ad hoc* disturbances were to coalesce into more organised collective action, the basis for internal political opposition to the Communist Party could be created.

The second pressure for political change would come from the business sector in circumstances where the need for further developments in economic institutions appear to be beyond the capacity of the One Party State to realise. The transparent and efficient administration of commercial law and public administration in general is the key issue here.

The twin political pressures, if combined with effective political mobilisation (which in turn would depend in part on overcoming policies of political repression by the current regime), could result in regime change and elections.

It is possible, looking at the Asian experience, that political transition to democracy can be accomplished without major disruption to economic development, but there are likely to be challenges before and after this transition. In the first case, as political opposition develops, the authority of the One Party State will be weakened and this might impact on international confidence and the flow of investment and technological know-how. In the second case, an incoming democratically elected government would lack experience, may fail to win the confidence of markets, and be hindered by conflicting pressures from different parts of its political constituency. The experience of Latin America indicates that pre-existing economic inequalities are a permanent hindrance to both economic development and political stability.

1.6.4 Implications for Western Australia

Clearly the stability of China, and its successful transition to more sustainable economic, social and political arrangements, is of vital importance for Australia, and especially for Western Australia. This is not just because of the central role of China in the current energy and resource boom, but because the second century of the State's development will be shaped by its relationship with China (and India) as dominant economies, both globally and in the Asian region. While little can be done, at least directly, to influence the resolution of the key social and political issues within China, State Government policy needs to be formulated on the basis of a recognition of the wide range of outcomes that remain possible.

2 Understanding Recent Developments in China

In this chapter we seek to document further some elements of recent developments in China, to throw light on the implications of those developments for other countries and regions, especially Western Australia, and for the ongoing evolution of China's strategy. With 1.3 billion people distributed across 31 provinces and autonomous regions and 44,000 townships, and with most major companies in the world now active in China, the reality of China's development process is intensely complicated, and the ability of the Central Government to control activities in the provinces is limited. Here we concentrate here on five themes, to bring out some of the main issues:

- the different stages of growth in China since the opening to the market in 1979, and especially the phase of export oriented growth based on industry and construction that has emerged since 2001;
- the changing face of industrial activity, including a shift to higher value export products, to services and to commercial R&D, as illustrated by the case of the information technology and telecommunications industries;
- the renewed emphasis on agriculture and on rural areas, and the increasing policy focus on supporting agriculture and rural populations;
- the deepening environment issues in China, including the question of water supplies; and
- trends in the key sectors of education and health, especially the heavy role of 'out-of-pocket' financing of these sectors and its implications for access and growth.

The last four of these themes, and other related matters, are explored in more detail in the relevant supporting papers.

2.1 Stages of Growth in China Since 1979

2.1.1 Three Stages of Growth Over 1979-2001

Since the beginning of reform in 1979 China's remarkable economic growth has been driven by both internal and external factors, with the balance of these factors changing over time. In 1978 the economy was dominated by a large, inward-looking and energy inefficient industrial sector, which accounted for nearly 50% of GDP in current prices. Exports were only 4.6% of GDP, and over half were from the primary sector. The initial impetus of the reforms was particularly favourable to the rural and services sectors, where loosening of the controls imposed in the command economy led to rapid expansion of activity. The growth rate of value added in both agriculture and services more than doubled in the 1980s relative to the 1970s, to 6.2% and 12.3% respectively, while there was little increase in the growth rate in industry (Table 2.1). The services share of GDP rose more than eight percentage points between 1980 and 1990, and over this time the primary and tertiary sectors contributed 62% of total growth.

These dynamics changed substantially during the 1990s, as the expansion of industrial activity, linked into global markets and driven in significant part by foreign investment and by a more competitive currency, became the main source of growth. Between 1990 and 1997 real industrial GDP grew by 15.7% per annum, while growth in both the agricultural and services sectors slowed (Table 2.1). As a result, the industrial share of GDP rose sharply from 37.0% to 48.9% between 1990 and 1997, and secondary industry contributed just on 60% of the growth of real GDP during this period.

Table 2.1 Real GDP by sector, 1980-2006 (at estimated 2000 values)

	Agriculture	Industry	Services	Total
		(100 billion yuan, at 2000 values)		
1980	23	28	22	73
1990	55	51	36	142
1997	101	126	114	341
2001	146	449	299	895
2005	177	746	480	1404
Annual growth rates		(per cent per annum)		
1970-1980	2.0	9.1	6.0	5.1
1980-1990	6.2	9.5	12.3	9.4
1990-1997	4.2	15.7	10.6	11.5
1997-2001	2.9	8.7	9.4	8.0
2001-2005	4.2	11.2	9.9	9.8
Share of GDP		(per cent)		
1970	31.6	38.7	29.7	100
1980	38.9	35.8	25.2	100
1990	29.6	37.0	33.4	100
1997	18.8	48.9	32.3	100
2001	15.6	50.4	34.1	100
2005	12.6	53.1	34.2	100

Source: NBSC (2005a, 2006a, 2006b) and estimates of the authors.

Between 1997 and 2001 the Chinese economy experienced a period of somewhat slower growth by its own lofty standards, with GDP growth averaging 'only' 7.9% and growth in industrial GDP being in single digit figures for four consecutive years for the first time since 1979. This reflected in part the turbulent international environment associated with the East Asian crisis of 1997-98 and the recession in the USA after the collapse of the high tech boom. Exports in current prices amounted to only 14.8% of GDP over 1997-2001. In November 1999 China reached a bilateral agreement with the USA about the terms on which China would enter the WTO. The full WTO membership formally approved China's entry two years later at Doha in Qatar, and China became a member in 2002. The emergence from that relative slowdown over 1997-2001, ushered in another stage of China's growth, one that is still continuing.

The New Growth Pattern Since 2001

In this new stage of China's development three inter-related features stand out. The first is the extremely rapid growth in merchandise exports. In just four years between 2001 and 2005 China's exports in US dollar terms increased nearly threefold, growing by 30% per annum and rising from US$288 billion in 2001 to US$762 billion in 2005. The share of exports in GDP increased from 20.1% in 2001 to 35.5% in 2005 and the increase in exports over the four years amounted to 59% of the growth in GDP, and to 70% in 2005. In the first half of 2006 goods exports were 25.2% higher than in the same period of 2005, so this trend is continuing. The second feature of this period has been heavy investment in fixed assets, which has increased sharply in recent years and surpassed household consumption spending as the dominant factor in domestic demand. Real fixed asset investment has more than doubled between 2001 and 2005, growing at an average annual rate of 20.2%, and in the first half of 2006 was well in excess of 20% in real terms.

These two factors of burgeoning exports and high levels of fixed asset investment are undoubtedly closely related. Creating the capacity for such a high level of exports required heavy investment in fixed assets, not only within firms but also in a wide range of economic and social infrastructure, ranging from power stations, ports and railways to housing and urban facilities. Revenues being received by various parties, both firms and government agencies, from the export boom would also assist with the financing of that infrastructure.

Thus the third feature of this period – a further rise in the role of the industrial sector in driving China's growth – is perhaps an inevitable result of these two trends. Measured in 2000 values, the share of secondary industry in GDP rose from 46.0% in 2001 to 48.5% in 2005 (Table 2.2), with virtually all the decline in the primary sector being taken up by industry. Real value added in industry was 13.4% higher in the first half of 2006 than in the same period of 2005.

Table 2.2 Trends in fixed asset investment and exports, China, 1991-2005

	Investment in fixed assets (billion yuan, 1991 prices)	Ratio of investment in fixed assets to household consumption (real terms, %)	Exports (US$ billion)	Exports/GDP in yuan (%)	Ratio of change in exports to change in GDP over period, in yuan (%)
1993	896.0	69.7	91.7	15.0	15.0
1997	1382.5	78.3	182.8	19.2	18.9[1]
2001	2044.7	86.9	266.1	20.1	14.8[2]
2002	2384.9	94.4	325.6	22.4	46.1
2003	2981.0	110.8	438.2	26.7	60.3
2004	3581.1	114.2	593.4	30.7	53.3
2005	4263.5	123.6	762.0	35.6	70.0

Notes: [1]For the period 1993-1996 inclusive.
[2]For the period 1997-2000 inclusive.
Sources: NBSC (2005a, 2006a) and estimates of the authors.

Thus the combination of China's entry into the WTO and a strong global economy has, since 2001, produced a striking new stage in China's development. The economy is being driven hard by very rapid growth in exports and in fixed asset investment, which are reflected in the growth in industrial output. Each of the three measures highlighted here – exports as a share of GDP, the ratio of fixed asset investment to household consumption spending and the secondary industry share of GDP – are at historically high levels, and are likely to increase further in the immediate future. There are undoubtedly many speculative elements in the current Chinese expansion. But the main driving forces – the transformation of China into the major trading nation on the globe and the investment implications of that transformation – are real. While growth in the world economy continues, and while China's strategy and competitiveness foster further increases in China's share of world markets, export led, energy intensive growth is likely to continue at a high level in China.

2.2 The Changing Face of China's Industry: The Case of ICT Goods and Services

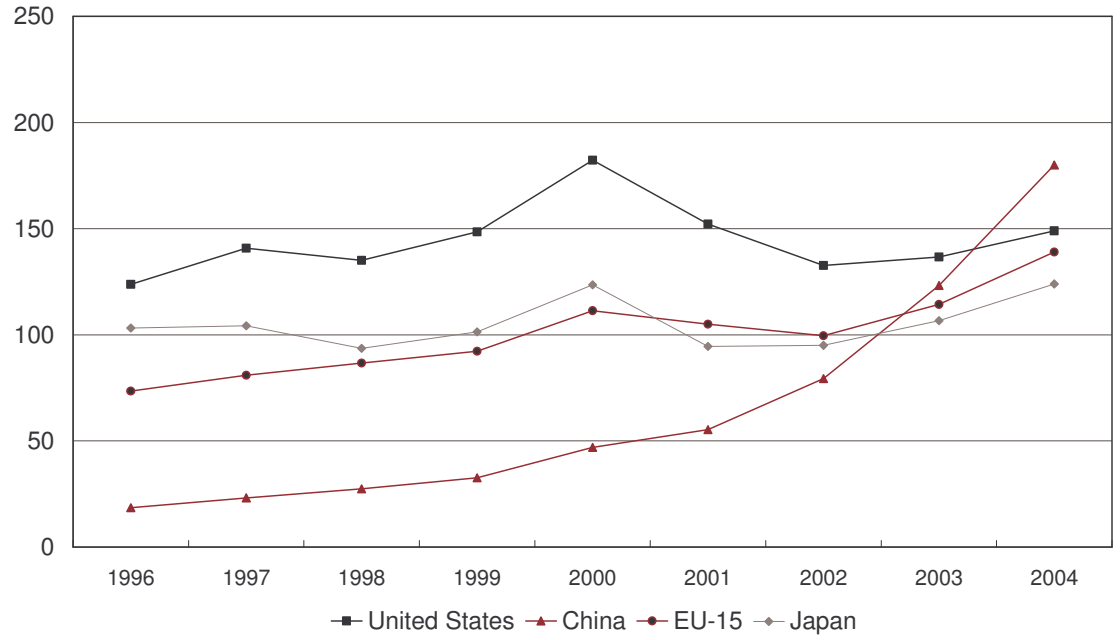
China's industry has traditionally been a mix of low value added processes (such as assembly operations or footwear and garment manufacturing) directed substantially at consumer goods and export markets and capital intensive processes (such as steel-making) directed primarily at meeting the needs of domestic customers. While the discussion above has emphasised the recent growth of heavy industry, important changes have also been occurring in the export sector. These changes can be illustrated by the case of information technology and communications (ICT) goods and services.

2.2.1 Trade in ICT Goods

International trade in ICT equipment (i.e. office and telecom equipment) rose 19%, to US$1,134 billion during 2004. It expanded at nearly twice the rate of world merchandise trade in the 1990s, but has fallen short of the rate of global trade expansion since the 'Dot Com' crash of 2000 – due, in part, to rapidly rising commodity prices.

Nevertheless, Asia's exports of ICT equipment rose by 25% during 2004, twice as fast as the exports of all other regions combined (WTO 2005). Data on a comparable basis is not yet available for 2005, but further strong growth in Asia's exports also took place in that year.

Figure 2.1 ICT equipment export trends, 1996-2004, USD billions (in current prices)



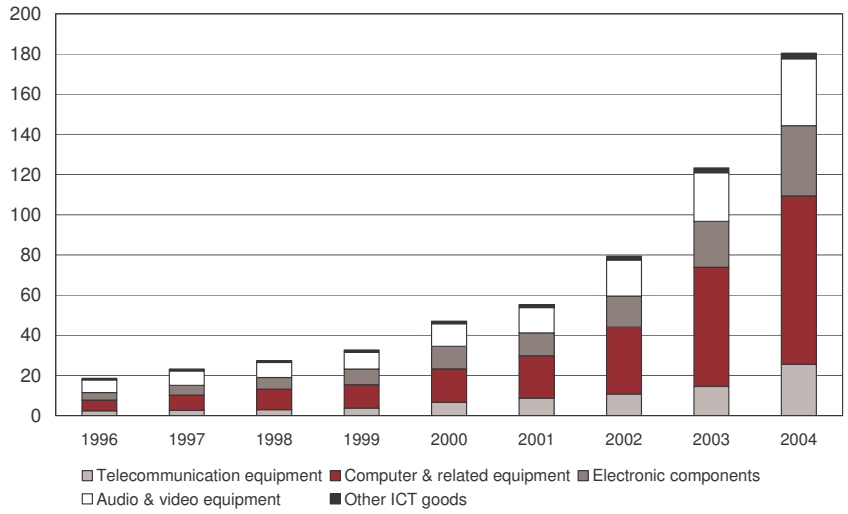
Note: Data for EU exclude intra-EU trade.
Source: OECD, CSES analysis.

Within Asia, China stands out. In the recovery from the 'Dot Com' crash, China has outperformed the major traditional suppliers and has become the largest exporter of ICT goods (at US$180 billion in 2004), surpassing Japan and the European Union in 2003 and taking the lead over the United States in 2004.[6] China's share of the world's total trade in ICT goods has grown rapidly. Worth less than US$35 billion in 1996, China's ICT goods trade reached almost US$329 billion in 2004, growing at almost 38% a year since 1996.

Over the last few years export growth has surpassed imports. This strong export growth is reflected in China's ICT trade surplus, which grew from US$3 billion in 2002, to US$32 billion in 2004. Year-on-year export growth slowed to 18% during 2001-2002, down from 44% in the previous year, but the slowdown was temporary. In 2002, China's ICT export growth exceeded the high growth rates of the Internet boom years of 1999-2000, and grew by 55% from 2002 to 2003, and by 46% from 2003 to 2004 (in current prices).

[6] This summary of China's ICT goods trade draws on OECD (2005a).

Figure 2.2 ICT equipment exports, 1996-2004, US$ billions

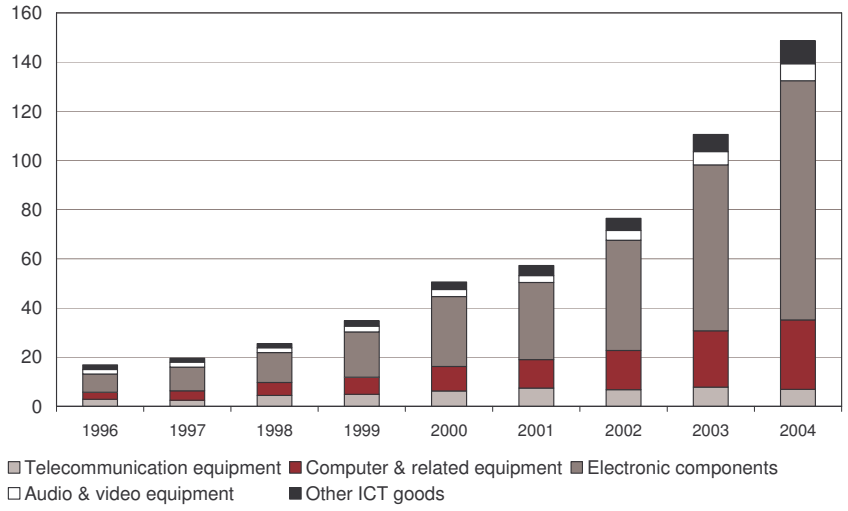


Source: OECD, CSES analysis.

The main destinations for China's ICT exports are the United States (24% of total ICT exports), Hong Kong (23%), the EU-15 (20%) and Japan (10%). The growing regional shift in ICT trade with Asia is notable, with exports to other Asian countries (e.g. Taipei, Korea, Singapore, Malaysia and Thailand) also growing. The major sources of China's ICT imports are Japan (18%), Taipei (16%), Korea (13%) and Malaysia (8%). The most notable shift is the falling share of imports from the EU-15 and the United States. Reflecting China's role in assembly, electronic components accounted for 65% of imports in 2004, while computer and related equipment accounted for 46% of total exports.

China has significant trade deficits in electronic components – with a US$50 billion deficit in integrated circuits (importing US$62 billion and exporting US$11 billion), and a US$7 billion deficit in semiconductors (importing US$10 billion and exporting US$3 billion). China has a significant trade surplus in computer and related equipment, with a US$45 billion trade surplus in data processing machines (including laptops but excluding PC accessories), and large surpluses in video cameras and recorders, television receivers and telephones.

Figure 2.3 China's ICT equipment imports, 1996-2004, US$ billions



Source: OECD, CSES analysis.

China's trade deficit in electronic components with Japan and other Asian economies (e.g. Korea, Malaysia and Japan) is significant, with China's trade structure depending more heavily on trade within East Asia and trade in intermediate goods growing particularly strongly. Imports into China are increasing sourced from Asian countries, especially in the field of electronic components (e.g. Taipei and Malaysia). The US-China trade relationship is characterised by a significant trade deficit for the United States in computer and related equipment and a small surplus in electronic components. China is the single largest exporter of ICT goods to the United States, with its share of total US imports growing from 10% in 2000 to 27% in 2004. Integrated circuits and semiconductors were the second-largest US manufactured product export to China.

Table 2.3 China's ICT equipment trade, 1996-2004, US$ billions

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Exports from China									
Telecommunication equipment	2,417	2,685	3,004	3,738	6,675	8,759	10,801	14,558	25,579
Computer equipment	5,317	7,513	10,168	11,697	16,577	21,076	33,253	59,245	83,790
Electronic components	3,782	4,922	5,781	7,766	11,263	11,371	15,520	22,879	34,884
Audiovisual equipment	6,283	7,168	7,501	8,453	11,165	12,616	17,855	24,289	33,309
Other ICT goods	785	906	965	1,009	1,316	1,483	1,948	2,332	2,859
Imports into China									
Telecommunication equipment	2,861	2,453	4,427	4,904	6,297	7,416	6,792	7,812	6,904
Computer equipment	2,877	3,864	5,300	6,968	9,883	11,607	15,929	22,890	28,209
Electronic components	7,375	9,664	12,149	18,386	28,432	31,333	44,849	67,442	97,302
Audiovisual equipment	1,889	1,989	1,961	2,345	2,920	2,796	3,978	5,438	6,877
Other ICT goods	1,848	1,618	1,677	2,169	3,065	4,117	4,900	6,949	9,371

Note: All data are current prices.
Source: OECD FTS Database, CSES analysis.

What is notable in these data is the contrasting performance of China, and other 'new' suppliers, and that of traditional suppliers like the United States in the post-'Dot Com' recovery. The recovery features a marked restructuring and a new wave of globalisation of ICT production.

2.2.2 Assembly or Higher Value Added Products?

With imports of electronic components amounting the US$97 billion in 2004 (65% of imports and 54% of the value of exports) it is evident that much of China's ICT industries remains focused on assembly operations. Nevertheless, it has been argued that a particular feature of China's merchandise exports is the unusually high share of high-value, non-traditional, higher productivity goods – including ICTs. As Rodrik (2006, p. 4) points out, China is an outlier in terms of the overall sophistication of its exports: its export bundle is that of a country with an income per-capita level three times higher than China's. China has managed to latch on to advanced, high-productivity products that one would not normally expect a poor, labour abundant country like China to produce, let alone export.

Rodrik concludes that: *what is so special about China's exports is not that they are voluminous or that its large pool of labour gives it a huge labour cost advantage. What stands out is that China sells products that are associated with a productivity level that is much higher than a country at China's level of income. This helps account both for why China's trade is viewed as problematic in advanced countries, and for China's rapid economic growth* (Rodrik 2006, p. 23).

There is no inconsistency between stressing the assembly character of most of China's ICT industries and its increasing concentration on higher value products – in the changing international division of labour, driven in good part by global Foreign Direct Investment flows, China is increasingly assembling higher value computing and telecommunications products. However, there is also a growing emphasis on higher value added activities within China, and on R&D and design services in these industries. For example, there has been a significant increase in FDI into semiconductor manufacturing in China (UNCTAD 2005). As a result, China plays an increasingly important role as a market for semiconductor manufacturing equipment – accounting for more than 30% of European semiconductor capital equipment manufacturers' sales during 2004 (The Information Network 2005). The US Semiconductor Industry Association recently noted, *there is no question that a major migration of chip manufacturing activities toward Asia is under way. More than two-thirds of all the state-of-the-art chip making facilities now under construction are being built in Asia* (SIA 2005). These investments are attracted by both cost advantages and market growth, as Asia is now the leading market for semiconductors, accounting for almost 45% of worldwide sales in 2005 (WSTS 2005).

2.2.3 Foreign Direct Investment

Trade has become somewhat less important as Foreign Direct Investment (FDI) has played and increasing role in globalisation. Direct investment activity is affected by cyclical fluctuations in income and growth. On the supply side, FDI is affected by the availability of investment funds, which have been boosted over the last year or so by a return to profitability and increasing stock market valuations. On the demand side, growing overseas markets lead multinational firms to invest, and strong growth in Asia and returning growth elsewhere has increased the attractiveness of international expansion (OECD 2006). As a result, FDI flows have recovered from the depressed levels of 2002 and 2003 – with worldwide FDI inflows increasing 2.4% to US$648 billion, and outflows by 18% to US$730 billion during 2004 (UNCTAD 2005).

A Shift to Developing Countries

A major feature of recent FDI flows has been the shift to developing countries – with inflows to developing countries rising 40% during 2004 to US$233 billion, while inflows to developed countries fell by 14%. The major recipient regions were Asia and Oceania, wherein East Asia experienced a 46% increase in FDI inflows during the year. China accounted for 9% of worldwide FDI inflows during 2004 (US$61 billion). Significant investment flows have also come from China (e.g. Lenovo's acquisition of IBM's PC manufacturing division) (UNCTAD 2005).

FDI is playing an important role in China's emergence as a major trader. China's total merchandise exports amounted to US$762 billion during 2005, of which almost 60% were produced by foreign companies or joint ventures, 22% by state-owned enterprises and the remainder by private firms. Of the US$660 billion of goods imported into China during 2005, almost 59% were imported by foreign invested companies, 30% by state-owned enterprises and 11% by local private firms (Ryan 2006).

A Shift to Services

The other major trend in FDI is a shift of focus from manufacturing towards services, including telecommunications, computer and information services, a range of IT-enabled business process services, R&D, technical testing and design services with a strong emphasis on ICT (e.g. mobile communications related R&D and semiconductor 'chip' design).

Over the period 2001 through 2003, FDI flows to services were 2.8 times greater than those to manufacturing, and services accounted for more than 60% of all cross-border M&As during the 1990s. Business services accounted for just 7% of inward FDI stock in developing economies in 1990, but by 2002 their share had risen to 38% (UNCTAD 2004).

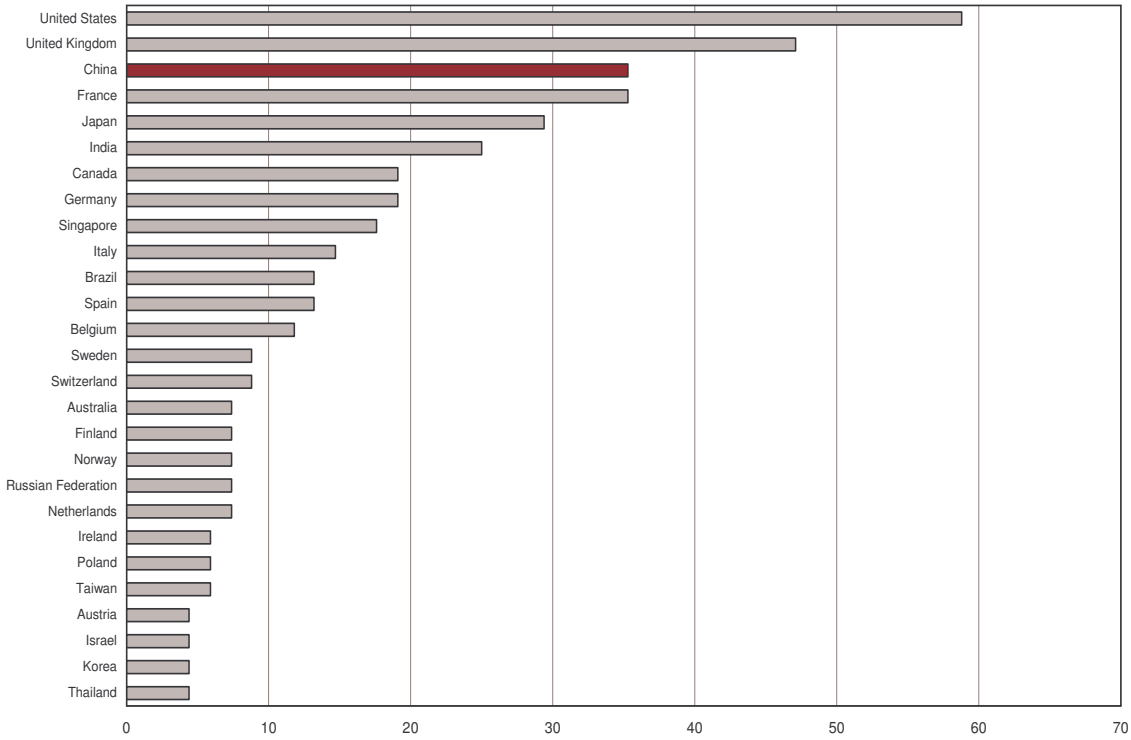
During 2002-03, there were a estimated 632 export-oriented greenfield FDI projects in IT services worldwide, with a further 513 call centre projects and 139 shared services centre projects. The number of IT services projects in developing countries more than doubled during 2003, while increasing just 6% in developed countries. South and East Asia dominated among developing regions, accounting for 265 or 42% of all IT services projects – with China and Hong Kong accounting for 74 or 11% of the worldwide total. More than half the 513 greenfield FDI projects in call centres went to developed countries. Nevertheless, Asia accounted for 33% of the call centre projects, and 47% of the shared services centre projects – with China and Hong Kong accounting for 6% and 3%, respectively (UNCTAD 2004). Almost 98% of the IT services projects were within the IT services and software industry, suggesting that they were focused on the global rationalisation of IT and IT-enabled services production.

A Focus on R&D

The growth of international investment in R&D has been particularly notable. Between 1995 and 2001, the growth of foreign affiliate R&D in manufacturing in OECD countries was more than twice that of total R&D expenditure. Multinational firms are key players. A conservative estimate is that they account for close to half of global R&D expenditures, and at least two-thirds of business R&D expenditures (estimated at US$450 billion). Between 1993 and 2002, the R&D expenditure of foreign affiliates worldwide rose from an estimated US$30 billion to US$67 billion (or from 10% to 16% of global business R&D). The rise was relatively modest in developed host countries, but quite significant in developing countries – with the share of foreign affiliates in business R&D in the developing world increasing from 2% to 18% between 1996 and 2002 (UNCTAD 2005).

Of the worldwide 1,773 greenfield FDI projects involving R&D during 2002-2004, the majority (1,095) were undertaken in developing countries or Eastern Europe. Asia and Oceania accounted for half the worldwide total (861), with the majority of R&D jobs going to China and India. Around 700 foreign affiliate R&D centres had been established in China by the end of 2004. An UNCTAD survey found that China ranked third as a global location for current R&D FDI projects (Figure 2.4) and was top of the list for new projects, ahead of the United States and India (UNCTAD 2005).

Figure 2.4 Current foreign locations of R&D, 2004, per cent of respondents



Source: UNCTAD (2005, p. 133).

ICTs are central. In 2002, three-quarters of the R&D expenditure of US majority-owned foreign affiliates in developing Asia was related to computers and electronic products, while in India more than three-quarters of their R&D expenditure went into services (notably software development). *From practically nothing in the mid-1990s, the contribution of South-East Asia and East Asia to global semiconductor design reached almost 30% in 2002* (UNCTAD 2005).

As is the case in manufacturing, there is a shift from FDI targeting market access to FDI in IT and a range of IT-enabled services that is clearly 'efficiency seeking'. This is leading to a new international division of labour and a global rationalisation of services production similar to that seen in high-technology manufacturing, with developing countries, particularly China and India, playing an increasing role.

2.2.4 Implications for Western Australia

This analysis shows the growing role of China in the production of ICT goods, together with its strengthening position in relation to R&D, design and production services in these industries and a growing trend to locate high value added processes in China. This is taking place within trends in the global distribution of production that are concentrating the development and production of ICT goods firmly in East Asia and the delivery of standardised ICT services in the developing countries. The Western Australia Government has rightly emphasised ICT as one of the four pillars of the State's diversification. While there may be niche product or service markets that prove important to firms within the State, the main implication is that it is likely to be in the area of applications services – services and software related to the application of ICT to key areas such as minerals and resources, the environment, health and so on – that Western Australia ICT firms are most likely to flourish.

2.3 Agriculture

2.3.1 Trends in China's Agricultural Sector

As would be expected during the process of industrialisation and economic development, the share of agriculture in China's GDP has been declining steadily over the past three decades and had fallen to 15.2% in 2004.

The output of China's major crop and animal output is shown in Tables 2.4 and 2.5 below. Total output of grains peaked in 1995 and fell steadily until rising to a new peak in 2004. Production of wheat has fallen every year since 1995, except in 2004, when it was higher than in the previous year, although still lower than in 1995. The reductions in the production of wheat since 1997-98 appear to have been far greater than the reductions in domestic consumption. China has run down of stocks that had been built up to high levels by the late 1990s. In 2004-05 China entered the world market as a large purchaser. Production of rice has been also falling since 2000. The output of maize, soybeans, cotton and oil-bearing crops has been rising steadily (Table 2.4). According to US Department of Agriculture (2005), production of maize, the dominant feed grain, rose markedly through much of the 1990s but has since levelled out. China's production of animal products has also been rising across the board (Table 2.5).

The available projections for grain demand are fairly consistent, range from 443 to 513 million metric tons for 2010, and from 549 to 594 million metric tons for 2020. The projections for grain supply range from 403-486 million metric tons for 2010 and 541 to 570 million metric tons for 2002. Based on the projections by Rosegrant et al., (1995), Huang et al. (1997), USDA (2006) and World Bank (2003), China's grain imports will be from 15 to 39 million metric tons for 2010, and between 24-25 million metric tons for 2020. It is safe to conclude that most studies indicate that China will remain a significant net importer of grains and the bulk of these imports will be wheat, followed by maize and other feed grains.

Table 2.4 China major farm output, selected years, 10,000 ton

	Grain	Rice	Wheat	Maize	Soybeans	Cotton	Oil bearing crops
1978	30467	13693	5384	5594	---	217	522
1990	44624	18933	9822	9781	---	451	1613
1995	46662	18522	10220	11198	1787	477	2250
2000	46217	18790	9963	10600	2010	442	2955
2001	45264	17758	9387	11408	2052	532	2865
2002	45706	17454	9029	12130	2241	491	2897
2003	43069	16065	8648	11583	2127	486	2811
2004	46947	17908	9195	13028	2232	632	3065

Source: NBSC (2005a).

Table 2.5 China major animal products, selected years, 10,000 ton

	Pork	Beef	Mutton	Dairy
1996	3158	355	181	736
2000	4031	532	274	919
2001	4184	548	292	1123
2002	4326	584	316	1400
2003	4518	630	357	1848
2004	4701	675	399	2368

Source: NBSC (2005a).

The changes in the demand for farm goods have been brought about mainly by income growth and urbanisation. Following the increase in incomes, consumption of meat, seafood, dairy products, vegetable oils, fruit and vegetables is rising, while consumption of starchy staples, including wheat and rice, is declining. Consumers move away from staple foods such as grains to include vegetables, fruits, meats and dairy products in their diet.

While there have been major changes in land use within agriculture, the total area of crops planted has remained relatively static at 150-155 million hectares (Roberts and Andrews 2005). The proportion of the area planted to cereals had declined from 63% in 1991 to 50% in 2003. The changes in the supply of farm goods have been determined by changes in the quantity and quality of farm input and efficiency of input use. The changes in the input use and efficiency are in turn caused by changes in the land and other resources available for agricultural uses, changes in the demand for farm goods and subsequent changes in prices, and government policies.

The reductions in arable land due to urbanisation and water constraints and land degradation pose serious threat to future increase in farm output. More importantly, the current land tenure system with undefined land ownership and very small size of farms have discouraged farmers from investing in land and kept labour productivity in agriculture extremely low, which has contributed to the current state of comparative disadvantage for a number of major farm products. It is expected that farm output could be greatly increased, when the land ownership is further clarified and a market for land is developed, and when the agricultural extension services are improved.

2.3.2 China's Agricultural Policies: From Taxing to Subsidising Agriculture

Highlighting the very low level of productivity, agriculture still provided employment to 46.9% of workforce in 2004. Rural incomes have generally remained far below urban incomes and have resulted in rising income inequalities. From 1998 to 2003, the income gap between urban and rural population widened from 2.51:1 to 3.23:1.

The Chinese Government has addressed some of the fundamental issues facing China's agriculture and rural economy by signalling a policy shift in 2004 from taxing to subsiding agriculture. The General Secretary of the Communist Party Mr He noted that the trend that had occurred in the developed economies should, in his judgement, also occur in China: *following the process of industrial development, a country tends to shift from taxing agriculture for industrial development to agricultural support so as to achieve more balanced development*, and *on the whole, China has reached the stage for supporting agriculture with industrial development and for supporting rural areas with urban development. We shall therefore actively support agricultural development* (MOA 2005, p. 22).

There have been heated discussions about how should China shift from taxing to protecting agriculture. The MOA has summarised the development of agricultural support in the developed countries in the following terms: *in general starting from price support, to the development of rural infrastructure, education, research and extension, and to direct income support, accordingly, the objective of support gradually shifting from output growth in the early stages to improvement in production capacities, income growth and sustainable development* (MOA 2005, pp.106-110).

In 2004, the government announced the decision to phase out special agricultural product taxes (except that for tobacco production) and to reduce agricultural taxes with the objective of removing agricultural taxes within five years from 2004.

The agricultural support measures introduced by the government since 2003 include 'the three agricultural subsidies', agricultural price support and government investment in rural infrastructure. 'Three agricultural subsidies' refers to direct subsidies to grain producers, hybrid seed subsides applied in certain areas and subsidies for purchases of large farm machineries. In 2004, the three subsidies totalled around 15 billion RMB (less than US$2 billion). Of which, subsidies for grain producers were provided to the producers in 29 provinces all over China and reached 11.6 billion RMB. The seed subsidies amounted to over 3 billion RMB (2.85 billion from the central government and over 0.3 billion from local governments) and the subsidies for farm machinery reached 0.5 billion in 2004, most from local governments. The seed subsidies have been used initially to support soybean production, following a sudden increase in soybean import. According to MOA, the outcome of the seed subsidies for soybean production has been very satisfactory.

The introduction of 'the three agricultural subsidies' signals a change in the way for government to assist agriculture: from subsidising marketing channels and urban residents and exporters to subsidise farmers. Prior to the introduction of the three subsidies, the government subsidies went mainly to marketing enterprises, such as the state-owned Grain Bureau system and to agricultural exporters, with the purpose to subsidies urban residents and export.

In 2004, the Chinese Government also introduced a protective price for grain. The floor price for rice was set at 1.4 RMB per kilogram. The central government investment in rural infrastructure in 2004 increased by 22.5% compared with 2003, reached 262.6 billion RMB. The investment ranged from irrigation, drinking water for human and animals rural roads, and biogas to water and electricity, fencing animal disease prevention, and integrated agricultural development.

The long term effects of such subsidies are less certain, with very small size of farms and subsequent very low labour productivity in agriculture. It would be difficult for the government to meet the need for ever-increasing subsidies for agricultural and grain production.

2.3.3 Implications for Western Australia

The Chinese Government has made 'building a new socialist countryside' a key priority for the Eleventh Five Year Plan and beyond. The key priorities in this major program are to implement modern methods and technologies, especially in grain production, develop rural infrastructure, extend the reform process in agriculture (including in 2006 rescinding agriculture taxes that have been levied for 2600 hundred years and which currently raise some A$12 billion from farmers) and improve environmental sustainability. Western Australia has been forced, over many years, to address issues concerning farm efficiency and sustainability, and the use of appropriate technologies, on a wide range of types of land, especially for wheat and other cereals. Thus firms and agencies within the State could play a significant role in this large scale attempt to transform the Chinese rural sector.

2.4 The Environment in China

According to some observers, China presents a picture of rising pollution and depleted environmental resources that are leading towards ecological collapse. Western environmentalists worry that ecological catastrophe will spill beyond China's own borders and affect the entire globe (Hayward 2005). Other observers present a more complex and sympathetic assessment of China's environmental situation and future prospects.

The Economist (2004) observes, for example, that China represents a contrast between projects and districts that have adopted world state-of-the-art environmental management techniques with some of the worst examples of third world environmental pollution. *Rapid progress and bold experiments in some areas are balanced by bureaucratic rigidity and stagnation in others* (p. 57).

2.4.1 China's Environmental Problems

Environmental problems in China range from air and water pollution, greenhouse gas emissions, land degradation, threats to biodiversity, and waste disposal and management.

Air Pollution

The major problems are urban air pollution, acid rain, and contamination by toxic chemicals (some of them affecting the atmosphere over long distances). Coal-fired power stations and the use of coal as a heating fuel in homes are the main source of air pollution in China, but emissions from urban transport are a rapidly increasing contributor. Acid precipitation has recently become an important environmental concern in China. At least two-thirds of acid depositions are caused by coal-fired power plants with outdated pollution control equipment. Acid rain has damaged around 0.28 million hectares of forestland in the Sichuan basin of China. It is reported that emissions of sulphur dioxide have begun to decline from 1995 onward.

Nearly two-thirds of China's 343 major cities currently fail to meet the nation's air quality standards, and air pollution is expected to get worse. The World Health Organization indicates that seven of the ten most polluted cities in the world are in China. Beijing and Shanghai are notorious for high levels of suspended particulates.

Water Pollution and Safe Water Supplies

Water pollution is perceived to be one of the most serious environmental problems in China. Water is an extremely scarce resource in China, although China is ranked fourth in the world in terms of total availability of water resources as it has 6% of world's renewable water resources. However, as China also has 22% of world's population, in terms of per capita availability of water resources China ranks 121st in the world. At 1856 cubic meters per capita, availability of water in China is only slightly higher than the international dividing line, of 1700 cubic meters per capita, between water sufficiency and water deficiency. Furthermore, groundwater resources have been badly depleted and surface water resources are also overused. The north and the west of the country experience regular droughts, which add to scarcity problems.

Water quality is also a major concern. Water quality has been declining in the south China, where water supply is ample. The Yellow River is among the world's most polluted waterways. There is also serious pollution in China's largest lakes. The problems of water quality are related to untreated sewage (sewage treatment covers only half the population) and the discharge of untreated industrial waste into rivers. China has passed a Water Law, which addresses these problems, and water quality is being improved, if off a low base.

It is clear from the above discussion that China faces multiple challenges in relation to its water resources. Shortage of water in the northern region, particularly in urban areas, calls for augmentation of water resources through schemes of water diversion and conservation. An example of these is the massive project – the South-North Water Diversion Project –

started in 2003 and with an estimated total cost of US$58.5 billion, for transporting water from South to North China. In the southern region, recent trends of deterioration in water quality need to be reversed. In the central and western regions, where agriculture remains the major consumer of water resources, irrigation infrastructure needs to be modernised. Water rights and pricing regimes need to be developed for encouraging efficiency in the use of scarce water resources. For further information see Supporting Paper 6.

Many of these challenges require responses that may be already available or may be capable of being developed quickly by Western Australia's State Government or local government bodies or private sector enterprises.

Land Degradation

Land degradation processes of particular concern include erosion, compaction, acidification, declining soil organic matter, weed infestation, soil fertility depletion and biological degradation. China is one of the countries experiencing the most severe water erosion. A major policy failure leading to land degradation is insecure land tenure, although economic pressures have also led to the over-exploitation of land holdings. Desertification is a problem in North China. Farmland erosion and desertification in the north of China have led not only to severe sand-storms over Beijing but have also affected South Korea and Japan.

Urban expansion, including land requirements for industry, transport and for leisure activities in all regions, increases pressures on land resources. China lost about 5 million hectares of farmland to towns and cities during 1987-92, and the loss has obviously been continuing since that time. Land degradation, river siltration and soil pollution from acid rain and industrial wastes, are some of the environmental issues associated with urbanisation and industrialisation.

Threats to Biological Diversity

UNEP reports on the unprecedented rate of decline in global biodiversity. Among the key threats are: unsustainable patterns of consumption, increasing production of waste and pollutants, urban development. Nitrogen deposition has become a major cause of biodiversity loss.

In China, the diversity of species is extremely high, particularly in the Hindu Kush-Himalaya belt and the Tibet plateau. Rapid urban expansion, the growth in transport infrastructure, the impact of pollution, and the expansion of industry all create pressures on biodiversity. Dams in the Yangtze basin are a major specific threat to biodiversity.

Disasters can occur as a consequence of the impact of a natural or a human-caused hazard. China experienced more than 300 natural disasters and recorded more than 311,000 deaths during 1971 to 2000. Floods have been a particular problem in China, but cyclones and landslides have also featured in the sequence of natural disasters.

Waste

Waste is generated by the activity of industries (notably agriculture, mining, manufacturing and construction as well as waste from the services sector, notably food retailing and health) and by households. Waste becomes an environmental problem when state-of-the-art waste management systems are not in place. Untreated waste leads to the pollution of waterways, lakes and coastal waters and it can also contaminate soil, vegetation and have adverse impacts on fauna and human health. China is a long way from having a national framework for waste collection let alone advanced waste disposal or prevention systems.

2.4.2 Environmental Prospects

Rising Awareness of Environmental Problems

The awareness of China's environmental problems is rising among policymakers at the highest level. At the same time, environmentally-related violent public protests have been occurring in China over recent years. These have been provoked by pollution from chemical plants, pharmaceutical plants, and chemical spills shutting off water supplies. Non-government organisations (NGOs) are also becoming more active in channelling the concerns of the poor about environmental issues.

International pressure on environmental problems is even greater than domestic pressure. Foreign companies are active in marketing their capabilities for environmental technologies and skills. International agencies are tying funds to environmental criteria. Foreign governments are beginning to complain about China's dust storms and greenhouse-gas emissions.

Leapfrogging Technology

The advances made in technologies for dealing with environmental problems in the richest economies enable developing countries to skip intermediate stages in technology and achieve greater short term improvements than would otherwise be possible. Similarly, advances in policymaking capabilities in the environmental area in rich countries (better data, institutional developments and the use of market instruments) become available to developing countries.

Constraints on Environmental Improvements

The major constraint on environmental problems is related to attempts to prioritise economic growth at the expense of the environment. This can produce an international 'race to the bottom' whereby poorer nations bid for investment by sacrificing environmental policies and richer nations outsource their environmentally harmful production to poorer countries.

An elaborate points system that determines the careers of officials is often blamed for many of China's problems. Targets for economic growth tend to take precedence over social and environmental issues. Points are awarded for an array of targets and this determines career prospects. GDP growth, population control and social order have been the most important of these targets. In an autocracy, officials often feel at liberty to pursue these targets at any cost. This system causes colossal waste and environmental damage as officials doggedly pursue growth targets.

China lacks an understanding of the concept that the polluter should pay. Utility charges are kept low to avoid sparking public unrest. Utilities are therefore unable to pass the costs of cleaner water or lower power-station emissions to consumers and therefore fight any drive for higher environmental standards.

Air and Water Quality

There have been declines in the level of ambient air pollution in China from 1990 to 2002. This has occurred despite an increase in total energy consumption over this period, suggesting qualitative improvements in the energy-producing and energy-consuming technologies in use. China's State Environmental Protection Administration (SEPA) reports some progress in improving the number of cities that achieve their grade II ambient air quality standards (which are comparable to US ambient standards), but northern Chinese cities (with colder winters and hence high pollution seasonally) have a long way to go to meet the standard.

Industrial discharge of petroleum-related pollutants and some heavy metals into rivers and oceans has been cut in half over the last decade. Wastewater treatment facilities are being built at breakneck speed; between 2000 and 2005, total wastewater capacity has probably doubled.

Spending in the Five Year Plans

The Tenth Five Year Plan for 2001-2005 set ambitious environmental targets and boosted environmental spending to 1.3% of GDP, up from 0.8% in the early 1990s, but still below the 2.0% recommended by the World Bank. Environmental expenditures are now increasing by about 15% a year, and the targets for spending set in the Tenth Five Year Plan have been nearly met. Besides setting ambitions targets for urban wastewater treatment (to reach 50%), an expansion of nature reserves, and an increase in the use of natural gas, the Tenth Five Year Plan included major investments in cleaning up key lakes and rivers, installing wastewater treatment and hazardous waste facilities, and carrying out a massive reforestation effort throughout the country. The Eleventh Five Year Plan committed even more investment (US$175 billion, or 1.5% of GDP, over 2006-2010, to environmental protection initiatives (*China Daily* 18 July 2006)). It also established wide-ranging targets for environmental protection and energy efficiency, indicative of a growing commitment (although not necessarily the capacity) in the central leadership to address environmental problems.

2.4.3 Implications for Western Australia

The central importance of environmental constraints and water issues in China at the present time has main implications for Western Australia in two main ways. To the extent to which these issues emerge from the rapid, resource based pattern of development within China that is fuelling global resources demand, they are a reminder of the deepening problems in China that must in due course lead to a moderation of that demand. But, perhaps more importantly, many of these issues are ones which Western Australian firms and agencies have addressed for some time, and continue to address, and in which they have built up substantial expertise and international recognition. There may thus be an opportunity for such firms and agencies to participate in the programs to address these matters, massive by global standards, which are being put in place in China.

2.5 Education and Health

Both health care and education are among the national strategic priorities of the Chinese Government. National strategic priorities are announced annually in the *Report on the Work of the Government*, released by the Premier in March every year. But annual announcements of strategic priorities by the Chinese Premier have not automatically translated into a higher flow of resources into health care and education. China's current level of public spending on health care and education is quite low and resources are distributed very unequally among China's sub-national government jurisdictions – provinces, prefectures, counties and townships. The overall shortage of public funding combined with unequal distribution of resources has given rise to serious issues of access and equity in vital areas of economic and social services, and to an increasing reliance on non-government funding. In recent years, the Chinese Government has been seeking to address these issues by not only directing more public spending into areas of greater need, but also by encouraging greater participation of the private sector in these areas.

2.5.1 Current Level of Spending and Decentralised Government Responsibility

A recent report by the Asian Development Bank (ADB 2005) found that alignment of budgetary allocations with strategic economic priorities remains a challenge in China. As shown in Table 2.6, spending on education accounts for only 3% of GDP. Spending on health care is not only low as a proportion of GDP, but has also not grown since 1994. Indeed, budgetary expenditure on health care had fallen to 0.5% of GDP in most of the intervening years between 1994 and 2002. Budgetary spending on health care had risen to 0.8% of GDP in 2003 (refer Table 2.6).

Table 2.6 Budgetary expenditure on education and health in China

Item	1994	1995	1996	1997	1998	1999	2000	2001	2002
					Proportion of total fiscal expenditure (%)				
Education	17.6	17.5	17.8	16.7	16.0	14.6	13.7	13.9	14.1
Health care	4.4	4.4	4.4	4.2	3.8	3.4	3.1	3.0	2.9
					Proportion of GDP (%)				
Education	2.2	2.0	2.1	2.1	2.2	2.3	2.4	2.7	3.0
Health care	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6

Source: ADB (2005).

China currently has five levels of government. In addition to central government, there are 31 provinces, autonomous regions, and municipalities; 333 prefectures; 2861 counties; and 44067 Townships. As there are significant disparities within and among the levels of sub-national governments, the level of services varies enormously between regions, provinces, counties and townships.

Responsibility for social services such as health and education rests primarily with sub-national governments, in particular at the grass-roots level of county and township governments. Virtually all the budgetary expenditure for health and environmental services and about 90% of budgetary spending on education is the responsibility of local governments. Governments below the provincial level (i.e. county and township levels) play a crucial role in the provision of services such as basic education, health care and housing. In the past, a range of social functions, including health care and housing, were provided by state-owned enterprises and consequently were not funded from taxation. In the wake of the structural reforms of state-owned enterprises, however, responsibility for delivery of these services has now fallen upon local government, particularly at the sub-provincial levels.

Local governments collect the so-called local taxes through their own tax administration bureaus, but have no authority to impose a tax or alter tax rate or tax base, except in very minor cases. Local government budgetary revenue consists mainly of revenue raised from these local taxes, share of revenue from the shared taxes and fiscal transfers. The distribution of intergovernmental fiscal transfers in 2002 is such that several of the rich provinces, such as Shanghai, Beijing, Tianjin, Liaoning, Heilongjiang and Jilin receive far higher per capita fiscal transfers than some of the poor provinces, such as Hunan, Hainan, Anhui and Guangxi. This pattern of financing local governments further exacerbates disparities in the provision of health and education.

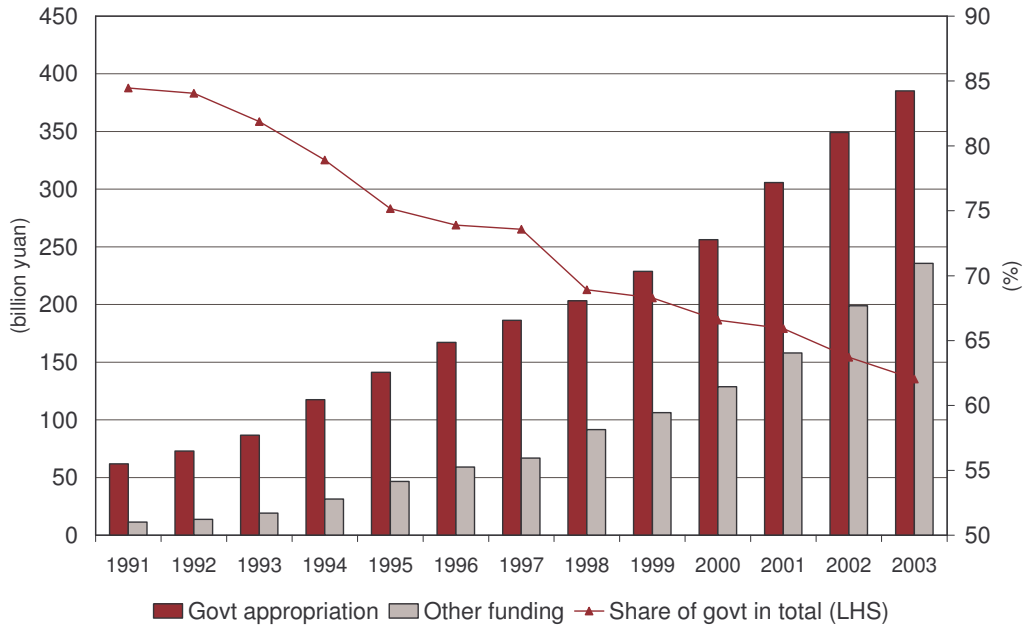
Almost always driven by the inadequacy of fiscal revenues, local governments often raise budgetary funds from fees and charges of various descriptions that are generally outside the budgets and are excluded from budgetary management. As they can set the rates of such fees, local governments prefer such fees to taxes. Indeed, a special phenomenon of fees-crowding-out-taxes appears to have come into existence at local government level in China in recent years.

2.5.2 Education

A key feature of recent developments in education in China – undoubtedly linked to the competing pressures on governments for public funding, the indirect access to these areas on the part of the central government and the underlying strong growth in the demand for educational services – is the rising reliance on private spending in these areas (Figure 2.5). While national spending on education rose 3.1% of GDP to 5.3% of GDP between 1992 and 2003, nearly three quarters of that increase (73%) was due to non-government spending. This is a strong indication of the unsatisfied demand for education in China.

Although the overall level of spending on education in China is comparable to that in other developing countries, and is higher than that in transition economies, the share of private spending on education is far higher in China than in the other comparators. This situation arises in part because school education in China is the responsibility of local governments, which generally do not have adequate revenues for financing education spending.

Figure 2.5 Government and other funding of education in China, 1991-2003



Source: NBSC (2005a).

Under the China National Educational Law, local governments are responsible for offering nine years of compulsory education (six years in primary school and three years in middle school) to children all over China. Within the four tiers of local government in China (provincial, prefectural, county and township levels), counties and townships are responsible for most of the budget outlays (estimated around bout 70%) on education spent by local government.

Although noted above, responsibility for basic education rests with sub-national governments in China, the central government provides support for compulsory education in the form of special tax treatment of several associated costs. This support includes exemption from tax for state educational prizes and interest earned on educational deposits. Educational goods can be imported duty-free and companies established by government and private schools are eligible for favourable tax treatment. Notwithstanding these measures, however, local governments in many regions are unable to raise sufficient funds to finance the cost of nine years of education, and many resort to imposition of unlawful fees and charges or to borrowing.

According to a study conducted in 2001 by Professor Junsheng Li of Central University of Finance and Economics, Beijing, it was common for local governments in rural areas in Yunnan, Henan and Shaanxi to borrow funds from the private sector to run schools. Some counties ran annual debts accounting on average for around 20% of their total annual fiscal expenditure. Under the National Governmental Budget Law, local governments in China are not allowed to borrow from the private sector to finance their budgetary outlays. However, in practice such borrowing continues to be ignored by the authorities, because there is no alternative. Li reported that during his investigation he had heard reports that in some cases, the creditors in the private sectors had even forced some schools to be closed because the local government could not pay off the loans for those schools.

Driven by the lack of funding, some local governments also require that students should pay fees to attend schools. Thus, in the northern parts of China, it is estimated that each middle school student in the countryside has to pay 1,200 to 1,500 yuan, accounting for nearly one half of the family's average annual income, for textbooks, food, stationery, lodging and reading materials. In some cases, school-age children may not attend school, because their families are too poor to afford such expenses.

Increasing the level of budgetary spending on education has been a goal of China's central government for several years. Thus, in 1993, a medium term goal was set for raising budgetary expenditure on education to 4% of GDP by 1999. Budgetary outlays on education had been raised in subsequent years, but only to 3.4% of GDP in 2002. The Tenth Five Year Plan had re-scheduled the timing of achieving the target of 4% of GDP to 2005, while encouraging the participation of the private sector in providing education services (OECD 2005b).

2.5.3 Health Care

China's total health spending of 4.8% of GDP in 2003 is a good deal lower than in OECD countries, but not far removed from the average level of spending in other transition or developing countries (Table 2.7). But what is distinctive about it is the very low share of government funding, only 0.8% of GDP or 17% of the total, and the heavy reliance on non-government funding, especially direct payments by individuals from their disposable income, which contributed 56% of total spending in 2003.

Table 2.7 Expenditure on health in China, by funding source, 1997-2003

	1997	2003	Rate of change (% pa)
	(billion yuan)		
Government[1]	52.2	111.7	13.5
Social[2]	93.8	178.9	11.4
Individual[3]	192.5	367.9	11.4
Total	**338.5**	**658.4**	**11.7**
	(per cent of total)		
Government[1]	15.4	17.0	1.7
Social[2]	27.7	27.2	-0.3
Individual[3]	56.9	55.9	-0.3
	(per cent of GDP)		
Government[1]	0.7	0.8	3.2
Social[2]	1.2	1.3	1.5
Individual[3]	2.4	2.7	1.7
Total	**4.3**	**4.8**	**1.9**

Notes: [1]Government expenditure refers to budget spending by all levels of government.
[2]Social expenditure refers to non-government budgetary capital input, mainly from health insurance, and includes expenditure on health institutions and health care by enterprises and rural collective entities.
[3]Individual expenditure refers to payments by individual from disposable income for health insurance and health services.
Source: NBSC (2005a).

Budgetary spending on health care in China is not only low, but is also highly unequal. Average budgetary expenditure on health care in 2002 was 48 yuan per capita. In individual provinces expenditure was as low as 22.2 yuan per capita in Hunan. In total, 71% of population lived in provinces in which budgetary expenditure on heal care was below the national average. On the other hand, budgetary spending on health care ranged between 116 and 266 yuan per capita in Beijing, Shanghai, Tianjin and Tibet – four jurisdictions whose combined population was 3.4% of total population (Table 2.8). Similar disparities also exist in the cases of budgetary spending on basic education, science and research and the environment. Disparities within the provinces are even more pronounced, because distribution of funds within the provinces is more arbitrary and *ad hoc* than among the provinces.

Table 2.8 Health spending by region, 2002

Region	Per capita expenditure on health care (yuan)	Share of total population (%)		Per capita expenditure on health care (yuan)	Share of total population (%)
China average	**48.1**	**100.0**			
100 yuan or more			**Below average**		
Beijing	266.5	1.1	Jilin	47.2	2.1
Shanghai	187.4	1.3	Liaoning	46.9	3.3
Tibet	182.1	0.2	Shanxi	45.8	2.6
Tianjin	116.2	0.8	Heilongjiang	45.5	3.0
Sub-total		**3.4**	Hainan	42.2	0.6
48-99 yuan			Gansu	41.0	2.0
Qinghai	83.6	0.4	Guizhou	40.1	3.0
Xinjiang	82.5	1.5	Sha'anxi	39.4	2.9
Guangdong	82.0	6.1	Hubei	37.3	4.7
Zhejiang	80.1	3.6	Guangxi	37.0	3.8
Yunnan	66.4	3.3	Shandong	37.0	7.1
Ningxia	65.1	0.4	Hebei	36.6	5.2
Jiangsu	56.8	5.7	Chongqing	30.4	2.4
Fujian	53.1	2.7	Jiangxi	30.3	3.3
Inner Mongolia	52.2	1.9	Sichuan	29.3	6.8
Sub-total		**25.6**	Henan	22.8	7.5
			Anhui	22.6	4.9
			Hunan	22.2	5.2
			Sub-total		**71.0**

Source: NBSC (2003, p. 291).

While there is clearly massive unsatisfied demand for health services in China, there has not been growth in non-government funding to the same extent as in education, at least over the period 1997-2003 for which data are available. This may well reflect both the already high level of non-government funding in 1997 and constraints on the supply of health services, especially in rural areas.

2.5.4 Conclusions and Implications for Western Australia

Demand for education and for health services is very strong in China, and has been stimulated by rapid economic growth. In spite of official statements, these two areas have not been given high priority in public spending, especially since the early 1990s, although efforts are being made to increase spending. The result has been that, where opportunities and income have been available, there has been rapid growth in funding of these areas by individuals and by other social groups, especially after Deng Xiaoping's southern expedition in 1992 encouraged the expansion of non-government institutions.

This is particularly the case in education, where nearly three quarters of the increase in national spending over 1992-2003 came from non-government sources. But there remains heavy unmet demand for these services, and the reliance on private funding sources has meant that inequalities in access have increased greatly. There are major opportunities for private sector investment, from within China and abroad, in both education and health care.

With its strong record of educational excellence, and long-standing experience in providing health services in rural and remote areas, Western Australia is well placed to take advantage of these opportunities. However, as discussed in Chapter 4, the State's educational institutions are not strongly oriented to Chinese students, and Western Australia's share of such students is well below its pro-rata share. These are issues to which we return in later chapters.

3 Obstacles Ahead: Revising China's Current Development Strategy

The previous two chapters have described the historic nature and global implications of China's emergence, and documented some features of the specific path on which it has embarked in recent years. They have also made clear that fundamental challenges lie ahead for China's rapid development model, and indeed for the global growth path within which it is embedded and to which it is such a major contributor.

In global terms three main concerns have been discussed. Firstly, the major issue is probably the environment, and in particular the impact of rapid, energy intensive growth based primarily on energy derived from coal. Between 2001 and 2005, world coal consumption increased by 5.3% per annum, and world energy consumption by 3.0% (BP 2006), implying growth in total CO_2 emissions from fuel combustion of the order of 3.5% per annum. In the Asia Pacific region, coal consumption grew by 9.5% over this period, and total energy consumption by 6.5%. Similar growth rates are occurring in 2006. Our assessment is that, on unchanged policies, both world energy use and CO_2 emissions from fuel combustion will grow by close to 3% per annum between 2002 and 2030. This will mean a level of CO_2 emissions of about 16 gigatonnes of carbon by 2030, up from 6.7 gigatonnes in 2002. According to standard climate models such an outcome would have very severe outcomes, including rapid increases in global temperatures over the next two decades, further extension of adverse weather conditions, irreversible melting of the Greenland ice-sheet, and so on. There will be growing international pressure for major change as the reality of such a path emerges.

Secondly, the world economy is moving deeper into uncharted waters in terms of the scale and persistence of financial imbalances between major regions. Major imbalances are developing, primarily between the USA (and to a lesser extent countries such as UK and Australia) on the one hand and East Asia and the oil producing nations on the other, and there is deepening concern as to how these imbalances might be reduced. The IMF's September 2006 base projections imply that the key East Asian countries and the fuel producers will continue to fund a US current account deficit of almost 2% of world GDP through to 2011. This implies net holdings of foreign assets – in good part in consisting of US Treasury bonds issued to finance the US budget deficit – on the part of these countries of about 15% of world GDP by 2011, with corresponding deficiency in net foreign assets held in the USA. While these imbalances are being successfully managed at the present time and there is no reason for immediate concern, the more they increase, the greater the risk of an abrupt and costly adjustment at some point in the future.

Thirdly, the rapid growth in China's share of world exports – from 4% in 2000 to about 15% in 2015, implying a more than tenfold increase in exports from US$249 billion in 2000 to over US$3000 billion in 2015 – will have growing ramifications in both developed and developing countries competing with Chinese manufacturers in both foreign and domestic markets. As domestic markets are penetrated and local firms fail or move production offshore, current anti-globalisation and protectionist sentiments are likely to intensify. Many countries, including Australia, are being cushioned from the full impact of rising trends by the current world boom, and rising protectionist pressures are most likely when the world economy enters a significant slowdown. Such pressures could give rise to heightened geopolitical tensions, which will be fuelled also by increasing competition for energy resources and growing concern about the climate.

There are severe problems facing the present growth path within China also. Many of these issues are recognised and publicly acknowledged by the Chinese Government, and this recognition is the basis for plans of action. For example, in his March 2006 Report on the Work of the Government 2006 to the National People's Congress, Premier Wen Jiabao (2006) said of the issues arising from the Tenth Plan period (2001-2005): *The main problems were an unbalanced economic structure, weak capacity for independent innovation, slow change in the pattern of economic growth, excessive consumption of energy and resources, worsening environmental pollution, serious unemployment, imbalance between investment and consumption, widening gaps in development between urban and rural areas and between regions, growing disparities between certain income groups, and inadequate development of social programs. We need to work hard to solve all these problems.*

The main items listed by Premier Wen Jiabao have been covered in Chapter 2 above, but two issues not listed should also but two other matters should also be mentioned. One is the issue of regime legitimacy, and of the continued survival of the Chinese Communist Party (CCP) as the ruling power if there is significant and growing dissatisfaction with the fruits of market-oriented growth. Opening to the world and facilitating the use of market mechanisms and institutions has brought great benefits to China, but it has also increased inequality and corruption, undermined part of the rationale for CCP rule and made a greater number of Chinese aware of the possibilities of other forms of government. Thus an effective development strategy that brings significant benefits to the bulk of the population and not only to the coastal elite, is a high priority for the current Chinese Government.

The second is the issue of increased vulnerability of China's economy to global trends. With exports approaching 50% of the value of China's GDP, its economy is becoming increasingly exposed to fluctuations in other economies, especially the US. The cases of Singapore and South Korea have shown that, while a trade-driven growth strategy can be highly effective, it can lead to a sharp slowdown if there is recession in key markets. Such a slowdown would have profound implications within China, given the social and political reliance on continued rapid economic growth.

3.1 Elements of a Revised Development Strategy in China

These global and domestic considerations add up to a powerful case, largely accepted by the Chinese Government, for a significant change in its current development strategy. A summary of the key dimensions of such a revised development strategy, on our assessment, is provided in Table 3.1. The most obvious feature of the task China faces in revising its strategy is the complexity of the undertaking, given the many inter-related areas of policy that need to be considered and the vast array of public and private agencies, both domestic and international, that now play a significant role in China.

These six elements of a revised strategy, while quite different in many respects, are all closely interrelated with one another. Achieving them requires recognition of this interdependence, and a stronger knowledge base on the factors determining current outcomes and on the inter-relationships between them, as well as the analysis of policy options in this full context. One example of the interrelationships is the following: if energy use and environmental damage is to be reduced while allowing strong growth to continue, the structure of growth may need to be changed; for this to occur, the application of knowledge within industry must be strengthened and service industries such as health must develop more rapidly, and reach the whole population; for this to occur, revised fiscal and governance arrangements might be necessary. In this context, four specific research sub-projects are suggested, as outlined below, together with an overall program of research coordination.

Table 3.1 Dimensions of a revised development strategy in China

Limitations of Existing Strategy	Towards a New Strategy
Focus on export oriented manufacturing	**Reduce preferential climate for exports**
Low employment growth in industry	Higher value for yuan
Low wages, limited broader benefits	Constraints on energy intensive activities
Big trade surplus, foreign exchange	Market pricing for energy and other inputs
Heavy call on energy resources	Higher wages/improved conditions in industry
	Reduction of incentives for foreign investment
Over-emphasis on investment activities	**Control over-investment**
Excessive, unproductive investment	Limitations on local government competition
High energy and other resource use	Market pricing for energy and other inputs
Development of speculative activities	Use interest rates and credit controls to avoid bubbles
Labour and energy intensive growth	**More knowledge and technology intensive growth**
Concentration on low value added activities	Become market leader in use of advanced technologies
Advanced technologies not available	Mandate leading transport and consumer energy use
Inefficient transport and consumer energy use	Require global companies to bring advanced technologies
	Seek greater external value adding to resource imports
Low growth of health, and other services	**Develop sources of services growth**
Low public spending; high private costs	Higher taxation of incomes and growth sectors
High savings; low consumer spending	Increased public outlays on 'soft' social infrastructure
Unequal access to basic services	Development of public health sector/other services
Low social dividend from growth many	**More employment and better services**
High level of rural poverty despite growth	Promote growth and income in agriculture
Limited access/high cost of rural services	Higher employment growth, especially in services
	Develop rural health, education and other services

Given that the development of coordinated policy responses over many aspects is likely to be critical to achieving an overall change in strategic direction, the continuing role of the planning process in China, as an instrument for strategy development and reform rather than for operating a command economy, is of considerable importance.

3.2 Implementing the Eleventh Five Year Plan (2006-10)

The Eleventh Five Year Plan for the period 2006-10, launched in early 2006, is the main formal vehicle by which the Chinese Government has attempted to address many of these issues. It outlines a vision of development that is socially and environmentally sustainable and that contributed to maintaining a harmonious society, and outlined broad programs to be implemented towards achieving such a form of development. As one observer has written, China's Eleventh Five Year Plan proposals for the period 2006-2010 are remarkable: *There emerges from this Plan document a rich and comprehensive vision of a sustainable development process in China, and a glimpse of the kind of government role that would be required by this development process. The vision is of a society that is more creative, more focused on human resource development, and treads with a lighter and more environmentally benign step* (Naughton 2006, p. 9).

It is, even in an autocratic state, one thing to outline a vision of a sustainable economy and a harmonious society and quite another to define and implement a detailed set of programs to give effect to this vision. This is especially so in such a diverse, vibrant and internationally engaged society as contemporary China. The forces shaping the current growth pattern – from the role of local governments and the limited power of the central government, the strong influence of foreign companies and investors and the level of the exchange rate to the popular desire for a strong China and a better life – are complex and inter-related, and it will take a major effort to re-align them. Given the unprecedented nature of the changes taking place in China, and their integration into complex global processes, limited knowledge is available of the factors driving change and hence of the ways in which policymakers can intervene effectively to shape the pattern of change.

The Eleventh Five Year Plan does not commit to all of the elements distinguished in Table 3.1, although most elements are being addressed to some extent in government statements and policy initiatives. Four important objectives of current government policy as expressed in the Plan are as follows:

- to make growth more sustainable and environmentally benign, and to reduce the rate of energy and water use, and of pollution;
- to increase innovation within all sectors, including industry, and shift the pattern of activity from low value added output based on low labour costs towards higher value added activities based on knowledge;
- to change the structure of growth towards the service sector, and accelerate the growth of particular service sectors that directly contribute to individual welfare; and
- to improve the position of people in the countryside, and to build structures to ensure that the benefits of growth flow to people in rural areas.

It is not possible to explore all of these objectives in any depth in this report, and some aspects (agriculture, health and education) have been touched upon in Chapter 2. Here we comment on three matters critical to the implementation of such a revised approach – reducing the energy intensity of the economy, bringing about an effective change in fiscal priorities and finding the right balance between public goods and market processes in different sectors of the economy.

3.2.1 Energy Use and the Environment

As discussed above, after two decades in which China's total energy use grew at only about half the rate of growth of GDP, over the past five years, energy use has grown at double-digit rates, implying an elasticity of energy use with respect to GDP of more than one. This explosive growth in energy use caught policymakers, energy analysts and energy providers in China unaware, power shortages began to develop in 2002 and a massive expansion in energy production capability has been put in train. However, the reasons for the abrupt shift in the elasticity of energy use are by no means fully understood, and as a result forecasts of the future level and pattern of energy demand cannot be made with much assurance. This limits the Government's ability to intervene effectively, even though continued growth in energy use in line with the growth of GDP would, if it occurred, have major implications for China's economy and environment, and indeed for the global environment.

This difficulty can be illustrated by developments in respect of energy consumption during 2006. In his March 2006 Work Report cited above, Premier Wen Jiabao made a key target for 2006 a reduction of 4% in energy consumption per unit of GDP. This meant that, on expected GDP growth in 2006 of 8%, the increase in energy consumption would be held to 4%.

On 31 July 2006, the government announced that in the first half of the year energy consumption had risen by 11.7%, relative to the same period of 2005, on GDP growth of 10.9%, so that energy consumption per unit of GDP had risen by 0.8% (NBSC et al. 2006). As a result, the government urged all regions and departments to adopt the energy-saving target, promote structural adjustment, to focus on energy-saving in key industries and enterprises, and generally to *make great efforts to achieve the energy-saving target for the year* (ibid). However, it is clear than that target for 2006 will not be achieved.

There is clearly a long road between the Government's intention to move to a more sustainable growth path and the reality of changing the direction of the Chinese juggernaut. Limited knowledge of the drivers of energy use constrains the pace of change. Nevertheless, the economic and social pressures for reduced energy intensity and for an improved environment remain central realities in contemporary China.

3.2.2 Changing Fiscal Priorities within China: The Constraint of the Federal Structure

If there is to be a change in the structure of growth to a more broadly based, sustainable form, which reaches people across the whole country, this is likely to require revised governance and fiscal arrangements. Effective change in development strategy needs to be driven by the central government. For this to be achieved in a decentralised, market economy appropriate instruments and incentives need to be in place for each level of government, as well as for the private sector. An important issue is the role of specific purpose payments to local governments in achieving the strategic objectives of the central government, and how such payments fit within China's fiscal reforms.

The federal structure of China's governance impacts strongly on these issues of strategy. Competition between local governments at various levels has been an important factor in, for example, uncontrolled and often sub-optimal expansion of energy intensive, polluting industries (such as aluminium smelting and some chemical industries), of inefficient forms of energy production (such as small, dirty coal mines) and of other industries not well adapted to China's needs (such as large luxury cars). Expenditure at both levels of government is also heavily concentrated on capital formation and on capital transfers to the enterprise sector. Like many other federations, the Chinese federal system suffers from vertical fiscal imbalance, with the central government receiving 55% of budget revenue but being responsible for only 30% of budgetary expenditure. In particular, virtually all operating expenditure for health and environmental services and about 90% of such spending on education, is the responsibility of local governments. These issues, and their implications for the revision of the development strategy, are documented further below.

Table 3.2 Share of local government in total budgetary expenditure, China, 1995 and 2002

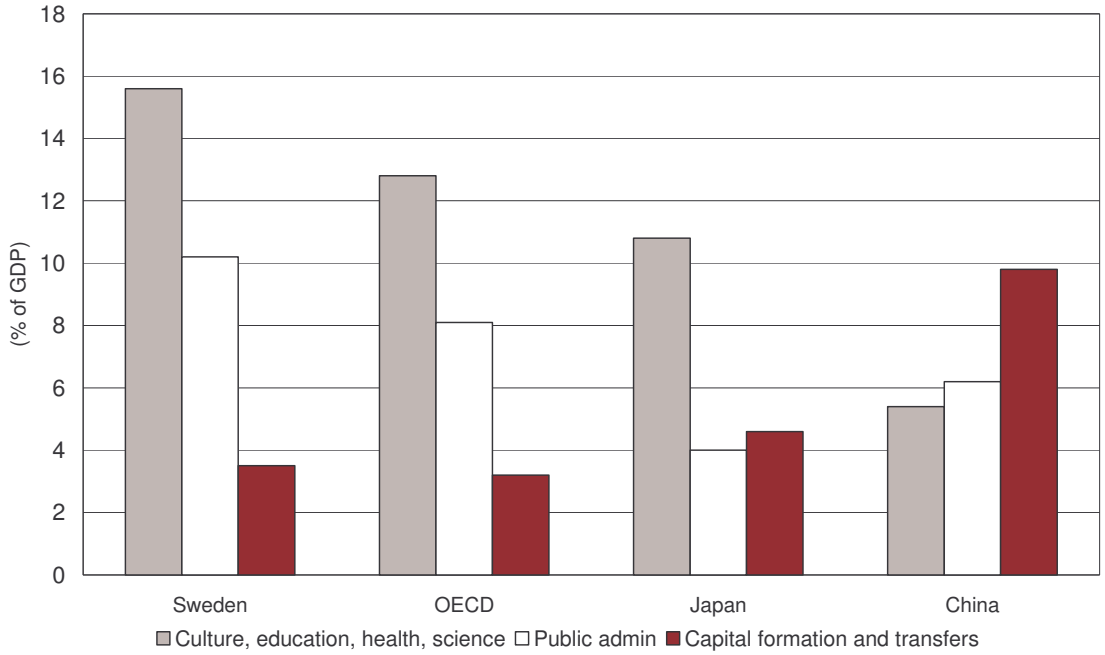
	1995	2002
Selected functions	Local government share of total expenditure (%)	
Capital construction	52.0	60.1
Innovation	90.3	97.0
Science and technology	5.1	44.5
Enterprise support	19.2	11.1
Agriculture	89.2	89.1
Culture, education, science and health (operating)	90.0	89.1
Government administration	92.0	83.4
Price subsidies	72.3	57.9
Urban maintenance and construction	100.0	100.0
Total	**70.8**	**69.3**

Source: ADB (2005).

China's current fiscal arrangements derive primarily from the fiscal reforms of 1994, which redefined the expenditure responsibilities of central and local governments and set up the new tax system (ADB 2005; OECD 2005b). In expenditure terms, while key items such as defence and debt servicing are retained for the central government and infrastructure is shared, most other major responsibilities such as health, education, urban maintenance and the environment, are the responsibility of sub-national, and to a large degree sub-provincial, governments. Table 3.2 summarises the position for major items in both 1995 and 2002, in terms of the share of total budgetary expenditure that is undertaken at the sub-national level. While the overall split of government expenditure remains about 70% local and 30% central, and the centre has a higher than average share in areas such as capital construction, science and technology and price subsidies, in the key areas of operating expenditure on culture, education, science, health and agriculture sub-national governments account for about 90% of the total. This lack of direct control reduces the ability of the central government to expand public spending in these areas, if this was deemed appropriate.

In Chapter 2 we noted the importance of private financing in health and education in China, and the rising reliance on private funds in education. These common trends in education and health – primary responsibility at the sub-national, and indeed sub-provincial level, concentration of government revenue sources at the central level and heavy reliance on private funding – are significant in shaping economic and social outcomes in China. On the one hand, these key services cannot expand as rapidly as China's current circumstances and the needs of individuals require. On the other, the need for families to meet future commitments in relation to education and health contributes to an already high propensity to save out of household income, constrains access to these services severely and contributes to the growth of poverty in low-income families. These aspects of the current federal arrangements thus have a major impact on economic and social outcomes.

Figure 3.1 Components of public expenditure, selected countries, 2002, share of GDP



Source: OECD (2005b).

The other related aspect of spending by all levels of government in China is the heavy concentration on construction and related capital activities. This spending, while important in maintaining growth over the 1997-2001 period, is now clearly adding to the boom in the construction sector, and exacerbating problems in that area. Figure 3.1 brings out the extent of focus in public sector spending in China on capital formation and capital transfers to enterprises, especially in relation to key service sectors. For the OECD countries as a whole, public spending on culture, education, health and science is four times greater than capital spending (and 4.5 times greater in Sweden and 2.3 times greater in Japan, for example), whereas in China this spending is only 60% of capital spending. While the comparison with OECD countries is not entirely appropriate, these data are an indicator of the bias in Chinese public spending towards capital.

Thus the structure of China's federal system has shaped the present development strategy and constrains changes to that strategy. To the extent to which this is so, changes to the arrangements of fiscal federalism – such as improved coverage of the personal income tax and the introduction of energy related taxes, both at the central level, together with revised arrangements through which the central government invests heavily in, and influences, education and health – could improve China's ability to move to a revised development strategy, although there are many issues about how they might be implemented. Mechanisms by which the central government might also exercise greater direct influence on investment, energy and environmental decisions are also required.

3.2.3 Finding the Balance Between Public Goods and the Market

While China has achieved rapid growth in industrial output through the use of market processes, the application of such an approach in some service sectors has been less successful. The case of health is particularly relevant, for several reasons. Better health and longer lives are a main benefit to individuals of economic development, and also contribute further to growth. But market failures and information asymmetries pervade health provision, so that finding the right balance in the roles of the public and private sectors in health is a key issue around the world. In addition, biomedicine is now the focus of global technological change, even as many of China's citizens lack adequate access to basic technologies.

Similar trends are also apparent in health, and reflect a reform in the health sector in 1996 aimed at establishing a market-based system. China's total health spending of 4.8% of GDP in 2003 is a good deal lower than in OECD countries, but not far removed from that, on average, of other transition or developing countries. But what is distinctive about it is the very low share of government funding, only 0.8% of GDP or 17% of the total, and the heavy reliance on non-government funding, especially direct payments by individuals from their disposable income, which contributed 56% of total spending in 2003.

3.3 Conclusion and Implications for Western Australia

The extent and timing of any major shift in Chinese strategy, or of the social and economic implications of failing to achieve that shift, will have important implications for Western Australia, as indeed for all regions and nations whose future is becoming linked to emerging China. Our thinking about the State's policy responses to future developments in China is based on two broad scenarios. One, which is specified quantitatively in Chapter 1, assumes that the government gradually succeeds in giving effect to the Eleventh Plan vision and in implementing a strategy as outlined in Table 3.1. As a result growth moderates to about 8% per annum by 2010, and to 7% and 6% respectively in the next two decades, the energy intensity of GDP begins to decline from 2010 and the central force in growth shifts to the service sector.

The other scenario, less well defined, is that rapid growth continues along the current path to about 2010 but that the contradictions implicit in that strategy – either within China or in the international arena or both – force a crisis, leading to period of much slower growth in China. Such an outcome, whatever its cause, would have major social repercussions within China.

In some respects the implications of the two scenarios for Western Australia's policy are similar. Demand for resources from China is likely to remain strong for several years, although the impact of that continuing demand on new investment in the State will depend on developments in other markets and the speed with which new capacity is brought on stream in other countries. However, by about the end of the decade, a slowing of the growth of demand from China is likely, either a gradual one if a transitional policy is effective or a more abrupt one if a crisis intervenes. In both cases there is a strong incentive for Western Australia to use the years of strong growth and of a deepening resource relationship with China to build broader links and shared capabilities in knowledge intensive activities and in key service industries.

4 China and Western Australia: Current Impact and Future Implications

The impact of the Chinese growth path since 2001 on Western Australia has already been massive, and is likely to continue for some time to come. Surging demand from China is a key factor driving up global market prices for oil and gas, coal and other resources and leading to large scale investment in the State and around the world. In this chapter we study the impact on Western Australia in three parts: first, the macroeconomic impact, including the effect on investment, output and employment; secondly, the impact through the key resource industries in the State; and thirdly, the impact on R&D. Then we look at three areas – exports of knowledge intensive business services, enrolment of foreign students and overseas visitor arrivals – where an impact of changing trends in China might be expected but does not seem to be apparent.

4.1 The Macroeconomic Impact

4.1.1 Investment Spending

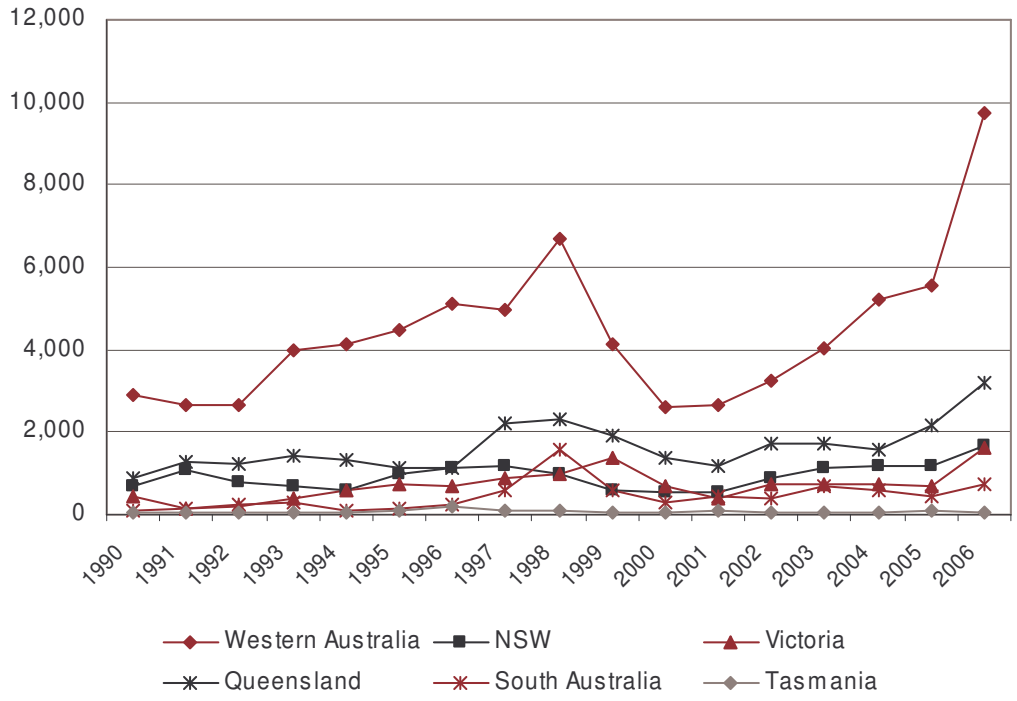
Increasing demand from China for energy and mineral resources has affected the Western Australian economy at the macroeconomic level in three main ways: by direct purchases of resources from the State, often under long-term purchasing agreements; by contributing to higher prices for resources on world markets and hence higher incomes for exporting firms; and by stimulating growth in other countries, which in turn generates higher demand for resources. While higher levels of resource exports and prices have an impact on the Western Australian economy through many different channels, the most tangible is through increased capital spending, in mining, in related areas of manufacturing and in some related service sectors. Recent trends in mining investment by state, in real terms, are shown in Figure 4.1.

The figure brings out both the scale of the increase in mining investment in Western Australia – during the four years to 2005-06 real private new capital expenditure in the State increased by 31.7% per annum – and the fact that the resources boom has led to an increase in this investment in all other states (other than Tasmania) as well. But the major action was in Western Australia, where mining investment in increased in real terms from $3.2 billion in 2001-02 to $9.7 billion in 2005-06, and accounted for 57% of all such investment, and 65% of the increase in mining investment since 2001-02, in Australia.

Investment in manufacturing has also been very strong in Western Australia over the period since 2001-02, increasing by 28.0% per annum in the four years to 2005-06, more than double the growth rate for Australia as a whole. This presumably reflects investment in projects closely linked to the State's resources, such as fertiliser and other petrochemical projects, investment in supplier industries to the resources boom and the more general effects of higher levels of demand. Reinforcing these points,

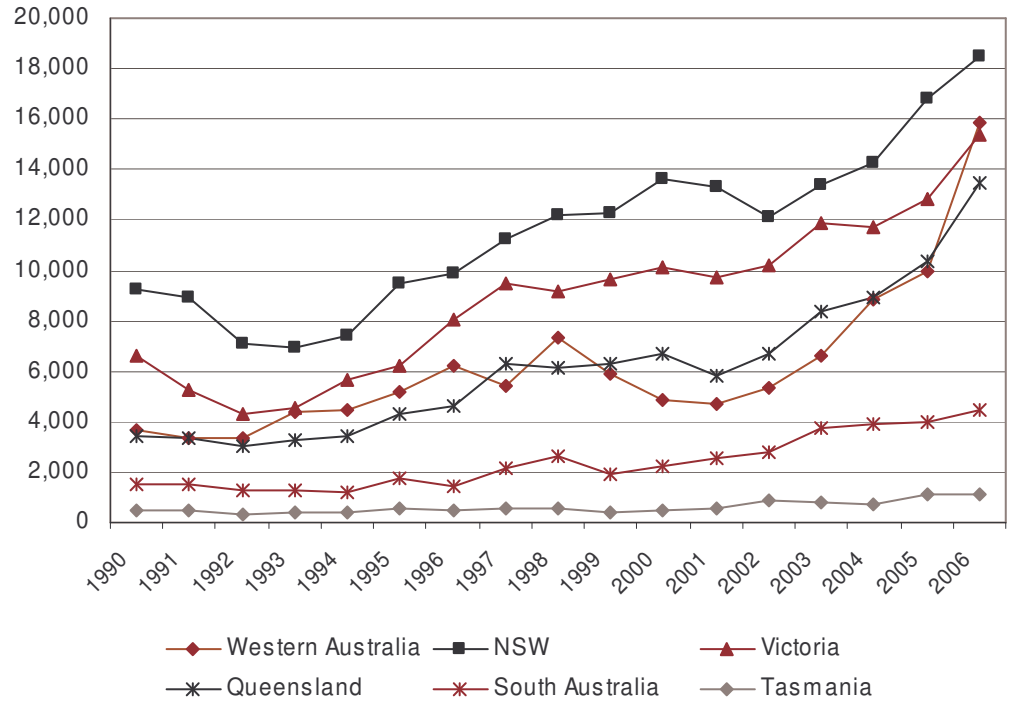
Queensland was the only other state to achieve an above average rate of growth in manufacturing investment over this period. Again the scale of these activities is significant – Western Australia's share of national manufacturing investment rose from 8.3% in 2001-02 to 13.6% by 2005-06.

Figure 4.1 Mining private capital expenditure, $million constant



Source: ABS 2006, Private New Capital Expenditure and Expected Expenditure, Australia, Cat. No. 5625.0, Canberra.

Figure 4.2 All industries private capital expenditure, $million constant



Source: ABS 2006, Private New Capital Expenditure and Expected Expenditure, Australia, Cat. No. 5625.0, Canberra.

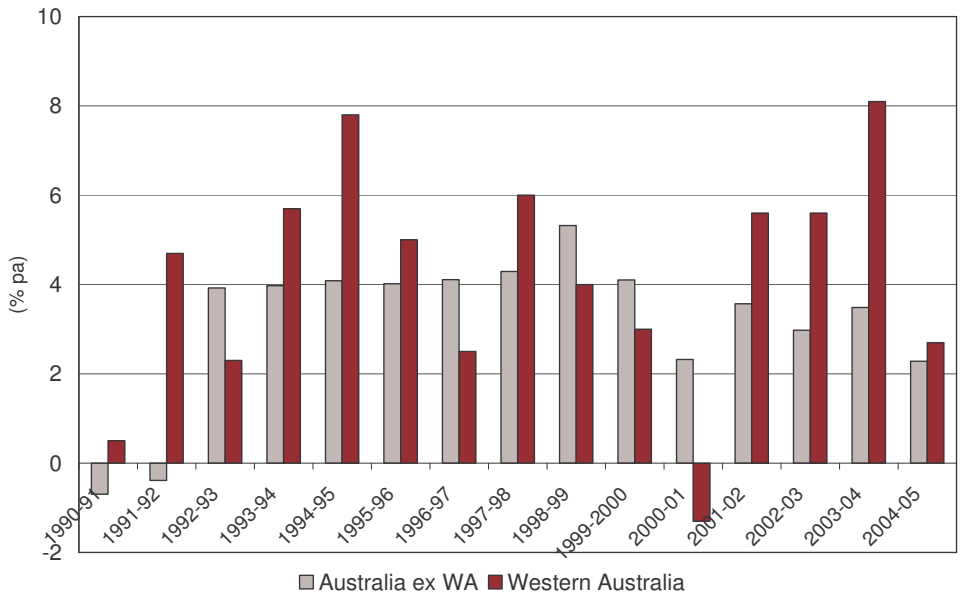
The same trend is available for all other industries taken as a whole, with investment in these industries in Western Australia also increasing, over the four years to 2005-06, at the fastest rate of any state (21.1%), with Queensland being the only other state to show a growth rate above the national average.

These data illustrate how pervasive the resources boom has been throughout the whole State economy. During the same period total private new capital expenditure, in real terms, increased by 31% per annum in Western Australia, to surpass by 2005-06 the level in Victoria and to approach that in NSW. Since 2001-02 34% of the increase in national private investment has taken place in Western Australia, by comparison with 20.8% in NSW and 16.9% in Victoria.

4.1.2 Trends in Gross State Product

For Western Australia intense resource based development founded ultimately on strong Chinese demand brings both benefits and risks. In recent decades growth in the State economy has been both more rapid and more volatile than for the rest of Australia. Between 1989-90 and 2004-05 the average annual growth rate in GSP (4.1%) was a full percentage point higher than the national GDP growth rate, and the growth in per capita GSP was, at 2.6% per annum, the highest of all the states. This is in spite of relatively subdued growth in real GSP for 2004-05, as surging imports ahead of the actual investment and export of products trimmed growth. Much more rapid growth, and a bigger differential relative to the rest of Australia, is likely to be recorded in 2005-06 and 2006-07.

Figure 4.3 Annual growth rate of real GDP/GSP, Western Australia and the rest of Australia, 1990-91 to 2004-05



Source: ABS 2005, Australian National Accounts: State Accounts, Cat. No. 5220.0, Canberra.

But, as Figure 4.3 shows, Western Australian growth has also been much more volatile than that of the rest of Australia. Since the national recovery from the recession of the late 1980s, growth in the rest of Australia has fluctuated in a fairly narrow band between about 2% and 5%, whereas the Western Australian band has been much wider, from about -1% to 8%. This high volatility is likely to continue over the next few years, with several years of very rapid growth followed by an inevitable slowdown as resource projects are completed.

4.1.3 Employment

High levels of investment in the resource sector have flowed through to the manufacturing, energy and construction sectors (Table 4.1). Employment in these sectors plus mining grew by 65,600 persons or 5.7% per annum in Western Australia between August 2001 and August 2006, by comparison with an increase of 46,300 or 1.5% per annum in the rest of Australia.

Thus the absolute increase in the number of jobs was almost 50% greater in the State than in the rest of Australia. While jobs in these industries are mostly full-time, there was a significant increase in part-time jobs as well (6.2% per annum). Within this group of industries (Table 4.2) growth over the five year period was more rapid in all industries other than construction. The case of manufacturing is particularly striking, with manufacturing jobs growing by 2.7% in Western Australia but falling in the rest of Australia.

Table 4.1 Employment by selected industry groupings and type, Western Australia and the rest of Australia, 1995-2006

	Mining, manufacturing, energy and construction		Property and business services		Other industries		All industries	
	Western Australia	ROA	Western Australia	ROA	Western Australia	ROA	Western Australia	ROA
	(Full-time employment – thousand persons)							
Aug-1985	144.7	1529.5	34.4	320.0	317.8	3117.6	496.9	4967.1
Aug-2001	179.6	1476.6	78.4	691.7	392.8	3669.9	650.8	5838.2
Aug-2006	236.8	1647.5	89.1	828.4	424.3	3989.7	750.1	6465.6
	(Growth rate per annum – per cent)							
1985-2001	1.4	-0.2	5.3	4.9	1.3	1.0	1.7	1.0
2001-2006	5.7	2.2	2.6	3.7	1.6	1.7	2.9	2.1
	(Part-time employment – thousand persons)							
Aug-1985	12.6	128.5	8.4	78.8	104.2	879.1	125.2	1086.4
Aug-2001	24.2	209.7	29.4	247.3	219.8	1842.4	273.4	2299.4
Aug-2006	32.7	248.2	43.6	284.7	234.7	2112.4	310.9	2645.3
	(Growth rate per annum – per cent)							
1985-2001	4.1	3.1	8.1	7.4	4.8	4.7	5.0	4.8
2001-2006	6.2	3.4	8.2	2.9	1.3	2.8	2.6	2.8
	(Total employment – thousand persons)							
Aug-1985	157.4	1658.0	42.8	398.7	422.0	3996.7	622.1	6053.4
Aug-2001	203.8	1686.4	107.7	939.0	612.7	5512.3	924.2	8137.7
Aug-2006	269.4	1895.7	132.6	1113.1	659.0	6102.1	1061.0	9110.9
	(Growth rate per annum – per cent)							
1985-2001	1.6	0.1	5.9	5.5	2.4	2.0	2.5	1.9
2001-2006	5.7	2.4	4.2	3.5	1.5	2.1	2.8	2.3

Source: ABS 2006, Labour Force, Australia, Detailed, Quarterly, Cat. No. 6291.0.55.003, Canberra.

The data also suggest that the strength of employment growth in mining, manufacturing and related industries is pulling labour from other service industries. Full-time employment in property and business services was lower in the State than for the rest of Australia, while this was compensated for in part-time employment, and in all other industries total employment growth over the four year period (1.5%) was much lower than in the rest of Australia (2.1%). The State's labour market is very tight, with the unemployment rate in August 2006 standing at only 3.4% (and at 2.9% for males) in spite of the highest participation rate in the country at 67.6%. While there has been a good deal of focus on labour shortages in the resource industries, it is likely that more broadly based labour shortages may increasingly impair the ability of the Western Australian economy to function at full capacity in other industries.

Table 4.2 Employment by selected industry groupings and type, Western Australia and the rest of Australia, 1995-2006

	Mining		Manufacturing		Energy and water		Construction	
	Western Australia	ROA	Western Australia	ROA	Western Australia	ROA	Western Australia	ROA
	(Total employment – thousand persons)							
Aug-85	26.7	74.9	75.7	1025.0	10.0	128.7	44.9	429.4
Aug-01	27.8	49.9	88.1	986.1	6.9	64.9	81.1	585.5
Aug-06	53.5	79.2	100.5	955.7	12.1	71.4	103.3	789.5
	(Growth rate per annum – per cent)							
1985-2001	0.3	-2.5	0.9	-0.2	-2.3	-4.2	3.8	2.0
2001-2006	13.9	9.7	2.7	-0.6	12.0	1.9	5.0	6.2

Source: ABS 2006, Labour Force, Australia, Detailed, Quarterly, Cat. No. 6291.0.55.003, Canberra.

4.1.4 Conclusion: The Risk of a More Volatile Economy

There is a direct link between the nature and speed of the current Chinese expansion and the boom in the Western Australian economy, but this very fact suggests that there is a risk of increased volatility also. The potential for increased volatility reside primarily in several characteristics of the resources industries. Not only are these industries inherently cyclical on a global basis, in terms of demand, prices and investment, but the strongest impact of the industry on the economy – in terms of employment, income effects and broader economic spillovers – occurs in the investment phase. With investment being about increments to capacity at the margin, fluctuations in industry demand are amplified in terms of their impact on investment. Other features of the resources industries, such as their highly capital intensive nature, which implies low levels of permanent employment, and their frequent remoteness also limit the extent to which these industries alone provide the foundations for a stable and prosperous economy. This is not to play down the massive contribution that they are making to the State's development, but only to argue that Western Australia has strong incentives to use its current close integration with China in resources to build the foundations of a more stable knowledge based economy.

4.2 The Key Resource Areas

It is apparent that the surging incomes of mining companies and the quadrupling of private fixed capital expenditure in mining over the past four years are the central driving forces behind the current Western Australian boom, so that future trends in these areas are of critical importance. Table 4.3 shows that in 2005 nearly two thirds of the value of production in the State's minerals and energy was in oil and gas and in iron ore, and that over three quarters of the projects identified by the Department of Industry and Resources in September 2006 as underway or planned were in these two areas. Thus in reviewing ongoing trends in the minerals and energy industries and their likely relevance to the concerns of this report, we concentrate particularly on oil and natural gas and iron ore, but briefly review also alumina, nickel and gold. As the table shows, there are significant levels of production, and of new projects underway or planned in other areas also (notably petrochemicals, diamonds, titanium oxide and copper).

Table 4.3 Value of minerals and energy production, 2005-06, and value of investment projects underway or planned, September 2006, Western Australia

	Value of production		Value of projects underway or planned	
	Value ($ billion)	Share of total (%)	Value ($ billion)	Share of total (%)
Major products				
Oil and gas	13.9	32	35.4	51
Iron ore	13.0	30	17.6	26
Alumina	4.1	9	2.4	3
Nickel	3.8	9	3.2	5
Gold	3.6	8	2.0	3
Total major products	38.4	89	60.6	88
Other minerals and energy	4.9	11	8.4	12
All mining and energy products	43.3	100	69.0	100

Source: DoIR (2006, 2006a).

4.2.1 Oil and Gas

Recent Developments in the Market

As is well known, the price of crude oil has increased significantly since 2002. In 2004 the price of oil went into the US$40-50 per barrel range which put it on par, in real terms, with the high prices experienced during the oil shocks of the 1970s. Since 2004 oil prices have continued to rise and during much of 2006 the spot price of crude has been in the US$60-70 per barrel range, although it has retreated to less than US$60 per barrel in recent weeks. The price of oil has increased due to the impact of various factors, such as geopolitical tensions and extreme weather conditions, on a tight balance between world oil production and consumption. World oil consumption has continued to increase despite the recent high prices, with China's consumption growing 28% between 2002 and 2004; which by itself accounts for more than 30% of the total world consumption growth in that period (ABARE 2005, 2006).

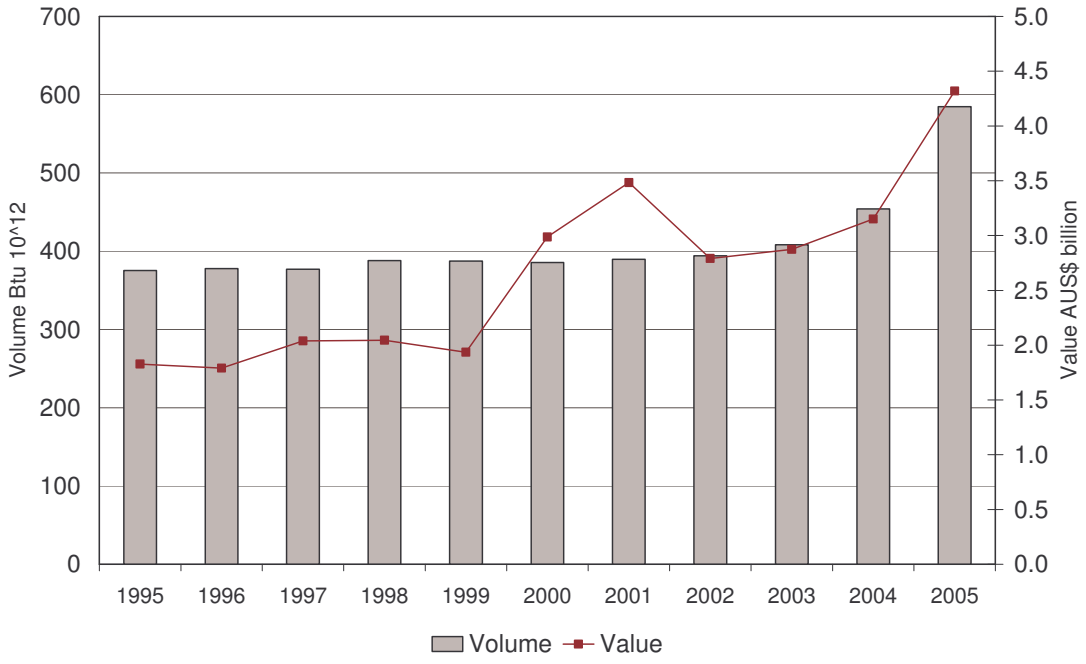
The total world petroleum refining capacity has reached record levels for the four consecutive years to 2005. These records were set despite fewer operational refineries; in fact numerous refineries were closed and only one new refinery was built during the period. The increase in capacity was been the result of capacity creep, expansions and restated capacities (O&GJ 2005).

World wide consumption of natural gas has been growing steadily at around 2% per annum for over a decade, making it the second fast growing energy resource after coal. Natural gas prices have followed a similar pattern to the crude oil reaching significant highs in the past two years (EIA 2006; ABARE 2006). Given long-term constraints on the supply of oil and the environmental consequences of increased coal use, it is likely that the demand for natural gas will grow rapidly in the future, subject to the limitation of the complex infrastructure and facilities needed for the transportation and use of natural gas. For example, a recent official Chinese report has called for greatly increased use of natural gas in China, both from domestic production and imports, but has also noted many of the infrastructural and policy issues that need to be addressed for that to occur (ERI 2006).

Role of Western Australia

In global terms, Western Australia is a small player in the crude oil market, producing around one quarter of one percent of the total world production. In addition to crude oil, Western Australia produces some condensate and small volumes of Liquefied Petroleum Gas (LPG). The volumes of these petroleum products decreased during 2003 and 2004 but have increased again in 2005. Despite the small volumes that Western Australia contributes to world capacity these petroleum products provided between $6 and $10 billion dollars value to the State's economy between 2000 and 2005 (DoIR 2006; ABARE 2005).

Figure 4.4 Western Australia liquefied natural gas (LNG) production



Source: DoIR (2006).

Western Australia also produces natural gas and Liquefied Natural Gas (LNG). Production of LNG in Western Australia remained relatively steady in the eight years to 2003 but has increased substantially in the years since (Figure 4.4), the volume growth between 2003 and 2005 was approximately 50% as the 4th LNG Train at the Woodside North West Shelf project came on stream. LNG production in Western Australia has contributed in the order of $3-4 billion per year to the State's economy since 2000, and the value of output was $4.9 billion in 2005-06, an increase of 24% over 2004-05 (DoIR 2006; ABARE 2005).

Prospects

In the short-term, oil prices are expected to remain relatively high since world oil production is not expected to increase rapidly and demand growth is expected to remain relatively strong. Some forecasts anticipate that towards the end of the decade oil prices are expected to decline more quickly in response to higher global oil production and a substantial increase in oil stocks by that time (ABARE 2006). On the other hand, an OPEC representative recently stated that investments in the refining sector are *coming in at a considerably slower pace than warranted by expected growth in demand*. Despite numerous expansion and new refining projects being announced during 2005 and 2006, OPEC expects that refining tightness will not ease until 2010 due the fact that sizeable projects require construction lead times of 4-5 years (O&GJ 2006).

Natural gas demand growth is forecast to continue steadily into the future. Natural gas prices are closely related to the price of crude oil and it is therefore likely that prices will also ease in the medium-term. The past few years has seen the launch of many new LNG projects and it is expected that numerous new facilities will be built; particularly in Asia, Africa and the Middle East (EIA 2006; O&GJ 2006).

Severe weather in Western Australia during the first half of 2006 had an adverse effect on crude oil and condensate production. Despite this, production of petroleum products from Western Australia is forecast to increase during 2006-07 as the result of expansion projects in the Carnarvon basin and the Cliff Head project near Perth. LNG production from the North West Shelf is expected to remain strong with new long-term supply contracts being recently signed with Japanese energy companies (ABARE 2006). LNG exports from the 5th LNG Train of the Woodside Energy project are expected to begin in the fourth quarter of 2008, while oil production from BHP Billiton's Stybarrow field and from Woodside's Vincent field is expected to commence in 2008 also.

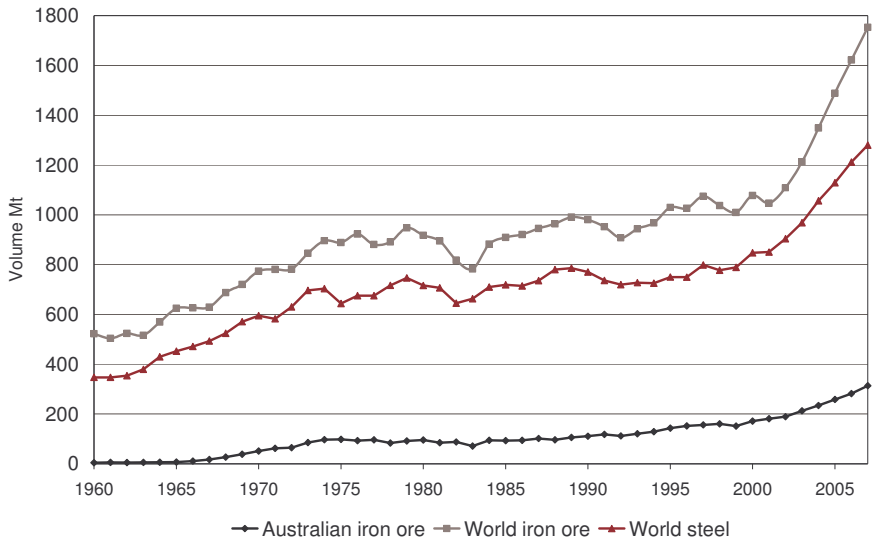
In a world increasingly hungry for reasonably clean energy sources, Western Australia's vast off-shore gas resources constitute an asset of great importance. LNG investment projects in excess of $A30 billion are currently in the planning stage (DoIR 2006a), and a major round of new investment in these facilities must be judged likely in the current international environment. This would give further impetus not only to Western Australia's resources boom, but also to its development as a major international knowledge hub for marine sciences and for technologies related to offshore oil and gas production.

4.2.2 Iron Ore

Recent Developments in the Market

World production of iron ore has been increasing at around 10% per annum since 2002 (Figure 4.5). This iron ore production surge has been the result of rapid growth in the production of crude steel which between 2000 and 2005 has neared post WWII levels of around 4% per annum. Steel production has been driven by strong economic growth globally and strong consumption of steel from China in particular. China's steel consumption more than doubled between 2001 and 2005 (ABARE 2005, 2006).

Figure 4.5 World iron ore and steel production



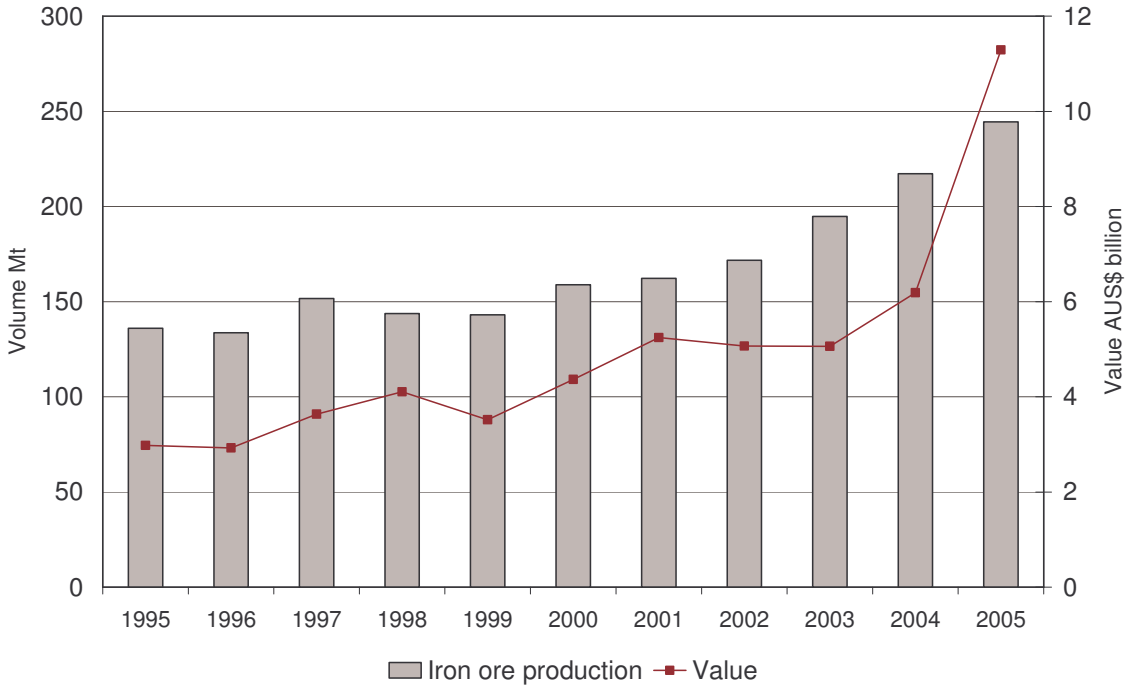
Source: ABARE (2006).

The negotiated price of iron ore fines for 2005 was US62.72c/dltu, an increase of more than 70% over the 2004 price. This is the highest real price paid for iron ore in more than a decade. Further increases have already been settled for 2006 due to significant supply disruptions due to poor weather conditions, the need to replace damaged equipment and civil unrest (ABARE 2005, 2006).

Role of Western Australia

In 2005, Western Australia was responsible for 98% of all iron ore produced in Australia and around 15% of the total world iron ore production. Production output in Western Australia has been increasing at a rate of approximately 12% per year since 2001 (Figure 4.6). For the years 2001 to 2004 iron ore contributed between $5 and $6 billion to the Western Australian economy. The price hike of 2005 boosted earnings significantly and in 2005, the industry was worth approximately $11 billion (DoIR 2006; ABARE 2005).

Figure 4.6 Western Australia iron ore production

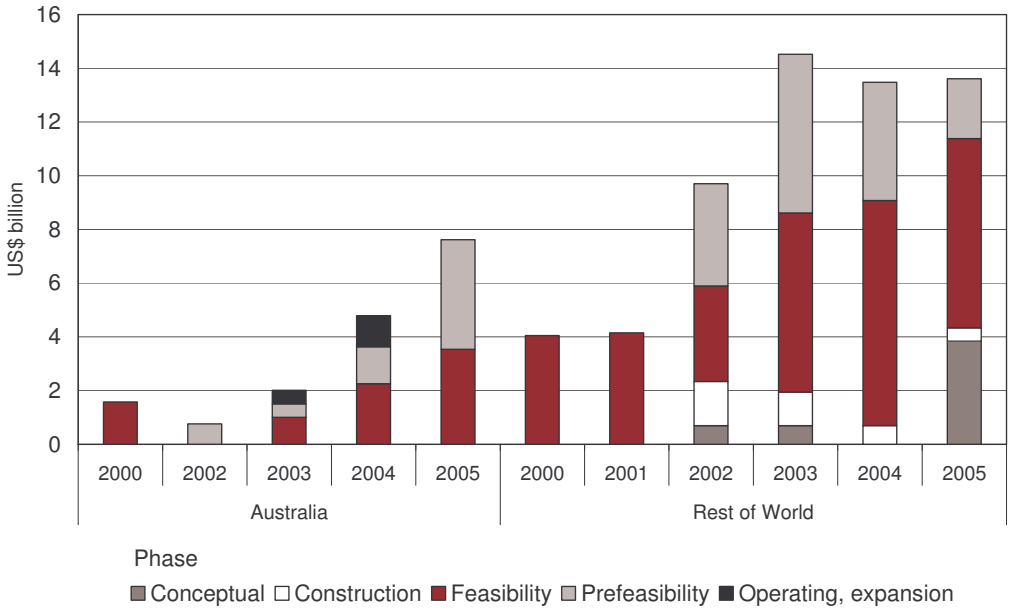


Source: DoIR (2006).

Prospects

Iron ore production is forecast to continue to grow at a rapid pace in the short-term. Demand is likely to run ahead of supply until sometime in 2007 to 2008, meaning that high prices will likely persist for the next few years. The long-term outlook for iron ore production and demand is highly dependent on strong global economic growth and in particular that of China. If all the potential projects (Figure 4.7) go ahead, there could be a small oversupply by the end of the decade while if demand falters to any degree, there could be substantial oversupply (ABARE 2006; DTF 2005). But the indications during 2006 have been that steel production in China has continued to grow very strongly (see Chapter 1).

Figure 4.7 Iron ore mining industry project pipeline, cost in US$ billion



Source: E&MJ (2000-2006).

Western Australia will continue to play a major role in the iron ore market and is forecast to provide much of the world's increase in production over the next few years. Severe cyclone activity in the first quarter of 2006, however, has led to a downward revision of iron ore production forecasts for the period (ABARE 2006).

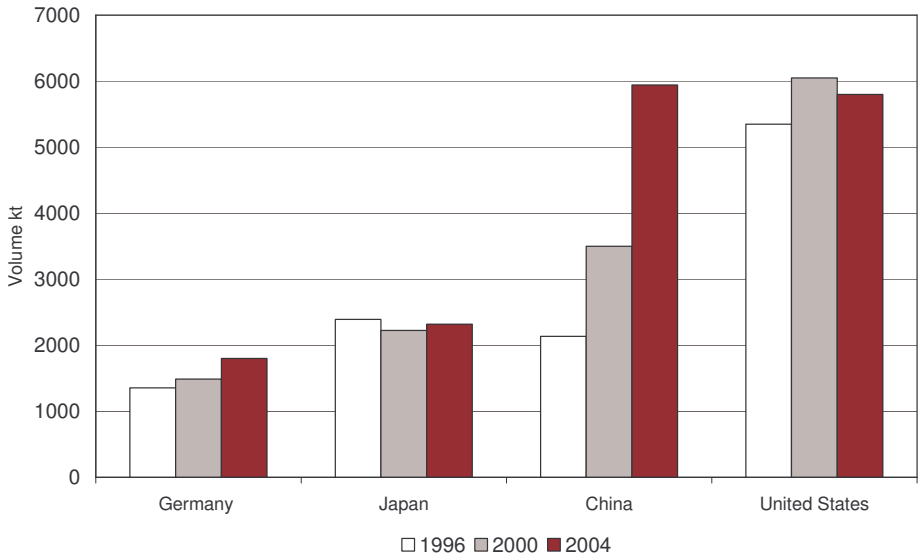
The *Engineering and Mining Journal* reported approximately US$10 billion in the Western Australian iron ore industry project pipeline for 2005, a value which is consistent with ABARE's project listing in early 2006. This is more than double that reported for the entire rest of the world in the same period. Other countries which are expected to provide significant increases in capacity include Brazil, India and China. Western Australia has a geographical advantage over Brazil to supply the booming economies of Asia though this has yet to be translated into a free on board negotiated iron ore price advantage (ABARE 2006; DTF 2005; E&MJ 2006).

4.2.3 Other Resource Products

Alumina

World Alumina production and production capacity has been rising steadily at an average of around 4-5% per annum since 1985. The majority of recent and forecast alumina production capacity increases have been the result of activity in Australia and Latin American. The average spot price of alumina was $443 per tonne in 2005 which was a 12% increase from the 2004 price and a 65% increase from on 2003 price. The high alumina prices have been the result of strong product demand from China and a shortage of alumina stocks (ABARE 2006).

Figure 4.8 Aluminium consumption, selected countries



Source: ABARE (2005, 2006).

Alumina is the raw material used to produce aluminium and a brief analysis of the aluminium market provides important insights to alumina trends. The nominal price of aluminium has risen considerably from US$1352 per tonne in 2002 to US$1898 per tonne in 2005. In real historic terms, these recent high prices are still relatively low. Since 2002 global consumption of aluminium has grown rapidly at a rate of around 8% per annum. Aluminium consumption has increased most rapidly in China, which has almost tripled its consumption in the period 1996 to 2004 (Figure 4.8). For the period 2001-2004 China's consumption of aluminium increased at a rate of 15% per year. In the last few years aluminium consumption growth has also been strong in other parts of Asia, the Americas and Europe (ABARE 2005, 2006).

In 2005, Western Australia was responsible for over 60% of all alumina produced in Australia and around 20% of the total world alumina production. Production output of alumina in Western Australia has been reasonably steady between 2001 and 2005 increasing slightly over the period. The value of alumina sales to the Western Australia economy has been over $3 billion per year for past five years and 2005 was the third biggest earner for the State (DoIR 2006; ABARE 2005).

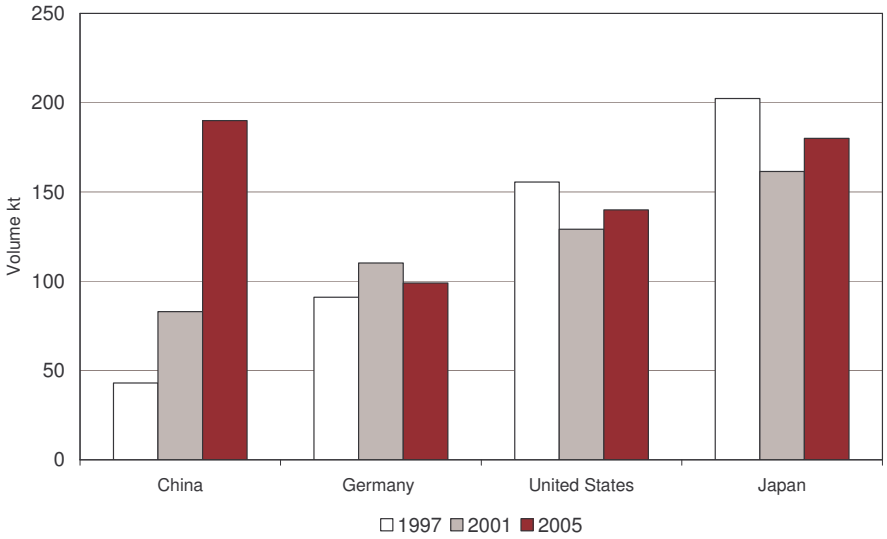
World consumption of aluminium is forecast to continue to increase by around 5-6% per annum over the next few years. In the medium-term, China's consumption of Aluminium is forecast to continue to grow at a rate of around 10-15%. Aluminium consumption is forecast to remain strong in the USA in 2006 but ease in the medium-term as the construction and motor vehicle industries are expected to slow (ABARE 2006).

In line with aluminium production growth, production of alumina is forecast to increase in the short to medium-term. Alumina prices are forecast to remain high throughout 2006 and ease during 2007 as new capacity comes online. Most new production will be the result of an expected increase in activity in Australia, Latin America and China. A number of significant alumina upgrades and expansions have recently been completed in Western Australia and some more remain in the project pipeline, indicating that Western Australia will remain a significant player in the world alumina market (ABARE 2006).

Nickel

Global production of nickel grew at an average rate 5% per annum between 1999 and 2004 before decreasing slightly in 2005. In the last 10 years nickel consumption in China has more than tripled while remaining steady in the other major nickel consuming countries of Japan, USA and Germany (Figure 4.9) (ABARE 2005, 2006).

Figure 4.9 Nickel consumption, selected countries



Source: ABARE (2005, 2006).

Nickel prices have increased rapidly since a relative low of $6000 per tonne in 2001 to a high of approximately $15000 a tonne in 2005. This is a reflection of the volatile nature of nickel prices generally in historic terms. The recent high prices represent the highest nominal prices ever paid for nickel and the highest real prices seen for over 15 years (ABARE 2005, 2006). Western Australia is the sole nickel mining region in Australia. In 2005, Western Australia produced approximately 190 kilo tonnes of nickel, which accounted for around 15% of total global production. The production of nickel in Western Australia has remained relatively steady over the past five years. The value of the nickel industry in Western Australia has grown from $1 billion in the mid to late 1990s to over $3 billion in the last two years (DoIR 2006; ABARE 2005).

Strong demand for stainless steel in China and stronger economic growth in the rest of the world is expected to support higher nickel consumption over the next few years. Despite this, the price of nickel is forecast to ease in the medium-term due to the expectation that next generation nickel projects will enter production in the period 2008-11, with a possibility that the market could be in surplus by the end of the decade (ABARE 2006).

Cyclone activity and wet weather in Western Australia during the March quarter of 2006 will result in a lower overall production for 2006. However, mine production for Western Australia is forecast to increase by around 15% in 2006-07 due to the anticipated startup of the Consolidated Mineral's East Alpha mine and upgrades to the LionOre's Maggie Hays mine. The E&MJ reported approximately US$8 billion in the nickel mining industry pipeline for Australia in 2005 which accounts for more than half of all such reported investment world wide. The majority of the E&MJ projects are located in Western Australia. ABARE reported eight less advanced nickel mining projects underway in Western Australia. These projects suggest that Western Australia will remain a significant player in the future global nickel market (ABARE 2006; E&MJ 2006).

Gold

The global production of gold has remained relatively steady over the last decade recording a 2% increase in production in 2005 following a dip in 2004. In 2001, the price of gold hit a 20-year low price of around US$270 per ounce. Since that time, gold prices have recovered substantially and in 2005 the price of gold was $445 per ounce. So far in 2006, the gold price has averaged $554 per ounce – the highest real price for over a decade. The recent price increases in the price of gold have been based on strong growth in investment demand (ABARE 2005, 2006).

Western Australia has traditionally been a significant producer of Australian gold and in 2005 accounted for approximately 66% of national production. In a global context, Western Australia was responsible for approximately 7% of total world gold production in 2005. In historic terms, gold production in Western Australia declined from 1997 to 2004 and recorded its first increase in production for many years in 2005. Despite the decrease in production, the gold industry in Western Australia has consistently contributed in the order of $3 billion to the State's economy for over a decade (DoIR 2006; ABARE 2005).

World gold mine production is forecast to increase only slightly in 2006. In 2007, production is forecast to increase by 3% as the result of increased activity in the USA, Latin America, China and Australia. Gold prices are forecast to stay high through 2006 and 2007 largely due to strength in investment demand which is being supported by hedging against global inflation, ongoing concerns about the large US current account deficit and general global uncertainty associated with terrorist activity (ABARE 2006). Western Australia will continue to play a significant role in global gold production with a number of operating expansion projects already underway in the State. Production of gold in the first quarter of 2006, however, was adversely affected by cyclones and production figures for this period were the lowest since the June quarter in 1995 (ABARE 2006).

The *Engineering and Mining Journal* reported approximately US$13 billion of investments in the gold mining industry project pipeline with a US$220 million feasibility project in Western Australia. ABARE reported numerous minor gold projects in various stages of completion in Western Australia (E&MJ 2006; ABARE 2006). The remaining world gold investments are concentrated in Latin America, North America and Russia (E&MJ 2006).

4.3 Research and Development Spending

The impact of China's growth path on the State is, while still being driven primarily by the resources sector, being felt in other ways also. The most striking of these is the strong expansion of research and development activities in Western Australia, particularly the consolidation of the State as a major global centre for resource industry R&D. In the three years to 2004-05 (the latest period for which data are available) business expenditure on R&D in Western Australia more than doubled, growing by 33.0% per annum by comparison with 8.8% per annum for the rest of Australia. There is every indication that further growth is underway, with companies such as BHP Billiton and Chevron announcing the establishment of global R&D centres in Perth. As a share of GSP, business R&D increased from 0.56% in 2001-02 to 1.04% in 2004-05, while for the rest of Australia the increase was only from 0.88% to 0.94%.

As with business investment, the expansion of business R&D, while sparked by Western Australia's global position in resources, is taking place more broadly than just in mining. Between 2001-02 and 2004-05, mining R&D more than trebled from its low level in 2001-02, growing by just on 50% per annum for these three years. But in both the other categories shown in Table 4.4, R&D in Western Australia increased much more rapidly than in the rest of Australia, but it remained a relatively low share of the national total in both cases.

Table 4.4 Business expenditure on R&D, by industry, by location

	R&D expenditure ($m)					Annual growth rate (% pa)	
	1992-93	1995-96	1998-99	2001-02	2004-05	1992-93 to 2001-02	2001-02 to 2004-05
Western Australia							
Mining	48	192	215	136	452	12.2	49.4
Manufacturing	180	208	162	184	305	0.2	18.4
All other	69	66	63	128	295	7.2	32.1
Total	**297**	**465**	**440**	**447**	**1,051**	**4.6**	**33.0**
Rest of Australia							
Mining	128	329	270	431	753	14.4	20.5
Manufacturing	1,513	2,185	1,866	2,353	3,147	5.0	10.2
All other	923	1,378	1,519	2,961	3,496	13.8	5.7
Total	**2,565**	**3,891**	**3,655**	**5,745**	**7,395**	**9.4**	**8.8**
Australia							
Mining	176	521	485	566	1,205	13.8	28.6
Manufacturing	1,694	2,392	2,028	2,537	3,451	4.6	10.8
All other	992	1,443	1,582	3,089	3,790	13.5	7.1
Total	**2,862**	**4,357**	**4,095**	**6,192**	**8,446**	**9.0**	**10.9**

Source: ABS 2006, Research and Experimental Development, Businesses, Australia, Cat. No. 8104.0, Canberra.

This business growth has also been mirrored in strong expansion in R&D in the higher education sector, where data are available on a biennial calendar year basis, with the latest data being for 2004. Between 2002 and 2004, R&D by this sector in the State grew by 22.2% per annum, more than double the rate for the rest of Australia. This may indicate that an expansion of research activities is underway in the universities, in parallel with that taking place in the business sector.

4.4 Three Areas of Limited Impact to Date

However, in other ways Western Australia is not yet well attuned to deal with the opportunities arising from China's growth. For example, in spite of some notable successes, exports of knowledge intensive business services from the State remain relatively low, at only 7% of the Australia total. In spite of the R&D growth, Western Australia lags in terms of exports of educational services through foreign students in higher education, with a relatively small proportion of students from the rapidly growing markets of China and India. Similarly, Western Australia lags the rest of Australia in tourism activity, measured in terms of arrivals and visitor nights, with a low share of the rapidly growing Chinese market. These three areas of limited impact are noted briefly below.

4.4.1 Exports of Knowledge Intensive Business Services

Given the depth of technical expertise in the State, and the massive projects that it effectively delivers, one might have expected a higher level of exports of what we here call knowledge intensive business services. Data on services trade remain far from adequate, and our approach to the measurement of such services is somewhat arbitrary. We define knowledge intensive business service as other business services as defined by the Australian Bureau of Statistics (Cat. No. 5368.0.55.004), excluding services related to trade and leasing. On this approach the term covers the items shown in Table 4.5.

Table 4.5 Exports of knowledge intensive business services, 2000-2005 ($m)

	Exports ($m)					
	2000	2001	2002	2003	2004	2005
Western Australia						
Architectural, engineering and other technical services	85	129	87	98	78	198
Professional services	np	12	5	np	7	7
Research and development	7	10	9	9	10	np
Agriculture, mining and on-site processing	-	11	np	np	14	29
Services between affiliated enterprises n.i.e	12	24	24	18	21	16
All other	40	25	41	np	67	np
Total other business services	143	211	165	190	197	275
Australia						
Architectural, engineering and other technical services	759	569	575	547	473	647
Professional services	507	773	776	669	536	640
Research and Development	238	254	273	311	350	369
Agriculture, mining and on-site processing	24	47	99	97	116	134
Services between affiliated enterprises n.i.e.	896	815	950	1045	1074	1052
All other	703	843	870	857	1078	1117
Total other business services	3127	3301	3543	3526	3627	3959
Western Australian share of Australia (%)	**4.6**	**6.4**	**4.7**	**5.4**	**5.4**	**6.9**

Source: ABS 2005, International Trade in Goods and Services, Australia, Cat. No. 5368.0.55.004, Canberra.

Western Australia's share of these services, so defined, is limited, averaging from 4.6% to 6.9% of the national total over the past six years. The State's exports of architectural, engineering and other technical services has been volatile in the past, but increased sharply in 2005 to reach $198 million, to account for 31% of the Australian total. Exports of services may be restricted by concentrating on local products, by the fact that many experts work for international companies that do export from Western Australia and by the difficulties of small firms seeking export work. But in the longer term this should be an area of strong development for the State.

4.4.2 Overseas Student Enrolments

For more than a decade now Australia has been attracting significant numbers of higher education students from abroad, including from China, and the share of overseas students in total enrolments in Australia is more than three times the OECD average. In 2005, there were 345,000 international students enrolled in Australia, in all educational sectors (Table 4.6). In terms of country of origin, 23.5% of these students came from China, which was by far the largest source of students, well ahead of India (8%). The number of Chinese students, has almost trebled since 2001, when they accounted for only 11% of all international enrolments. The rapid growth in Chinese students since 2001 has more than offset declining numbers from south east Asia, particularly Singapore and Indonesia but also, to a lesser extent, Hong Kong and Malaysia.

Table 4.6 International student enrolments in Australia by country of origin

	1999	2000	2001	2002	2003	2004	2005	% share of total 2005	% pa change 1999 to 2005
China	8,859	14,948	26,844	47,931	58,584	68,857	81,184	23.5	44.7
India	9,581	10,572	10,416	11,364	14,350	20,749	27,661	8.0	19.3
Republic of Korea	9,633	11,485	18,051	18,658	22,159	23,810	26,259	7.6	18.2
Hong Kong	18,833	20,739	24,602	22,091	23,880	22,970	21,184	6.1	2.0
Malaysia	16,544	19,602	20,231	17,530	19,811	19,998	19,342	5.6	2.6
Japan	9,828	10,220	12,869	17,329	19,083	19,743	19,031	5.5	11.6
Thailand	6,709	8,179	11,125	15,643	17,029	16,289	16,496	4.8	16.2
Indonesia	19,172	17,868	18,619	20,985	20,355	18,102	16,042	4.7	-2.9
United States	2,699	3,487	4,770	11,064	12,217	12,648	12,452	3.6	29.0
Singapore	19,207	20,866	23,164	12,062	11,853	10,854	9,885	2.9	-10.5
All other	41,800	50,311	62,717	79,198	85,480	88,756	95,279	27.6	14.7
Total enrolments	**162,865**	**188,277**	**233,408**	**273,855**	**304,801**	**322,776**	**344,815**	**100**	**13.3**

Source: AEI (2006).

In terms of higher education students (Table 4.7), in 2005 there were 14474 overseas students enrolled in higher education in Western Australia, 8.8% of the Australian total (AEI 2006). However, the State's share of higher education students has been declining, with growth over the 2002-2005 period well below the national average.

Table 4.7 Overseas higher education student enrolments in Australia by State/Territory and major sector, 2002-2005

	2002	2003	2004	2005	% change 2004 to 2005
New South Wales	40,672	47,141	53,492	59,082	10.5%
Victoria	36,252	43,260	47,935	51,070	6.5%
Queensland	18,575	20,482	22,356	23,773	6.3%
Western Australia	11,392	13,074	13,893	14,474	4.2%
South Australia	5,005	6,440	7,895	9,346	18.4%
Australian Capital Territory	2,957	3,695	3,960	4,120	4.0%
Tasmania	1,144	1,381	1,618	1,903	17.6%
Northern Territory	239	210	155	162	4.5%
Australia	**116,236**	**135,683**	**151,304**	**163,930**	**8.3%**

Source: AEI (2006).

The reason for Western Australia's declining share of enrolments of international students in higher education seems to lie in the country composition of enrolments in the State (Table 4.8). Relative to the Australian average, the State has a much lower share of overseas students from China (only 4.3% of the national total) and a much higher share of students from Malaysia, Singapore, Indonesia and Hong Kong (15.6% of the national total, as a whole). For historical reasons, Western Australia's universities are specialised, in terms of international student enrolments, in countries in which the national market is declining. Their delivery on higher education courses on site seems also to be concentrated in South East Asia, in institutions such as Curtin University's campus in Sarawak. This means that, to date, they have missed much of the growth in students from China.

Table 4.8 Higher education enrolments, 2005, by country of origin, Australia and Western Australia

	Number of enrolments		Western Australian share of Australian total (%)
	Western Australia	Australia	
China	1728	40054	4.3
Malaysia	2748	15375	17.9
Singapore	1958	8349	23.5
Indonesia	1263	9543	13.2
Hong Kong	875	10703	8.2
South Korea	204	5380	3.8
USA	170	2629	6.5
Thailand	313	5252	6.0
India	558	22279	2.5
Other	4443	44366	10.0
Total	**14474**	**163930**	**8.8**

Source: AEI (2006).

4.4.3 Tourist Activity

In 2003 there were 20.2 million outbound tourists from China worldwide, an increase of 19.1% per annum since 1998, and this had increased to 31 million by 2005. The World Tourism Organization forecasts that the number will rise to 100 million by 2020 (a growth rate of 10% per annum) and this is may well prove conservative. The number of Chinese tourists visiting Australia, although only about 1% of the global total, has been growing more rapidly than that total (Table 4.9). Between 2000 and 2006 the number of short-term visitor arrivals from China almost trebled (growing by 18.6% per annum), while the national total increased by only 2.8% per annum (Table 4.9). There is also evidence that Chinese tourists stay longer and spend more on average than other tourists to Australia.

Table 4.9 Short-term visitor arrival estimates, Australia

Year to	Total arrivals	China arrivals	China share
Jun-1992	2,519,700	18,200	0.7
Jun-1993	2,785,600	19,600	0.7
Jun-1994	3,168,700	25,000	0.8
Jun-1995	3,535,300	34,500	1.0
Jun-1996	3,966,200	49,700	1.3
Jun-1997	4,252,800	60,200	1.4
Jun-1998	4,220,100	72,100	1.7
Jun-1999	4,288,100	81,600	1.9
Jun-2000	4,651,800	105,100	2.3
Jun-2001	5,031,300	143,400	2.9
Jun-2002	4,768,300	172,300	3.6
Jun-2003	4,655,900	177,200	3.8
Jun-2004	5,057,200	216,800	4.3
Jun-2005	5,408,200	274,300	5.1
Jun-2006	5,484,100	292,300	5.3
Growth 2000-06 (% pa)	**2.8**	**18.6**	

Source: ABS 2006, Short-term Visitor Arrival Estimates, Australia, Cat. No. 3401.0.55.001, Canberra.

In spite of its unique and varied attractions, Western Australia received only 5% of Chinese visitor nights in 2003 and only 4.3% of all Chinese visitors in 2005-06. There is clearly scope for the State to attract a much larger share of a large and rapidly growing number of Chinese tourists in the years ahead. For example, if 2% of China's tourists visited Australia by 2020 and 10% of those came to Western Australia the number of Chinese tourists visiting the State would increase twelve fold by 2020, relative to the current level. While further investment in facilities would undoubtedly be required, the major requirement would seem to be much greater recognition within China of the State and its attractions.

4.5 Implications for Western Australia

The impact on global boom driven by China's expansion on Western Australia is primarily being felt through the resources sector and its macroeconomic impact, but is also being felt in other ways. The most striking is the strong expansion of research and development activities in Western Australia, particularly the consolidation of the State as a major global centre for resource R&D. The review of the detailed commodity activity suggest that, in several areas, both the project pipeline in Western Australia and the global demand-supply situation is such that further expansion over at least the next couple of years, is likely. This is particularly so in the areas of natural gas and iron ore, where Western Australia has resource assets of major importance internationally.

However, in other ways Western Australia is not yet well attuned to deal with the opportunities arising from China's growth. For example, in spite of some notable successes, exports of knowledge intensive business services from the State remain relatively low, at only 7% of the Australian total. In spite of the R&D growth, Western Australia lags in terms of exports of educational services through foreign students in higher education, with a relatively small proportion of students from the rapidly growing markets of China and India. Similarly, Western Australia lags the rest of Australia in tourism activity, measured in terms of arrivals and visitor nights, with a low share of the rapidly growing Chinese market.

The boom will continue for some time, but will inevitably end. Investment will fall, perhaps as sharply as it has risen. The high level of expertise gathered together in the State during the construction phase of major projects will tend to dissipate, even though production levels will be high. The key challenge is to use the skills, commitment and relationships developed during the boom to build longer term sources of economic growth, including exports of technical services, education and recreational services, as well matters such as renewable energy. The difficulty of this task arises from the fact that, while the economy is booming, it is hard to focus public and private resources on the longer term; but when the boom breaks, much of the opportunity has been lost. The policy challenge is to build these sustainable sources of growth now, while the opportunities abound.

5 A Unique Opportunity: Building a Global Knowledge Hub in Western Australia

The current situation presents both major opportunities and serious risks for Western Australia. The State economy is growing very rapidly, even to the point of overheating. That growth seems likely to continue, and even intensify, in the immediate future. However, the very scale of the current boom and its dependence on volatile global markets, in particular on continued rapid resource use in China, contains its own risks. There is a danger of the State becoming even further exposed to a range of adjustment processes, both within the resources industries themselves and in the global economy, and to the resulting economic volatility that they are likely to generate. As Western Australia has experienced on several previous occasions, the higher the resource peak, the more difficult the consequent adjustment may be.

There is, therefore, a powerful incentive for the State Government to build on the boom to create new streams of sustainable, less volatile and knowledge intensive growth. The deep, long-term relationship with China that is implicit in current developments provides a sound basis for that activity, as does the deepening of Western Australia's knowledge capabilities that is occurring as the State becomes increasingly central to R&D in some of the resources industries. In these final two chapters we address some of the opportunities that are available, and some of the key policy issues that arise. In our judgement Western Australia has a major opportunity, unique in Australia at the present time, to build a global knowledge hub, involving private and public R&D, knowledge based business services and education. This chapter is devoted to outlining this concept and exploring some of the policy issues involved. Chapter 6 addresses some of the other opportunities available to Western Australia, and some of the important strategic issues for national and state governments that arise from the impact of China and the creation of a new global economic order.

5.1 The Foundations of a Global Knowledge Hub

The State Government has identified four pillars for Western Australia's diversification beyond the boom – biotechnology, information and communications technology, marine and defence and renewable energies. On the basis of these four pillars and through strong collaboration with China (and India), Western Australia can build a knowledge hub that is significant in global terms and unique in Australia. When we use the term 'knowledge hub', we mean an integrated cluster of R&D activities, advanced educational programs and knowledge based business service activities that is recognised as a world leader and that provides a growing level of exports of services to firms and agencies around the world.

Both scale and excellence are vital in the creation of such a global knowledge hub. This means that the core activities must be focused in a cluster of related areas where Western Australia can claim, or can reasonably set out to achieve, world best practice and in which it can attract and maintain a high level of demand. The knowledge areas in which these two criteria are met would be the comparative advantages of the knowledge hub. In our assessment they can be met in four areas: engineering and technical services, especially related to resources and energy; environmental services; marine science and technologies, related both to offshore and subsea platforms and to coastal management; and agriculture and water. These components of the knowledge hub are documented further in section 5.2, however, we will first explore the foundations for creating such a hub in Western Australia. Policy issues are taken up in Section 5.3.

5.1.1 The Underlying Foundations – The Four Pillars

The four pillars for Western Australia's diversification beyond the boom identified by the State Government are biotechnology, information and communications technology, marine, subsea and defence technologies, and renewable energies. These capabilities provide the underlying foundations on which a global knowledge hub might be built.

In terms of biotechnology, the Government launched its biotech strategy in August 2006 in which it announced a range of initiatives *to position Western Australia as a competitive player in the global biotechnology industry, maintaining and maximising our strengths in biomedical technology, agricultural biotechnology, environmental biotechnology and bio-mining*(DoIR 2006b, p. 3).

The Government's information and communications technology industry development strategy, released in November 2004, noted that: *Western Australia has significant natural advantages and industry capabilities in the areas of mining, mineral processing, energy, health, education and agriculture. Local industry has developed world-class ICT skills and capabilities in these areas.* (DoIR 2004, p. 5)

The strategy also identified one focus for development as being the *provision of exportable ICT services (professional consulting related design, installation, integration and management of ICT products* (DoIR 2004, p. 5).

The Government has also highlighted the State's capabilities in the areas of marine and subsea technologies and defence, particularly in the area of shipbuilding and related facilities. Much of this activity has centred on the Australian Marine Complex (AMC) at Cockburn Sound. AMC has four precincts – shipbuilding, fabrication, support industries and technologies – and $270 million has been spent or earmarked by the Western Australian and Australian Governments for facilities there. Tenants include Raytheon Australia and Challenger TAFE, which operates a substantial process training facility that caters for the needs of the oil and gas industry. As offshore oil and gas production moves into deeper waters, production economics are likely to increasingly favour subsea rather than platform technologies, and there is developing capability in Western Australia in subsea technologies. This includes FMC Technologies, a leading global manufacturer and supplier of subsea production systems and technologies, becoming a tenant at AMC, and the proposed construction of the Well Integrity and Subsea Services facility at AMC.

Finally, Western Australia has substantial capability in several areas of renewable energy, with expertise and current activities in wind, hydro, solar (photovoltaics) and biomass forms of power generation. Considerable attention is being focused on the use of biofuels for energy production in Western Australia (see Supporting Paper 12).

5.1.2 Recent Trends in R&D and Exports of Knowledge Intensive Services

In addition to these underlying foundations, the basis for such a knowledge hub has been greatly reinforced by the surge in business R&D in Western Australia in recent years (see Chapter 4). Business R&D in Western Australia grew by only 4.6% per annum over 1992-93 and 2001-02, but between 2001-02 and 2004-05 it jumped by 33% per annum. Growth for the rest of Australia over the latter period was 8.8% per annum. As a share of GSP, business R&D increased from 0.56% in 2001-02 to 1.04% in 2004-05, while for the rest of Australia the increase was only from 0.88% to 0.94%. It is likely that rapid growth is continuing as companies such as BHP Billiton, Chevron and others establish R&D centres in the State.

There is a real prospect that, in the context of effective programs and continued company support, the business R&D/GSP ratio in Western Australia could increase to over 2% within five years. This would be unprecedented within the Australian context. There are also indications that this surge in business R&D is being supported by rapid growth within the State's universities also – R&D in higher education in Western Australia increased by 22.2% from 2002 to 2004, by comparison with 10.7% for the rest of Australia.

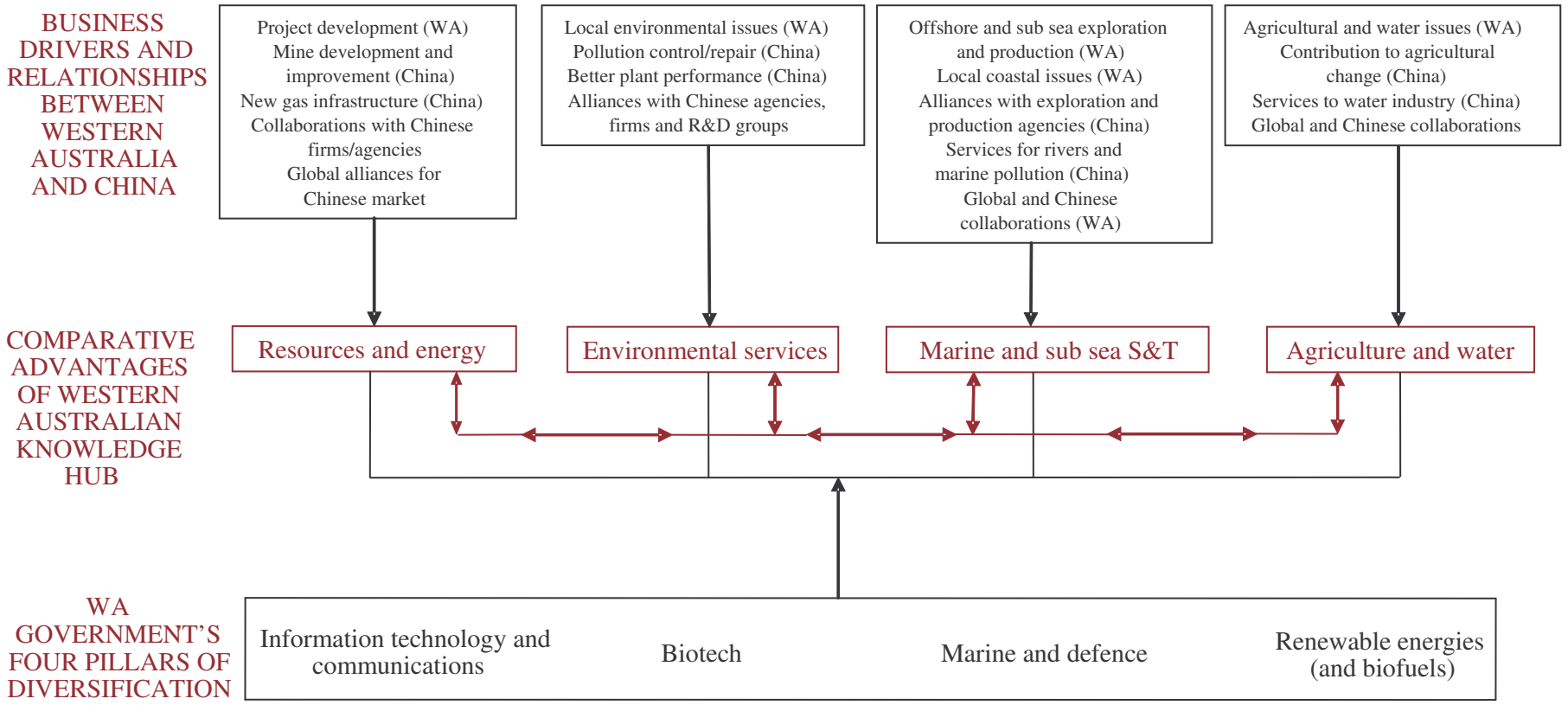
In terms of knowledge-based services, domestic firms provide a high level of services to resource and other projects within the State, but the level of identified exports of knowledge-based services from Western Australia remains relatively modest. Nevertheless exports of architectural, engineering and other technical services from Western Australia reached $198 million in 2005, 30% of the Australian total. There is thus a significant base on which to build. But overseas student enrolments have grown more slowly in Western Australia than in any other state over the last three years, partly because of a low share of the rapidly growing Chinese student market (4.3% share in 2005). Western Australian higher education exports have been focused on markets within Asia – such as Hong Kong, Singapore, Malaysia and Indonesia – that are now in decline or only growing slowly, and not on the more rapidly growing markets of China and India. Building the educational component of the knowledge hub will thus require a significant redirection of effort.

5.1.3 Building Scale and Excellence through the China Relationship

A major opportunity for building scale and excellence for a global knowledge hub in these areas lies in increased collaboration with China, as China emerges as a global power in science and technology with a growing thirst for knowledge in areas in which Western Australia has expertise. China's R&D priorities are closely aligned to the State's areas of expertise, and spending in these areas by both governments and firms in China is growing rapidly. Figure 5.1 spells out how a deepening relationship with China, at both commercial and government levels, could play a major role in developing the scale and excellence of the State's global knowledge hub.

Many aspects of China's development, and of its response to the massive challenges that it faces, could be supported by expertise from Western Australia. Two of many possible examples illustrate the potential scale involved. First, China has a growing need for natural gas, as an efficient and relatively clean energy source for cities in the south of the country, far removed from China's main coal deposits. Western Australia could provide some of this gas from new fields, but the growth of the China market is constrained by technical and infrastructure issues at the Chinese end, as well as by domestic policy issues. The market for technical expertise and services in this area in China over the next decade will be very large. Second, China realises that it must address deep environmental problems in many areas arising from rapid growth. To do so it has allocated US$175 billion of government funding over 2006-2010, and is placing great pressure on firms to improve their performance. In both of these areas Western Australia has substantial expertise, created to meet its own needs, which could be the basis for large scale exports of knowledge-based services to China. There are many other areas also, some of which are noted in Figure 5.1.

Figure 5.1 Developing a global knowledge hub in Western Australia: China linkages



Building strong relationships with Chinese firms, government agencies and research institutions can also help to strengthen the quality and relevance of Western Australian R&D and education in these areas. China is moving rapidly from being a mere recipient of modern scientific knowledge to being a leading creator of knowledge on a very large scale. Mutual R&D collaborations, with shared R&D activities in both countries, are being recognised by many countries as highly valuable vehicles for increasing the scale, quality and relevance of local R&D. Similarly, high quality Chinese graduate students, and closer links with the institutions from which they come, could contribute greatly to academic life within Western Australia.

5.1.4 The Knowledge Hub as a Self-Reinforcing System

It is important to stress that the knowledge hub would be a self-reinforcing system, in the sense that its many elements would be closely inter-related and that growth in one area would spill over to strengthen the scale and/or quality of activity in other areas. For example, collaboration with Chinese and global partners to undertake R&D and to provide knowledge based services in a particular area should feed back to strengthen domestic R&D and educational capability in related areas, increasing the ability of universities to win Australian Government grants, and to recruit high quality Australian and foreign students and provide services to other firms. Equally, the various areas of comparative advantage are inter-related, so that strengthening scale and/or excellence in one area may well spill over into other areas. For example, deepening expertise in marine and subsea science and technologies will not only directly inform the technological and environmental aspects of offshore gas platforms, but could also strengthen aspects of coastal and fisheries management, as well as providing technologies for application in other environmental areas.

5.1.5 The Scale of the Knowledge Hub

In the scope of this report it has not been possible to explore fully this potential to create a global knowledge hub in Western Australia, nor to analyse in detail the policies required to develop it. But it is, in our view, a major opportunity and a realistic possibility. In quantitative terms it might involve, by 2012, outcomes such as the following: a level of business expenditure on R&D in excess of 2% of GSP; exports of knowledge intensive business services in excess of $1 billion per annum; over 5,000 Chinese students, many of the highest quality, studying in the State's universities and a wide array of international collaborations with Chinese and other firms, agencies and research and educational institutions. Such outcomes would be unprecedented within the Australian context, and would have a major impact on Western Australia, but are achievable. For example there is a very real prospect that, in the context of effective programs and continued company support, the objective of business R&D at 2% of GSP in Western Australia by 2012 could be achieved.

5.2 Area of Comparative Advantage of the Western Australian Knowledge Hub

5.2.1 Resources and Energy

There is little need to elaborate on the point that one of Western Australia's key strengths is in engineering and technical services, with many companies with world leading capabilities. For example, business R&D in the area of metal ore mining in the State amounted to $277.2 million in 2004-05, 67% of the total for the whole of Australia; R&D in services to mining was $70.6 million in 2004-05, 53% of the Australian total (ABS Cat. No. 8104.0, 2006).

There is every indication that further growth is underway, with companies such as BHP Billiton and Chevron announcing the establishment of global R&D centres in Perth. In 2005 the State exported architectural, engineering and other technical services to the value of $198 million, 30.6% of the Australia total for this category.

The recent consolidation of knowledge based activities in resources and energy in Western Australia has been facilitated by important State Government initiatives and by the existence of a range of local firms active in this area. The initiatives included support for the establishment of the Australian Resources Research Centre (ARRC) in 2001, with CSIRO and Curtin University as founding members, and support for the more recent establishment of the Western Australian Energy Research Alliance, also based at ARRC and bringing in the University of Western Australia.

West Australian engineering and technical service companies range from small niche to large multi-disciplinary consulting firms. Many of these firms have experience outside Australia and are internationally competitive. Some of the larger firms have established overseas offices and are accustomed to working in a diverse range of economies, cultures, languages, geography and climatic conditions. In addition, a range of technical services companies are based in Western Australia. Many of these companies support the mining and resource, infrastructure and urban development industries. The areas of operation include GIS, IT, design, training as well as research and development.

It is clear that demand for such services from China is expanding rapidly, and this will be particularly so as China strives to increase the energy efficiency of its economy and the quality of its resource industries. There is clearly a major opportunity to increase the export of these services to China. The experience and expertise of West Australian engineering firms in large infrastructure development projects, public private partnerships, design, construction and project management has great potential to assist China in its rapid economic development. Western Australian engineering firms also have the potential to transfer and exchange expertise, technology and skills to proficient Chinese engineers.

There is clearly an issue in inducing firms to broaden their export base at a time in which demand in the local market is so strong. But there are long-term benefits, both public and private, for pursuing such a course of action, and this provides a rationale for government support and incentives.

5.2.2 Environmental Services

Western Australian firms and agencies have been addressing environmental issues, not only in agriculture and mining but more broadly, for many years, and again many companies and agencies are world leaders. As noted above, this is now a key priority in China, and in the Eleventh Plan the Chinese Government has committed US$175 billion, or 1.5% of GDP, over 2006-2010 to environmental protection initiatives (*China Daily* 18 July 2006). The priority now being given to environmental protection and restoration in China reflects not only economic and environmental perspectives, but widespread unrest arising from the impact of environmental degradation on people's lives. This is a very large market of which Western Australian firms and agencies should be able achieve a significant share, given appropriate support mechanisms.

China presents a mixed picture of rising pollution and depleted environmental resources on the one hand, and applications of some of the world best environmental management techniques in some projects and districts, on the other hand. As detailed in Chapter 3, environmental problems in China range from air and water pollution, greenhouse gas emissions, land degradation, threats to biodiversity, and waste disposal and management.

Western Australia is a home to many small and medium sized firms providing environmental management, design and consulting services. The focus of these companies is on the urban development, construction, mining, natural resource, processing and manufacturing and industries. Services include environmental design and management, impact assessment, waste management, revegetation, contaminated site remediation, soil and water management as well as environmental monitoring and analysis. A number of these companies have experience working internationally.

Western Australia is the origin of a small number of innovative companies specialising in the design, manufacture and distribution of environmental products. These products include such things as analysis and monitoring devices, waste disposal equipment, and water and wastewater management equipment. The State is also home to various companies designing, manufacturing and distributing renewable energy equipment and devices.

The Chinese Government has committed significant funds to environmental protection and restoration and as such, China represents significant market potential for environmental service companies, though these opportunities are not without their challenges. The challenges include, similar to technical services, limitations on the forms of partnerships Australia firms can establish with Chinese firms, restrictive regulations on the employment of Chinese nationals and of foreign nationals and restrictions on where activities can be undertaken (DFAT 2006). The Chinese market for environmental products is potentially huge though a number of obstacles also exist. The obstacles include frustrating quantities of red tape and regulatory inconsistencies, cost of import licenses, 'absence of a level playing field' due to industry support in China, lack of international standards and technical regulations, intellectually property concerns, contract enforcement challenges as well as competition with others who pay less tariffs for selling their products on the Chinese market (DFAT 2006).

5.2.3 Marine Science and Technologies

Western Australia has many diverse knowledge assets in the area of marine sciences and technologies. With its major reserves of oil and gas in the Carnarvon and Bowen Basins, the State has already become a leading centre of expertise in scientific and technological issues related to offshore exploration and production. Private business R&D in Western Australia in 2004-05 in oil and gas extraction was $87 million, 78% of the national total, and much of this would have been focused on offshore issues. This is likely to increase further, with major gas projects in the planning stage and facing major technical and practical issues.

Given its vast coastline and the importance of maritime issues to the State, there are significant research resources in the public sector also, as the Centre for Marine Science and Technology at Curtin University and the State nodes of the Coastal Zone CRC. The Australian Marine Complex at Cockburn Sound is another important research and training asset, building on the State's substantial involvement in the marine defence area. The Government has also made a substantial contribution in its recent biotechnology strategy statement of $21 million to the Western Australian Marine Science Institution, to promote increased understanding of the State's biodiversity.

5.2.4 Agriculture and Water

As noted above, the Chinese Government has made 'building a new socialist countryside' a key priority for the Eleventh Five Year Plan and beyond. The key priorities in this major program is to implement modern methods and technologies, especially in grain production, develop rural infrastructure, extend the reform process in agriculture (including in 2006 rescinding agriculture taxes that have been levied for 2600 hundred years and which currently raise some A$12 billion from farmers) and improve environmental sustainability.

Western Australia has been forced to address over many years, issues concerning farm efficiency and sustainability, and the use of appropriate technologies, on a wide range of types of land, especially for wheat and other cereals.

China, like Western Australia, faces severe water problems, with serious shortages of water in many rapidly growing areas. In both cases, the problem appears to be not a shortage of water over the whole land mass, but of the distribution of water across regions and the quality of water in urban centres and other areas that even have ample supply of water. In many such areas the commonality of problems and the established expertise in Western Australia provide important opportunities for collaboration for mutual benefit.

Western Australia is home to a number of companies that design, manufacture and distribute agricultural technologies. A small number of companies have established themselves in the field of precision agriculture through the design, manufacture and distribution of high tech software and hardware for the agriculture industry. A small number of companies design and manufacture basic as well as high tech agricultural equipment such as fertiliser spreaders, seeders, mobile grain cleaners, and general farm machinery. The State is also home to many small consultancy groups which provide financial advice, farm business planning, technical advice, market and product research, property management as well as soil and water management advice for farmers.

A handful of companies in Western Australia design, manufacture and distribute water technology equipment. Such technologies include water treatment systems, chemical dosing and control equipment, and water desalination equipment. A small of number of Western Australian based companies specialise in water services. Such services include groundwater engineering, hydrogeology, water resource management, surface and groundwater modelling as well as water and wastewater treatment. Many engineering and environmental consulting firms also provide water services.

A major focus of the State's biotechnology strategy is agriculture and the environment, and that strategy brings out the range of public knowledge assets that Western Australia possesses in these and related areas.

5.3 The Policy Framework

Given the strong growth of business and higher education R&D in Western Australia, further measures by companies to create global R&D centres in the State and a range of advanced research capabilities outside of the resource sector, Western Australia has the foundations for a major advanced research and educational hub within the State and should take urgent action to grasp that opportunity. In doing so, it would not be alone. Noting the rise of China, and in due course India, as major forces in the advancement of science and its economic and social application, many countries have responded with new initiatives (such as President Bush's American Competitiveness Initiative, with a cost of US$136 billion over 10 years) and by establishing a vast range of joint research initiative with China. For example, by 2004 there were over 600 research centres in China run by multinational corporations (Augustine 2005). In a similar way the strengthening of Western Australia's capabilities for R&D requires a systematic and far-sighted program to partner, on a basis of mutual benefit, with emerging leaders in China.

It also requires urgent action to increase the flow of high quality students, particularly at the post-graduate level, from China (and India). Universities within China are both increasing student numbers rapidly and improving the quality of research and teaching, and the global market for overseas students in becoming more competitive.

Nevertheless Western Australia has the capacity to increase its educational exports to China significantly, but this needs to be done in the context of preserving and enhancing the quality of local institutions and the education that they provide. A strongly growing level of university and corporate research activity, with a strong recruitment market for researchers, also provides a sound basis for increasing the flow of high quality students to the State.

To realise the multi-billion dollar potential of this knowledge hub for Western Australia three issues need to be addressed. There needs to be an *increased orientation* of private services firms, government agencies and universities to export markets, especially in China. Building stronger *relationships and collaboration*s, especially with Chinese firms and agencies, will be crucial. Finally, *building recognition of quality* is necessary if firms, agencies and individuals in other countries are to participate in knowledge activities in Western Australia. While this recognition is growing rapidly in some sectors, in others, such as higher education, a perception in some countries that the major knowledge centres in Australia are located in the eastern states may hinder the growth in high quality student enrolments in Western Australia.

Two specific programs could contribute greatly to achieving these objectives and to building the knowledge hub. Firstly, a program is required to support private firms embarking on knowledge based collaborations with China, and to encourage universities and government agencies to enter into such relationships. This could provide funding, on a competitive basis, to joint R&D activities in China and Western Australia, to local companies developing products in conjunction with Chinese partners, to government agencies embarking on research or development activities with their Chinese counterparts, to shared R&D and teaching activities and so on. If such a program were of significant scale, say $80-100 million over five years, it would also signal the Government's intention to create a more export-oriented culture in knowledge-based services in Western Australia. Similar programs have been implemented in relation to China by other governments around the world, with some signs of success.

Secondly, a central part of the knowledge hub would be a growing level of internationally engaged, high quality activity in post-secondary education in Western Australia. To increase the involvement of high quality Chinese postgraduate students in the State's universities, the Government could offer a PhD program for leading graduates from China. Such a program, perhaps reaching a total stock of students of about 100 by the third year at a cost of $3-4 million per annum, would attract good students emanating from China's leading universities. If widely advertised within China it could help to build recognition of the State as a knowledge base and as a student destination. Preference could be given to students embedded in a broader collaborative relationship.

We have identified four areas in which, in our assessment, Western Australia could achieve substantially increased long-term activity, based in substantial part on a deepening relationship with China.

5.4 Conclusion

In the scope of this report it has not been possible to explore fully the potential to create a global knowledge hub in Western Australia, based on existing assets and on a systematic development of relationships with China, nor to fully analyse the policies required to develop it. But it is, in our assessment, a major opportunity, and a realistic possibility, with substantial benefits to the State. Such a hub could build effectively on the four pillars of the State's diversification strategy, with key applications of these core technologies in many areas. It is recommended that such an opportunity, and the policies necessary to achieve it, be the subject of further detailed study.

6 Other Opportunities and Strategic Policy Issues

The first four chapters of this report have documented the way in which the emergence of China is a major factor in creating a new world economic order, which will have fundamental ramifications throughout all industries, regions and institutions. We have sought to describe some of the implications of emerging China for Western Australia to date, as well as some of the obstacles to be faced, both globally and within China, if the present high growth path is to be continued. In Chapter 5 we have described the potential for Western Australia to create a global knowledge hub based on its existing capabilities and greatly enhanced linkages with China (and India) But the analysis of the report has also suggested a number of other opportunities for Western Australia that require more substantial analysis than has been possible here. These are noted briefly below. Finally, the scale of change, and the differential impact that it is having within Australia, raises some key strategic issues for policy at both the national and state levels. These issues require sustained consideration and debate at both levels within Australia, if we are to respond effectively to the challenges ahead of us. The report concludes by briefly noting them, as a spur to that further consideration and debate.

6.1 Other Opportunities for Western Australia

6.1.1 Tourism

In 2005 there were 31 million outbound tourists from China worldwide, an increase of 20% per annum since 1998, although a high proportion visit neighbouring economies such as Hong Kong, Macao and Taiwan. The World Tourism Organization forecasts that the number will rise to 100 million by 2020 (a growth rate of 10% per annum) and this may well prove conservative. The number of Chinese tourists visiting Australia, although only about 1% of the global total, has been growing more rapidly than that total, and Chinese tourists stay longer and spend more on average than other tourists to Australia.

In spite of its unique and varied attractions, and receiving 10.7% of national visitor nights in 2005-06, Western Australia received only 5% of Chinese visitor nights in 2003 and only 4.3% of all Chinese visitors in 2005-06. International visitors to the State come predominantly from six countries – UK, Singapore, NZ, Japan, USA and Malaysia – and visitor numbers from some of these countries have been falling recently. As a consequence, Western Australia is under-represented in terms of tourist numbers from the rapidly growing Chinese market.

There is clearly scope for the State to attract a much larger share of a large and rapidly growing number of Chinese tourists in the years ahead. For example, if 2% of China's tourists visited Australia by 2020 and 10% of those came to Western Australia, the number of Chinese tourists visiting the State would increase twelvefold by 2020, relative to the current level. While further investment in facilities would undoubtedly be required, the major requirements would seem to be much greater recognition within China of the State and its attractions, and increased promotion of those attractions.

6.1.2 Renewable Energy

Given the continued growth of energy use based on fossil fuels in China and other countries, there is little doubt that global concerns about climate change and renewable energy sources will deepen in coming years. Western Australia has a number of avenues to pursue further development of renewable energy, and considerable expertise in this area.

One particular matter being widely debated at the present time is the possibility of increased production and use within Australia of ethanol or biodiesel, and the tax and/or subsidy arrangements that might be appropriate for this case. Our assessment is that high energy demand from China, India and other countries is likely to mean relatively high oil prices for the long-term, although high prices will in due course both moderate demand and increase the supply of oil from both conventional and non-conventional sources. Western Australia has the potential to produce a large volume of fuel ethanol from wheat, both for domestic use and possibly for export, and some potential for biodiesel production. Our analysis suggests that under the full excise tax exemption, the production of ethanol from wheat is commercially viable even at long run oil prices below US$50 per bbl, but that viability declines markedly as the tax exemption is withdrawn. Detailed attention to this and a range of other renewable energy products and services is clearly in the State's interest in the emerging world context.

6.1.3 Value Added Industries

There has long been debate about why Australia, and states such as Western Australia in particular, cannot add more value to resource exports before they are shipped overseas. Some notable investments have been undertaken to this end in Western Australia, for example in the HiSmelt process and in fertilizer production on the Burrup peninsula, and a number of fertilizer and ammonia nitrate projects are on the drawing boards. However, if China is to move up the industrial value chain while getting serious about controlling energy use, there is a case to be made for more processing of resource imports before they come to China. With industrial output continuing to drive growth within China (in the first three quarters of 2006 real value added of secondary industry grew by 13% relative to the same period of 2005) and energy use continuing to surge (China's energy use in the first six months of 2006 was 11.7% higher than for the same period in 2005), the pressure continues to build for China to adopt a significantly different strategy.

This option will become more attractive if, as seems inevitable, there is a substantial increase over time in the value of the RMB. With China's foreign exchange reserves likely to exceed US$1000 billion before the end of 2006, there is ample scope for an increase in the value of the RMB and for increased imports of value added products. Whether such value adding activities could or should take place in Western Australia is another matter, but this issue is one that will demand continued policy attention as the global situation develops.

6.1.4 Human and Government Services

As outlined in the body of the report, strenuous efforts are being made in China to shift its development strategy to one that places much greater emphasis on the service sector, and especially on health. China currently spends a very low proportion of its budget on health services, and faces complex problems of improving health services, both in urban areas and in remote rural regions. China also has an extremely complex governance system within which to deliver these changes, and there are significant disparities within and among the four levels of sub-national governments, and the level of services varies enormously between regions, provinces, counties and townships. The Communique of the Sixth Plenum of the 16th Central Committee of the Chinese Communist Party, released in October 2006, again emphasised the building of a harmonious society, and both the reform of government and the development of government programs that are seen as necessary to move China towards such a society (*China Daily* 11 October 2006).

Over the next few decades there will be a vast and growing market within China for expert services related to these challenges. Many of them have been addressed over a long period of time in Western Australia, so that local firms and public sector institutions should be well positioned to compete for this business.

6.2 National and State Strategic Policy Issues

The centrality of China, and the new world order of which it is a key part, to the future prosperity of Australia, and especially Western Australia, raises a number of broader issues that need to be addressed at both state and national levels. These relate both to how Australia deals more effectively with emerging China and to how the Australian federation deals with the very different impact of China, and indeed of the emerging new world order, on different states within Australia.

6.2.1 Social and Cultural Orientation

Firstly, the social and cultural prerequisites within the Australian, and the Western Australian, communities for dealing effectively with a world in which China is a dominant player need to be addressed in a much more serious fashion than at present. This covers such matters as Chinese history, language and cultural studies in schools, much more extensive programs in these areas in the universities and more general programs to share information and to create awareness. If the prosperity of Australia, and particularly of Western Australia, is to be the emergence of a country such as China, with fundamentally different history, language, cultural and business traditions than those prevailing in Australia, these matters should be given high priority.

6.2.2 Long-term Relationships

Secondly, using the emergence of China in an effective way to promote local growth will depend above all on the development of long-term relationships, networks and linkages at many levels between Western Australia and China. Doing business successfully with Chinese firms and agencies, whether in terms of purely commercial matters or in research and education, is highly dependent on the establishment of such long-term relationships, which exhibit mutual understanding, trust and respect. Given the existing resource relationships, the State has a head start in this matter, but the extension and deepening of these relationships should be another high priority of the State Government.

6.2.3 Strategic Issues in Dealing with China

Thirdly, attention needs to be given to some of the strategic issues in developing closer relationships with Chinese firms and agencies. These include the possible use of direct investment by Chinese agencies as a mechanism for controlling the use of resources and of curtailing the operation of markets, and of the unique and complex issues involved in doing business in a rapidly growing, increasingly market oriented economy governed by the Chinese Communist Party in a way that can be heavily bureaucratic. China is changing rapidly in many relevant respects, but there remains a strong element of government involvement in business and strong nationalistic sentiments even when governments are not directly involved. These issues remain important for firms and governments dealing with China, including governments at both the state and national levels.

6.2.4 Rethinking National Institutions

Finally, the initial impact of China's emergence as a global economic power on Western Australia is quite different from its impact on the south eastern states of Australia. For the former, it is driving the resources boom, leading to a strong trading surplus and an increased concentration of global knowledge resources in Western Australia. For the latter, the impact is initially felt mainly through greatly increased competition in manufacturing, as indicated by a trading deficit on elaborately transformed manufactures of $71 billion in 2005, and increased pressure on knowledge resources as the manufacturing base erodes. Both regions need to develop considered strategic responses to the challenges and opportunities that they face. However, these increasingly divergent paths mean major problems for key national institutions – those concerned with matters ranging from immigration and monetary policy to wage, price and exchange rate determination and fiscal equalisation – in producing outcomes that meet the needs of the whole of Australia. These divergent paths are likely to provide a major challenge to the Australian federation in the years ahead.

References

Antkiewicz, A. and Whalley, J. 2004, 'China's New Regional Trade Agreements', NBER Working Paper 10992, National Bureau of Economic Research, Cambridge, Mass.

Asian Development Bank (ADB) 2005, *People's Republic of China: Fiscal Management Reforms*, Technical Assistance Consultant's Report TA3979-PRC, January, Asian Development Bank, Manila.

Augustine, N.R. 2005, 'Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future', Statement to the Committee on Science, U.S. House of Representatives, 20 October, Washington DC, available at: http://www7.nationalacademies.org/ocga/testimony/Gathering_Storm_Energizing_and_Employing_America2.asp

Australian Bureau of Agriculture and Resource Economics (ABARE) 2005, *Minerals and Energy Commodities Statistics 2005*, ABARE, Canberra.

Australian Bureau of Agriculture and Resource Economics (ABARE) 2006, *Australian Commodities – June Quarter 2006*, ABARE, Canberra.

Australian Education International (AEI) 2006, *International Student Data*, Australian Department of Education, Science and Training, Canberra, available at: http://aei.dest.gov.au/AEI/MIP/Statistics/default.htm

China Daily 18 July 2006, 'In brief', available at: http://www.chinadaily.com.cn/cndy/2006-07/18/content_642894.htm

China Daily 11 October 2006, 'Communique of the Sixth Plenum of the 16th Central Committee', available at: http://www.chinadaily.com.cn/china/2006-10/11/content_706239.htm

Department of Foreign Affairs and Trade (DFAT) 2006, *Trade in Services Australia 2004-05*, Department of Foreign Affairs and Trade, Canberra.

Department of Industry and Resources (DoIR) 2004, *Information and Communications Technology Industry Development Strategy*, Western Australian Government, Perth, available at: http://www.doir.wa.gov.au/businessandindustry/9B5B664FA2E64AB093861750DBB964ED.asp

Department of Industry and Resources (DoIR) 2006, *Western Australian Minerals and Petroleum Statistical Digest 2005*, Western Australian Government, Perth.

Department of Industry and Resources (DoIR) 2006a, *Prospect*, Western Australian Government, Perth, available at: http://www.doir.wa.gov.au/mineralsandpetroleum/EB8B31A1819240AFB81852E9F747550B.asp

Department of Industry and Resources (DoIR) 2006b, *Western Australian Biotechnology Industry Development Strategy*, Western Australian Government, Perth, available at: http://www.doir.wa.gov.au/businessandindustry/C5FBB1B831524987B3BEE79C54ADD5FC.asp

Department of Treasury and Finance (DTF) 2005, *The World Iron Market in 2005*, Department of Treasury and Finance, Western Australian Government, Perth.

E&MJ 2000-2006, 'Mine project survey', *Engineering and Mining Journal*, January.

Energy Information Agency (EIA) 2006, *Annual Energy Outlook 2006*, EIA, Washington DC.

Energy Resources Institute (ERI) of National Development and Reform Commission, and Power Economic Research Center of State Grid Corporation 2006, *Policy Study: Gas-fired Power Generation in China, Synthesis Report*, Joint Study Team, Beijing.

Fahey, S. 2006, 'Australia-China Services Trade: Opportunities and Challenges to a Free Trade Agreement: Session 3: Education', Speech to the Australia-China Services Trade Conference, Beijing, by Prof. Stephanie Fahey, Deputy Vice-Chancellor (International) Monash University, Beijing, 24 April, available at: http://www.dfat.gov.au/geo/china/fta/060424_beijing_fahey_speech.html

Hayward, S. 2005, 'The China Syndrome and the Environmental Kuznets Curve', *Environmental Policy Outlook,* 21 December, American Enterprise Institute for Public Policy Research, Washington DC, available at: http://www.aei.org/publications/pubID.23617/pub_detail.asp

Hilton, I. 2006, 'Karl, China needs you', *The Australian Financial Review*, 3 March, p. 4.

Huang, J., Rozelle, S. and Rosegrant, M.W. 1997, 'China's food economy to the 21st century: Supply, demand, and trade', 2020 Vision Discussion Paper No. 19, International Food Policy Research Institute, Washington DC.

International Energy Agency (IEA) 2004, *World Energy Outlook, 2004,* OECD and IEA, Paris.

International Monetary Fund (IMF) 2006, *World Economic Outlook: Globalisation and Inflation*, Washington DC.

International Monetary Fund (IMF) 2006a, *World Economic Outlook: Financial Systems and Economic Cycles*, Washington DC, available at: http://www.imf.org/external/pubs/ft/weo/2006/02/index.htm

Maddison, A. 2003, *The World Economy Historical Statistics*, OECD, Paris.

Ministry of Agriculture (MOA) 2005, *Agricultural Development Strategy Studies in the New Era*, China Agricultural Press, Beijing.

Ministry of Science and Technology (MOST) 2006, *National Medium and Long Term Strategy and Plan for Science and Technology Development, 2006-2020*, Beijing.

National Bureau of Statistics China (NBSC) 2003, *China Statistical Yearbook, 2003*, China Statistics Press, Beijing.

National Bureau of Statistics of China (NBSC) 2005a, *China Statistical Yearbook 2005*, China Statistics Press, Beijing.

National Bureau of Statistics of China (NBSC) 2005b, 'Key Advancements of the First National Economic Census with New Changes of China's GDP Aggregates and its Structure', Beijing, available at: http://www.stats.gov.cn/english/newsandcomingevents/t20051220_402297118.htm

National Bureau of Statistics of China (NBSC) 2006a, 'Statistical Communique of the People's Republic of China on the 2005 National Economic and Social Development', Beijing, available at: http://www.stats.gov.cn/english/newsandcomingevents/t20060302_402308116.htm

National Bureau of Statistics of China (NBSC) 2006b, 'Announcement on Revised Result about Historical Data of China's Gross Domestic Products', Beijing, available at: http://www.stats.gov.cn/english/newsandcomingevents/t20060110_402300302.htm

National Bureau of Statistics of China (NBSC) 2006c, 'The Figure of GDP by Expenditure Approach in the Year of Economic Census', Beijing, available at: www.stats.gov.cn/english/newsandcomingevents/t20060322_402312186.htm

National Bureau of Statistics of China (NBSC) 2006d, 'Fast and Stable Economic Growth in the First Half of 2006', Beijing, available at: http://www.stats.gov.cn/english/newsandcomingevents/t20060718_402337744.htm

National Bureau of Statistics China (NBSC), National Development and Reform Commission, and Office for National Energy Leading Group 2006, 'Communiqué on National Energy Consumption for Unit GDP in the First Half of 2006', 31 July, available at: http://www.stats.gov.cn/english/newsandcomingevents/t20060802_402341896.htm

Naughton, B. 2006, 'The new common economic program: China's Eleventh Five Year Plan and what it means', *China Leadership Monitor*, no. 16.

O&GJ 2005, *Oil and Gas Journal*, December.

O&GJ 2006, *Oil and Gas Journal*, June.

Organization for Economic Cooperation and Development (OECD) 2005a, *OECD finds that China is biggest exporter of Information Technology Goods in 2004, surpassing US and EU*, OECD, Paris, accessed August 2006, available at: http://www.oecd.org/document/8/0,2340,en_2649_201185_35833096_1_1_1_1,00.html

Organization for Economic Cooperation and Development (OECD) 2005b, *Economic Survey of China 2005*, Paris.

Organization for Economic Cooperation and Development (OECD) 2006, *Information Technology Outlook 2006*, Paris.

Planning Commission (PC) 2005, *Mid-Term Appraisal of the Tenth Five Year Plan 2002-2007*, Government of India, New Delhi.

Planning Commission (PC) 2005a, *Draft Report of the Expert Committee on Integrated Energy Policy*, Planning Commission, Government of India, New Delhi.

Planning Commission (PC) 2006, *Eleventh Five Year Plan 2007-2012*, Government of India, New Delhi.

Roberts, I. and Andrews, N. 2005, 'Developments in Chinese Agriculture', ABARE eReport 05.7, Canberra, July.

Rodrik, D. 2006, 'What's so special about China's exports?', NBER Working Paper No. W11947, National Bureau of Economic Research, Cambridge, Mass.

Rosegrant, M., Agcaoili-Sombilla, M. and Perez, N. 1995, Global food projections to 2020: Implications for investment', 2020 Vision Discussion Paper No. 5, International Food Policy Research Institute, Washington DC.

Ryan, C. 2006, 'Seeing red: China's profits walk away,' *Australian Financial Review*, no. 11872, 27 February, p. 11.

Semiconductor Industry Association (SIA) 2005, *Semiconductor Industry Sees Globalization as Growth Opportunity*, July, SIA, San Jose, Calif.

Sinton, J. E. and Fridley, D. G. 2003, 'Comments on recent energy statistics from China', *Sinosphere*, vol. 6, no. 2, pp. 6-12.

State Administration of Foreign Exchange (SAFE) 2006, Balance of Payments 2005, Beijing, available at: http://www.safe.gov.cn

The Economist 2004, 'Special Report: China's environment', August 21, pp. 57-59.

The Economist 2006, 'Balancing act: A survey of China', March 25.

The Information Network 2005, *US Capture 50 Percent of Global Semiconductor Processing Equipment in 2005*, TIN, October.

UNCTAD 2004, *World Investment Report 2004: The Shift Towards Services*, United Nations, New York and Geneva.

UNCTAD 2005, *World Investment Report 2005: Transnational Corporations and the Internationalisation of R&D*, United Nations, New York and Geneva.

US Department of Agriculture (USDA) 2006, *Production, Supply and Distribution Online*, Foreign Agriculture Service, USDA, Washington DC, available at: http://www.fas.usda.gov/psdonline/psdHome.aspx

Wen Jiabao 2006, *Report on the Work of the Government 2006*, delivered at the Fourth Session of the Tenth National People's Congress on March 5, People's Republic of China, Beijing, available at: http://english.gov.cn/official/2006-03/14/content_227248.htm

World Bank 2003, *China: Promoting Growth with Equity*, Washington DC.

World Semiconductor Trade Statistics (WSTS) 2005, *WSTS Semiconductor Market Forecast Spring 2005*, WSDS, San Jose, California, available at: http://www.wsts.org/plain/content/view/full/2076

World Trade Organization (WTO) 2005, *International Trade Statistics 2005*, Geneva.

World Trade Organization (WTO) 2006, *International Trade Statistics 2006*, Geneva.

A Steering Committee and Consultation Team

The membership of the Technology & Industry Advisory Council (TIAC) Steering Committee for this project is listed below:

Ms Sharon Brown	Strategic Business Manager, AlphaWest Services Pty Ltd *Chair of Steering Committee (TIAC Member)*
Mr Rob Meecham	Director Business Development, Challenger TAFE *(TIAC Member)*
Mr Graeme Rowley AM	Executive Director Operations, FMG Limited *(TIAC Member)*
Ms Lyne Thomas	Assistant Director General, State Development Strategies, Department of Industry and Resources (DoIR)
Ms Karen Hall	General Manager, Trade and Services, State Development Strategies, Department of Industry and Resources (DoIR)
Ms Sally Mansfield	State Director, Department of Foreign Affairs and Trade
Mr BJ Zhuang AM	Regional Director, Western Australian Trade and Investment Promotion, Shanghai

The Steering Committee was assisted in its task by the Centre for Strategic Economic Studies (CSES), University of Victoria:

Professor Peter Sheehan	Director
Professor Bhajan Grewal	Professional Fellow
Professor John Houghton	Professional Fellow
Dr Enjiang Cheng	Senior Research Fellow
Mr Ainsley Jolley	Senior Research Fellow
Dr Fiona Sun	Research Fellow
Mr Jason Nielsen	Research Officer
Mr Zhang Bo	Research Officer
Ms Alison Welsh	Research Analyst
Mrs Margarita Kumnick	Research Information Coordinator

Also assisting the Centre for Strategic Economic Studies were:

Mr Peter Morris	Managing Director, Telesis Consulting
Mr Jim Lang	Managing Director, TradeData International

TIAC Executive Staff:

Mr Earl White	Executive Officer
Ms Deanna Fleming	Senior Policy Adviser
Ms Shelley Rush	Executive Assistant

B Western Australian Technology & Industry Advisory Council

Background

The Western Australian Technology & Industry Advisory Council (TIAC) was created by legislation in 1987 (Technology Development Amendment Act - No. 32 of 1987) and was continued under Section 20 of the Industry and Technology Development Act 1998.

TIAC was preceded by the Technology Review Group 1978-83, and the Science, Industry and Technology Council (SITCO) 1983-87.

Council is made up of representatives from various sectors of the State's economy who, in terms of the relevant Act, use their varied background and experience to provide independent policy advice to the Minister so as to make a significant contribution to the development of strategies relating to the State's economic development.

Members of the Council are appointed by the Minister, under Section 22 of the Industry and Technology Development Act 1998 so as to be representative of the interests of the people of the State.

TIAC reports through the Minister to Parliament under Section 26(1) and Section 26(2) of the Industry and Technology Act 1998.

TIAC reports under the Financial Administration and Audit Act 1985 through the Department of Industry and Resources under Section 26(3) of the Industry and Technology Development Act 1998.

Objectives of the Industry and Technology Development Act 1998

The objectives of the Industry and Technology Development Act 1998 under Section 3 are to:

(a) promote and foster the growth and development of industry, trade, science, technology and research in the State;

(b) improve the efficiency of State industry and its ability to compete internationally;

(c) encourage the establishment of new industry in the State;

(d) encourage the broadening of the industrial base of the State; and

(e) promote an environment which supports the development of industry, science and technology and the emergence of internationally competitive industries in the State.

Functions of the Council

The Council, under Section 21 of the Act is required to:

(a) Provide advice to the Minister, at the initiative of the Council or at the request of the Minister, on any matter relating to the objects of the Industry and Technology Development Act 1998.

(b) Carry out, collaborate in or produce research, studies or investigations on any matter relating to the objects of this Act, including matters relating to the:

(i) role of industry, science and technology in the policies of Government;

(ii) social and economic impact of industrial and technological change;

(iii) employment and training needs and opportunities relating to industrial, scientific and technological activities in the State;

(iv) adequacy of, priorities among and coordination of, scientific, industrial and technological activities in the State;

(v) methods of stimulating desirable industrial and technological advances in the State;

(vi) application of industrial, scientific and technological advances to the services of the Government; and

(vii) promotion of public awareness and understanding of development in industry, science and technology.

The Ministerial advice takes the form of reports and discussion papers which undergo a public consultation phase before submission to the Minister.

Participation on State Advisory and Funding Committees and Councils

Council has accepted invitations for representation and participated in:

(a) The Federal Government's Commonwealth, State and Territory Advisory Council on Innovation;

(b) The Federal Government's Innovation Festival Committee;

(c) The Ministerial Education Export Advisory Committee;

(d) The Centres of Excellence State Funding Advisory Committee of the Office of Science and Innovation.

Promotion and Public Awareness Raising Activities

Council's promotional and public awareness raising programs consist of two main types:

(a) The 2020 Breakfast Seminars, commenced in 1990, are short, economic development focussed, information dissemination events.

(b) TIAC's Internet website, to promote and increase the public awareness of its reports and encourage school students to participate in TIAC's virtual Science and Technology Forum. This activity is managed in conjunction with the Science Teachers' Association (STAWA) Talent Search Organisation.

Financial Provisions

The expenses of Council are provided for under Section 15 of the Industry and Technology Development Act 1998 via the Western Australian Industry and Technology Development Account.

Present Membership

Mr John Thompson
TIAC Chairman

Ms Sharon Brown
Strategic Business Manager
AlphaWest Services Pty Ltd

Dr Jim Limerick
Director General
Department of Industry and Resources

Mr Rob Meecham
Director of the Business Development Unit
Challenger TAFE

Ms Wendy Newman
Principal Consultant
Quintessence Consultancy

Mr Graeme Rowley AM
Executive Director Operations
Fortescue Metals Group Limited

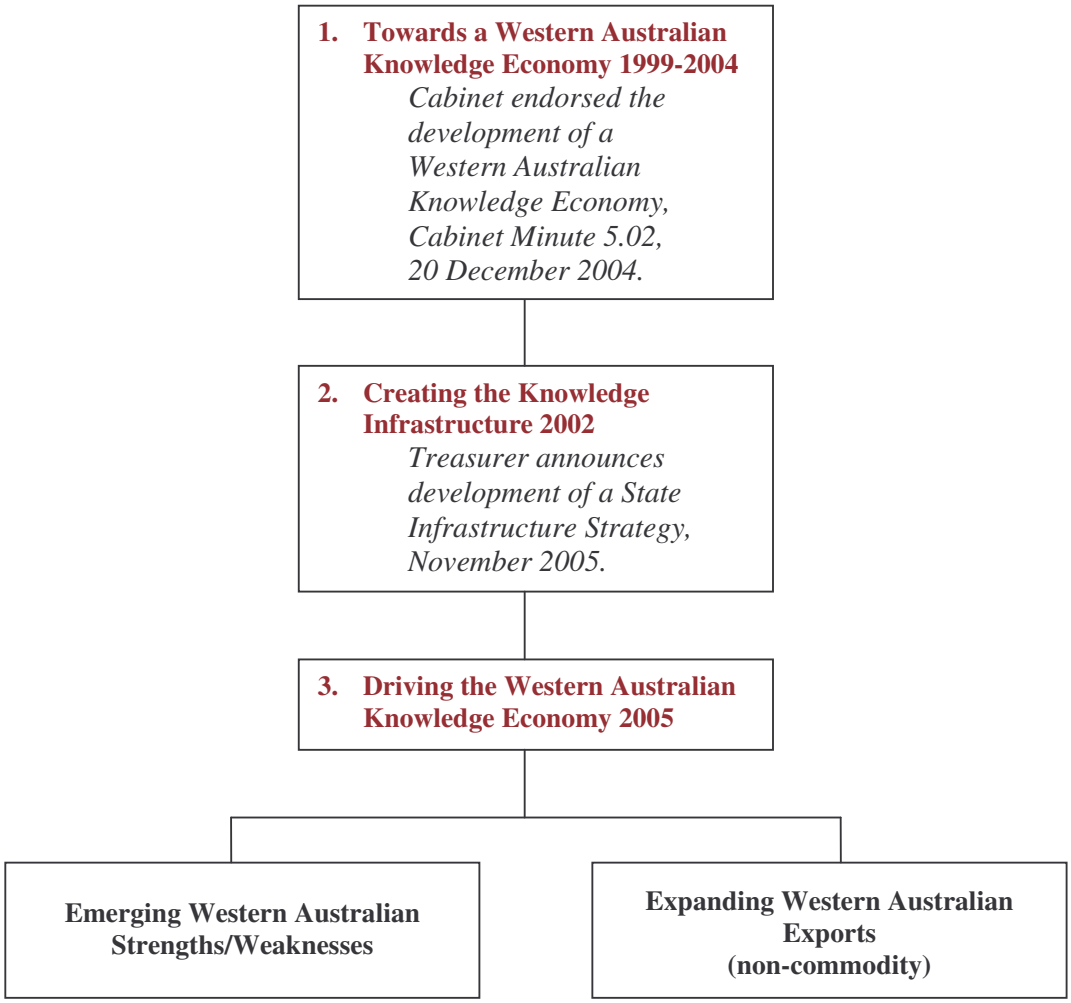
Mr David Singleton
CEO and Managing Director
Clough Limited

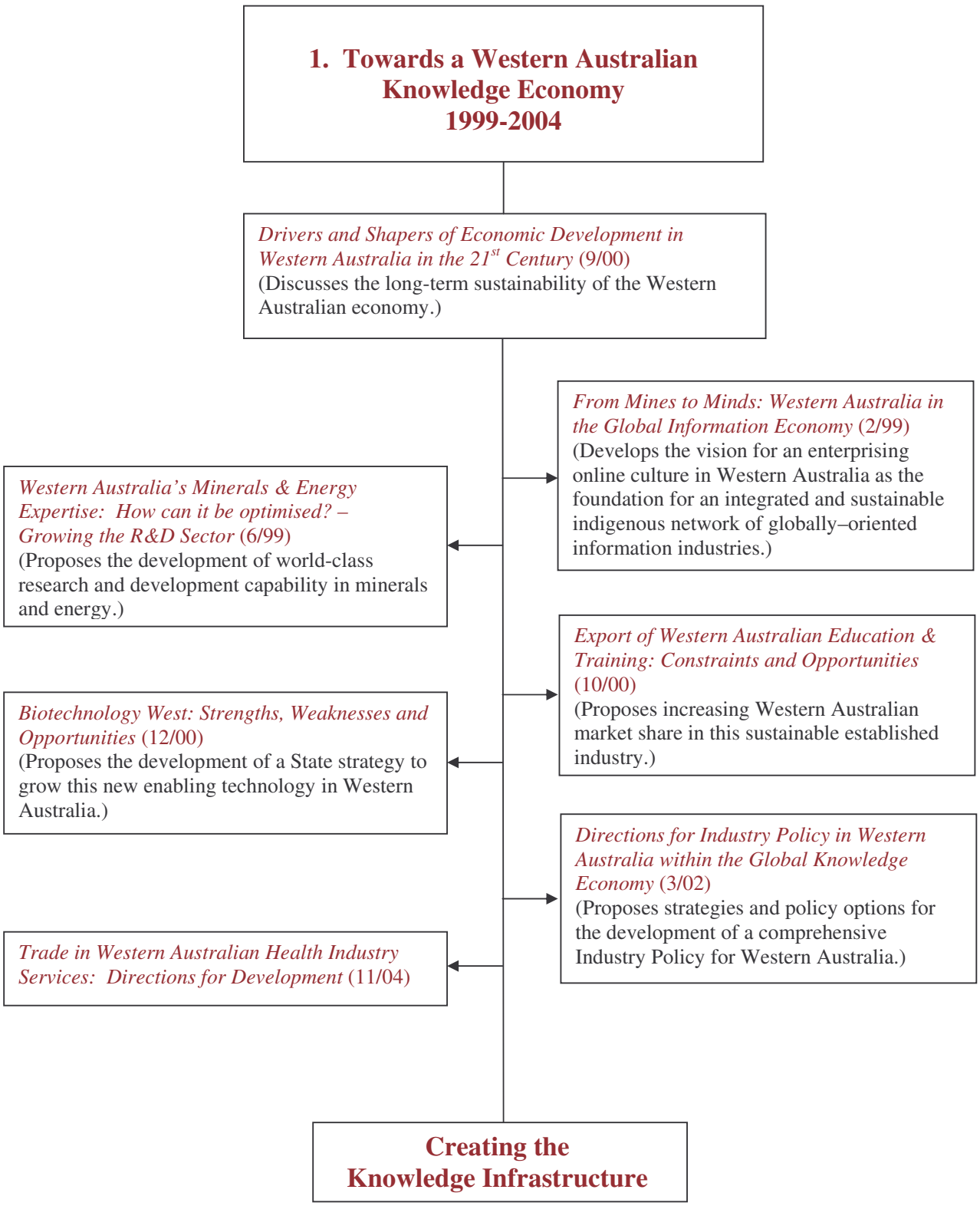
Ms Vivienne Snowden
Executive Consultant
Snowden

Professor Lance Twomey
formerly Vice Chancellor
Curtin University of Technology

C TIAC Themes and Published Reports

A diagrammatic summary of TIAC's series of reports under the theme, Towards a Western Australian Knowledge Economy, and details of subsequent themes, Creating the Knowledge Infrastructure 2002, and Driving the Knowledge Economy 2005, are provided on the following pages.





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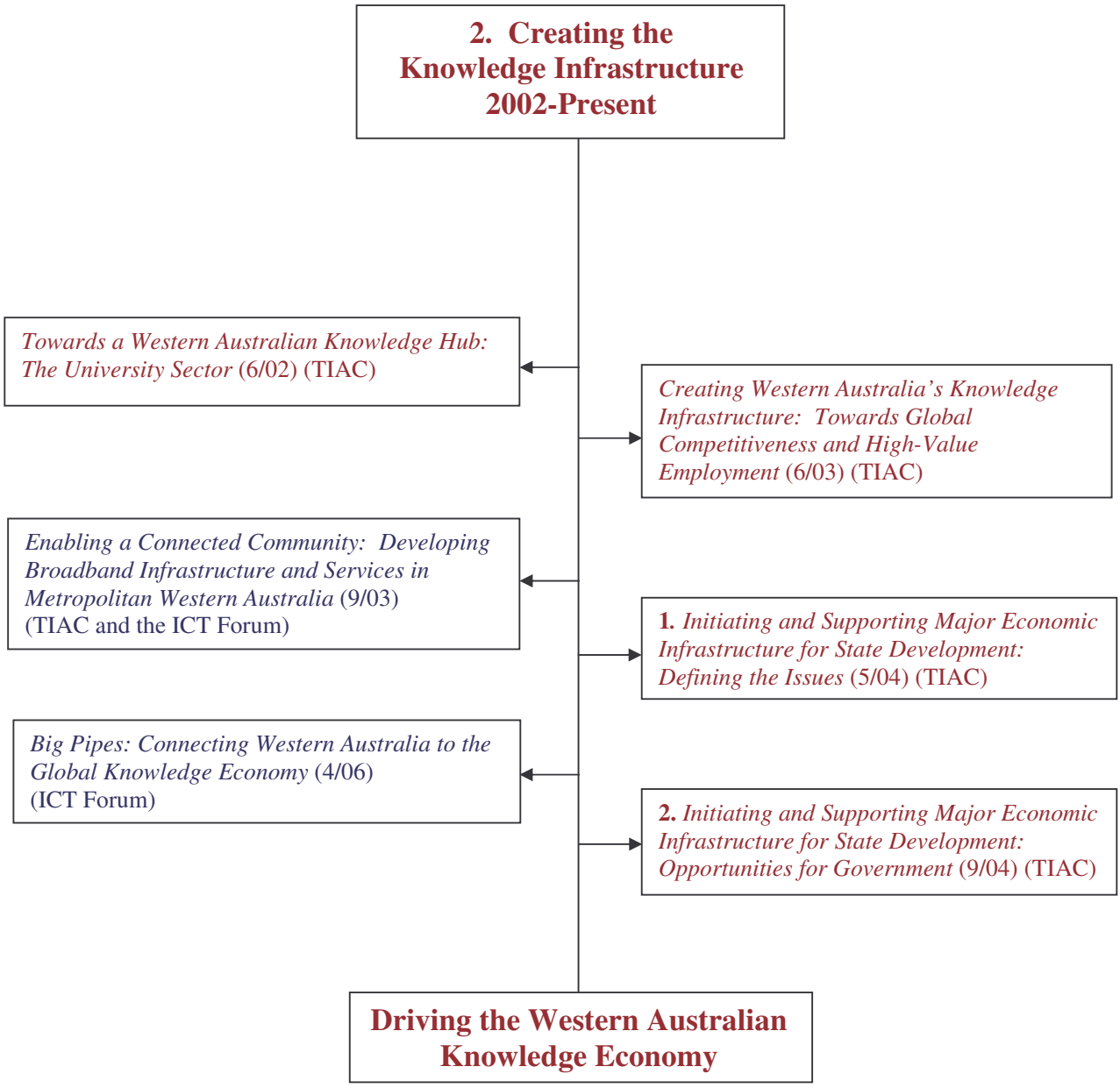

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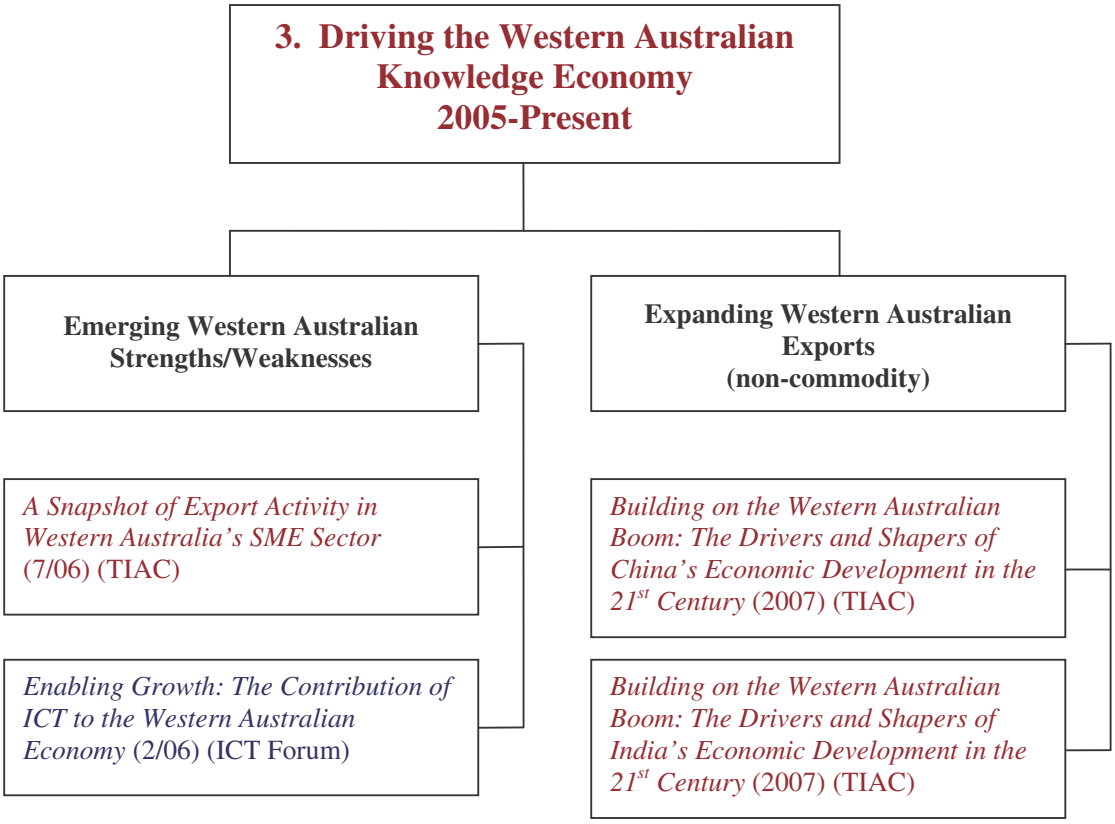

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Publications of TIAC 1988-2007

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Support for West Australian Software Industry	July 1988
New Challenges & Opportunities	July 1988
Technology Parks	July 1988
Intelligent Buildings: What role for the WA Government?	Sept 1988
US State Government Policies Designed to Encourage the Commercialisation of New Ideas: Some Recommendations for WA	Sept 1988
WA Software Industry (Second Report)	Oct 1988
An Industrial Science Policy for Western Australia: Some Seed Ideas	Oct 1988
Towards a West Australian Science Policy for the 1990's	Nov 1988
Inquiry into Venture Capital in Western Australia	Mar 1989
The Case for a New Branch of Manufacturing to Provide Smart Equipment for the Mining Industry	Mar 1990
The Export Debate	May 1990
Tomorrow's People in Science & Technology	Mar 1991
Bentley Technology Precinct: An Exploratory Study	Sept 1992
The Western Australian Technology School of the Future: A Feasibility Study	Oct 1992
Capturing Opportunities in Asia with Western Australian Science & Technology	Nov 1992
Telecommuting 2000: Making the Future Work for Western Australia	Dec 1992
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R&D and the State's Economic Development: What is the best fit?	Apr 1994
Medical Research Infrastructure Funding in Western Australia	Apr 1995
Towards an Information Infrastructure Policy for Western Australia – the Business Aspect	Feb 1996
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Telecommunications Deregulation – Is Western Australia Prepared?	Dec 1996
Western Australia's Minerals and Energy Expertise: How can it be optimised? – Defining the Issues – A Background Paper	Sept 1997
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Publications of TIAC 1988-2007 (Cont'd)

Publication Title	Date
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