

**Western Australian**

**Technology & Industry**

**Advisory Council**

**Annual Activity Report**

**July 1999 – June 2000**



WESTERN AUSTRALIAN  
TECHNOLOGY & INDUSTRY ADVISORY COUNCIL



WESTERN AUSTRALIAN  
TECHNOLOGY & INDUSTRY ADVISORY COUNCIL

## **ANNUAL ACTIVITY REPORT**

**July 1999 - June 2000**



WESTERN AUSTRALIAN  
TECHNOLOGY & INDUSTRY ADVISORY COUNCIL

Hon Hendy Cowan MLA  
Minister for Commerce and Trade;  
Regional Development; Small Business  
Parliament House  
PERTH WA

Dear Minister

On behalf of Council I am pleased to submit the Annual Activity Report for the Western Australian Technology and Industry Advisory Council (TIAC) for the year ending 30 June 2000, for your information, and subsequent presentation to Parliament in accordance with Section 26 (1) and Section 26 (2) of the Industry and Technology Development Act 1998.

Council has also reported through the Department of Commerce and Trade's Annual Report and Financial Statement in accordance with Section 26 (3) of the Industry and Technology Development Act 1998 in compliance with Section 62 of the Financial Administration and Audit Act 1985.

Council acknowledges the valuable support given to TIAC by both your office and the Department of Commerce and Trade.

Yours sincerely

□

**JOHN THOMPSON**  
**CHAIRMAN**

1 July 2000

For and on behalf of Council Members:

Mr Rex Baker  
Dr Lesley Borowitzka  
Ms Leslie Chalmers  
Mr Robert Meecham

Mr Richard Muirhead  
Mr Paul Piercy  
Dr Nigel Radford  
Mr Bruce Sutherland

Prof Tony Tate  
Prof Lance Twomey  
Mr Lloyd Zampatti

# TABLE OF CONTENTS

Letter of Transmission	.....	
1	Introduction	..... 1
2	Objectives of the Industry and Technology Development Act 1998	..... 1
3	Functions of the Western Australian Technology and Industry Advisory Council	..... 2
4	Outcomes	..... 2
5	Financial Provisions	..... 5
6	Members' Remuneration	..... 5
7	Executive Staff	..... 5
8	Financial Statement	..... 6
9	Outlook for 1999 - 2000	..... 6

**APPENDIX 1 Summary and Recommendations of TIAC Report:**

**“The Drivers and Shapers of Economic Development in Western  
Australia in the 21<sup>st</sup> Century”**

**APPENDIX 2 Summary and Recommendations of TIAC Report:**

**“Technology, Skills and the Changing Nature of Work”**

**APPENDIX 3 Council Membership**

**APPENDIX 4 Publications of TIAC 1988 – 2000**

## **1 Introduction**

The Technology and 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. A list of members is provided in Appendix 3.

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 Commerce and Trade under Section 26 (3) of the Industry and Technology Development Act 1998.

## **2 Objectives of the Industry and Technology Development Act 1998**

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

- 1 to promote and foster the growth and development of industry, trade, science, technology and research in the State;
- 2 to improve the efficiency of State industry and its ability to compete internationally;
- 3 to encourage the establishment of new industry in the State;
- 4 to encourage the broadening of the industrial base of the State; and
- 5 to promote an environment which supports the development of industry, science and technology and the emergence of internationally competitive industries in the State.

### **3 Functions of the Western Australian Technology and Industry Advisory Council**

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

- 1 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; and
- 2 carry out, collaborate in or produce research, studies or investigations on any matter relating to the objects of this Act, including matters relating to -
  - a) the role of industry, science and technology in the policies of government;
  - b) the social and economic impact of industrial and technological change;
  - c) employment and training needs and opportunities relating to industrial, scientific and technological activities in the State;
  - d) the adequacy of, priorities among and co-ordination of, scientific, industrial and technological activities in the State;
  - e) methods of stimulating desirable industrial and technological advances in the State;
  - f) the application of industrial, scientific and technological advances to the services of the Government; and
  - g) the promotion of public awareness and understanding of development in industry, science and technology.

### **4 Outcomes**

Council's functions are divided into two areas:

#### **1 Provision of Ministerial Advice**

The advisory role to the Minister on the objectives of the Act and the encouragement, promotion and use of technology in the State, centres around three key activities:

- a) the development of reports on issues pertaining to the Act and the role of science industry and technology development in the State. Council's reports are subjected to a public consultation phase before recommendations are submitted to the Minister;

- b) the analysis of reports written or commissioned by various national and international technology and economic development focused organisations and when appropriate, the submission of recommendations to the Minister on strategies relevant to Western Australia; and
- c) Council's participation on various State advisory and funding committees or councils.

**Report Activity (July 1999 - June 2000)**

In its advisory role to the Minister, Council has:

- a) completed a background paper entitled “In an International Context: Is there a case for positive assistance programmes, within an industry policy framework, for the Western Australian Manufacturing Industry?”. This paper was provided to the Department for its consideration in developing an industry policy for the State.
- b) completed a discussion paper entitled “The Drivers and Shapers of Economic Development in Western Australian in the 21<sup>st</sup> Century”. It is planned to launch this report for public consultation in September 2000.
- c) commenced a report entitled “Export of Western Australian Education and Training: Constraints and Opportunities”. The launch of the report for public consultation is planned for October 2000.
- d) commenced a report entitled “Biotechnology West: Strengths, Weaknesses and Opportunities”. It is planned to launch this report for public consultation in November 2000.

Copies of TIAC's reports are available in the Parliamentary Library, State Library, the universities' libraries and on the Internet at [www.wa.gov.au/tiac](http://www.wa.gov.au/tiac).

A copy of the Executive Summary of “The Drivers and Shapers of Economic Development in Western Australia in the 21<sup>st</sup> Century” is detailed later in this report.

**Participation on State Advisory and Funding Committees and Councils**

Council has accepted invitations for representation and participated in:

- a) the State's Co-ordination Committee on Science and Technology;
- b) the Steering Committee for the CSIRO National Centre for Petroleum and Mineral Resources Research;
- c) the “State Funding Advisory Committee” (SFAC);
- d) the State's “Information and Communications Policy Advisory Council” (ICPAC);

**Annual Activity Report  
July 1999 – June 2000**

- e) the Department of Commerce and Trade's "Technology Operations Group" (TECHOP);
- f) the Department of Commerce and Trade's "Enabling Technologies Reference Group";
- g) the Federal Government's "Commonwealth, State and Territory Advisory Council on Innovation".

**2 Promotion and Public Awareness Raising Activities**

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

- a) the 2020 Breakfast Seminars, which are short, economic development focused, information dissemination events; and
- b) the Science and Technology Forums which were established under the State's Science and Technology Policy in April 1997 in order to "raise the awareness of science and technology in the community and increase the community's input in the State's directions in Science and Technology".

**2020 Breakfast Seminars**

One 2020 Breakfast Seminar was conducted in 1999-2000 focussing on Y2K issues. It was entitled "If bitten...Remedial Care for Millennium Bug Bites – The First Five Days". Conducted in December 1999, the emphasis of the seminar was on follow-up actions a company could take to minimise legal obligations if it experienced Y2K problems in its computer systems.

**Science and Technology Forum Activities**

In fulfilling its Science and Technology Forum requirements under the State's Science and Technology Policy, TIAC:

- a) conducted Science and Technology Forums in the regional centres of Carnarvon and Broome. These Forums completed a series of 10 Forums conducted under the theme of "Technology, Skills and the Changing Nature of Work". A report on this series was distributed to the Regional Development Commissions and every participant in the Forums.

A copy of the Executive Summary of this document is detailed later in this report.

- b) co-operated with the Science Teachers Association of Western Australia (STAWA) Science Talent Search to develop the "Science and Technology Forum Website Competition". Websites developed by the winners of these competitions may be viewed at [www.wa.gov.au/tiac](http://www.wa.gov.au/tiac).



- c) launched through the Telecentre Network, its video production of “Hollywood meets the Labcoats”.
- d) participated, through the Science and Technology Forum programme, in the statewide “Bush to Beach” Science Quiz Night by supporting the publication and printing activities of this Science Week 2000 event.

## **5 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.

The 1999-2000 Budget was \$314,000.00 with an additional \$80,000.00 specifically allocated for the conduct of Science and Technology Forums under Objective 3 of the State’s Science and Technology Policy.

## **6 Member’s Remuneration**

Council member’s remuneration and allowances are determined under Section 24 of the Technology and Industry Development Act 1998 resulting in:

1	Chairperson’s Salary	\$40,000.00 (per annum)
2	Members Sitting fee – Non-Public Sector	
	Council Meetings	\$800.00 (per meeting)
	Other Meetings	Nil
3	Members Sitting Fee – Public Sector	
	Council Meetings	Nil
	Other Meetings	Nil

Council conducted 10 Board meetings, 17 Steering Committee meetings for the planning and developments of its reports, two Science and Technology Forums and one 2020 Breakfast seminar and participated in 19 meetings of other funding and advisory committees and councils.

## **7 Executive Staff**

Council is provided with a full time executive staff of two officers seconded from the Department of Commerce and Trade. The current Executive Officer is Mr Earl White.

## **8 Financial Statement**

TIAC reports under the Financial Administration and Audit Act 1985 through the Department of Commerce and Trade’s Annual Report and Financial Statement.

## **9 Outlook for 2000 - 2001**

Council's activities for 2000-2001 are grouped into two areas:

- 1 The development of reports with working titles:
  - a) "Towards a Western Australian Knowledge Hub: The University Sector";
  - b) "Business Formation in the New Economy";
  - c) "The Oil and Gas Industry: Developing the Potential for WA Industry to Supply Scientific Services";
  - d) "Natural Resource Management through the Application of Science and Technology".

and the completion of:

  - a) the report titled "Export of Western Australian Education and Training: Constraints and Opportunities"; and
  - b) the report titled "Biotechnology West: Strengths, Weaknesses and Opportunities".
- 2 The commencement of a new series of regional Science and Technology Forum programmes under a theme of "Biotechnology" or "Sustainable Development".

Opportunities to co-operate and leverage the Federal Government's Biotechnology Australia Regional Forum programme are being explored.



WESTERN AUSTRALIAN  
TECHNOLOGY & INDUSTRY ADVISORY COUNCIL

**Drivers and Shapers of Economic Development  
in Western Australia in the 21<sup>st</sup> Century**

**May 2000**

**(Foreword and Executive Summary)**

## **Table of Contents**

Foreword

Executive Summary	i
1 The Context of Development in the 21 <sup>st</sup> Century	1
1.1 Context of Development	1
1.2 Drivers and Shapers of Demand	6
2 Trade Patterns and Industrial Structure	9
2.1 Trade and its Structural Implications	9
3 Global Environmental Drivers	23
3.1 Global Climate Change	23
3.2 Sustainable Development	31
3.3 Implications for the Western Australian Economy	34
4 Demographic Trends and Changing Social Values	37
4.1 Demographic Trends	37
4.2 Social Values	42
5 Structure of Trade and Production: Implications and Responses	53
5.1 Implications for Western Australia	53
5.2 What Does the Future Hold?	57
5.3 Responses and Directions for Development	59
6 Environmental Drivers: Implications and Responses	74
6.1 Environmental Problems and their Potential Economic Impact	74
6.2 Policy Responses and their Potential Economic Impact	75
6.3 Dealing with Greenhouse and the Kyoto Protocol	77
6.4 Squaring the Circle on Greenhouse	79
6.5 Rethinking Western Australia's Economic Structure	85
7 Future Study Options	88
7.1 Diversification of the Economy	88
7.2 Environmental Issues	92
7.3 Broader Questions for Study	93

### **APPENDIX 1 – STEERING COMMITTEE AND CONSULTANT TEAM**

## Foreword

The last half of the century has seen massive changes in the global economy which have, in turn, driven transformations in the Western Australian economy. Some industries, like whaling, have disappeared. Others, like the wool industry, are shadows of their former glory. The resources boom and North West Shelf developments are among a range of new activities that have supported wealth creation over recent years, whilst the global information and communications technology revolution is enabling further change by transforming how business is conducted.

The 21<sup>st</sup> Century will bring with it new drivers and shapers of demand that will result in further changes to the Western Australian economy. In order to manage these forces we need to develop policies which address issues relating to the environment, sustainable development, global trading and competition, shifting patterns of demand, changes in demographics and in social values.

With this in mind, and in the context of globalisation and the emerging knowledge economy, TIAC has produced a discussion paper that seeks to identify and evaluate:

- the impacts on Western Australia of global trading patterns and the consequent structure of production in Western Australia;
- environmental drivers that will influence global economic development into the first quarter of the 21<sup>st</sup> Century;
- how the pursuit of sustainable development might affect future economic growth in Western Australia, given the pursuit of unsustainable development policies by competing economies; and
- the impact of demographic changes and changes in social values on the pace and direction of economic development in Western Australia over the coming decades.

This discussion paper is intended to provoke debate. We have sought to explore the likely positive and negative effects on industry in Western Australia, outline possible scenarios and responses and recommend options for future studies, which might assist the Western Australian Government to develop policy in order to optimise economic development in Western Australia over the next 25 years.

I would like to thank Professors Peter Sheehan and John Houghton from the Centre for Strategic Economic Studies (CSES), Victoria University, Professor Ron Johnston from the Australian Centre Innovation and International Competitiveness (ACIIC), Doctors John Phillimore and Dora Marinova from the Institute for Sustainability and Technology Policy (ISTP), Murdoch University, and Peter Morris from Telesis Communications for their help in undertaking research and analysis and in supporting the TIAC Steering Committee in the development of this paper.

Bruce Sutherland  
Chair, Steering Committee

## Executive Summary

### A Major Achievement

In 1962, the year in which the Australian Government lifted export controls on iron ore, the economy of Western Australia was a relatively backward one within the Australian Federation. Average living standards in Western Australia, as measured by per capita gross state product (GSP), amounted to only about 75 per cent of those in the rest of Australia. However, in a period of less than 40 years since that decision the economy of Western Australia has been transformed.

This remarkable transformation has above all been driven by export related activity in the resource industries. Agriculture and mining now account for over 20 per cent of GSP in Western Australia compared to less than 10 per cent in the other states, and a high proportion of output is exported. The State's growth has also been tied into the rapid expansion of East Asia over the last 30 years, with about 60 per cent of merchandise exports now going to East Asia.

### Another Turning Point

In spite of these impressive achievements, it seems clear that Western Australia is at another crucial turning point in its economic history. The world is changing rapidly. It is no longer the one in which Western Australia's recent growth was achieved, and the economy of the State will need to change equally rapidly. Indeed, if Western Australia is to maintain its high living standards, the State's economy may need to be transformed as much in the next 20 years as it has in the last 40.

This is because the world economy is undergoing a period of fundamental change – often referred to as the emergence of the global knowledge economy. It is likely that, looking back from 2050, the period from around 1985 to 2020 will be seen to represent as dramatic a change in human affairs as did the original Industrial Revolution. The joint forces of globalisation and the emergence of the knowledge-based economy are *driving* a transformation of the nature and structure of the world economy. Increasing national and international pressures to halt environmental degradation, long-term demographic trends, national and international market deregulation, the opening of trade in goods and services, and the advent of global e-commerce are among a range of factors *shaping* that process of change.

The consequences of these emerging trends are likely to be particularly acute for Western Australia, given the nature of the economy which has been built over the last 40 years and on which the State's prosperity currently depends. Western Australia certainly has both the opportunity and the vitality to achieve another transformation in its economic structure, but the issues must be addressed as a matter of urgency. In this discussion paper we examine the implications of global change for Western Australia and explore, at a broad strategic level, some of the options available to the State in developing a response.

## Three Key Challenges

When the economy of Western Australia is considered in the emerging global context, three challenges are most striking.

### 1. Structure of Trade and Production

As knowledge becomes increasingly embodied in goods and services, resources become relatively less important. Intense global competition in resource industries, and in the manufacturing industries which are their major markets, also contributes to pressure on prices, volumes and the terms of trade. Even for an economy with such a rich resource base as Western Australia's, heavy reliance on the resource industries is unlikely to provide a passport to prosperity in the emerging knowledge economy.

Western Australia is heavily dependent on commodity exports – with relatively low growth opportunities. The knowledge intensity of world trade is increasing – with high-technology manufactures and services offering higher growth potential than commodities. Western Australia also faces a significant exposure to greenhouse gas emission targets – with a large proportion of Western Australia's exports either carbon-based or produced by heavy users of greenhouse gas emitting fuels.

Western Australia's trade structure is suggestive of an economy competing mainly via exchange rates and wages, rather than through technology and innovation – with declining terms of trade and negative implications for employment and living standards. The structure of production in Western Australia reflects its resource dependence – with mining, construction, agriculture and energy highly represented; and manufacturing, finance and business services relatively thinly represented.

The structure of the Western Australian economy has a number of adverse implications. Outside mining there are relatively few innovating companies and few avenues for innovation. The industrial structure limits job creation opportunities. Apart from a few very large companies, firms are small in Western Australia, leading to lower levels of innovation, export activity and productivity. With a heavy reliance on foreign firms and on firms headquartered in the Eastern States, companies operating in Western Australia have limited mandates for action. They also have limited exporting experience – 86 per cent of Western Australia's merchandise exports come from the top 10 products and only about 4 per cent of firms export.

### 2. Climate Change and Sustainable Development

Global environmental drivers will be among the most significant factors shaping the development of Western Australia's economy and society over the next 10 to 20 years. Paramount among these will be global climate change, and the need to achieve or approach sustainable development. What may once have been dismissed as 'green' issues are now central to economic development. They are mainstream business issues.

## **Annual Activity Report July 1999 – June 2000**

The threat of global climate change through greenhouse gas emissions presents a major challenge. Predicted changes in temperature and sea level could have major consequences. The physical and biological impacts of global climate change are difficult enough to predict, but addressing the possible impacts of policy and regulatory responses flowing from the Kyoto Protocols is even more hazardous and uncertain.

In addition to the challenge of global climate change the pressure to achieve sustainable development is likely to be a major shaper of the Western Australian economy over the next 20 years. The adoption by Australia, along with another 178 governments, of a programme of action for sustainable development worldwide at the UN Conference on Environment and Development in 1992 (ie. *Agenda 21*) marks an international commitment. Increasing global pressures on Australia to reduce resource consumption and waste production are inevitable.

For Western Australia, as for other states in Australia, this is not just a global problem. The impact of human development on the local environment has also been significant, particularly in terms of land salinisation, the loss of biodiversity and the salinisation of inland waters. For example, it is estimated that 9 per cent of the State's agricultural land is affected by salinity, and this proportion is increasing. It could rise to 35 per cent before a new equilibrium is reached, if appropriate action is not taken.

The highest priority areas for Western Australia's sustainability can effectively be divided into three groups of issues: land and inland waters – the pollution of which is closely related to land degradation; the atmosphere – greenhouse and ozone depletion; and biodiversity.

### **3. Demographic Trends and Changing Social Values**

Attitudes and values are changing as the global village becomes a reality. The world economy is becoming more unequal, both within and between countries, but there is growing resistance to this trend as global communications make these changes more apparent to both the advantaged and disadvantaged. As the global economy becomes more polarised, many of those on high incomes seek improved quality of life, while others become more dissatisfied. As a consequence, both business migration and refugee flows are likely to grow – as may more direct expressions of dissatisfaction. There is also increasing emphasis on the treatment of disadvantaged groups, such as aboriginal people, and on the importance of environmental sustainability.

Demographic trends are very different in different regions. By 2025 over half the world's population will live in a dozen Asian countries, while Western Australia will have fewer than three million people occupying more than 40 per cent of Australia's land mass. How Western Australia is positioned in this emerging world – in terms of population growth, migration, integration with Asia, and the role of aboriginal people – will be an important determinant of its future prosperity.

Social values will also be an important shaper of development. Attitudes to globalisation, the environment, green production, genetic modification, increasing inequality, isolation, rural and regional development can all make or break even the most carefully thought through development strategies. Mobilising broad coalitions of support and staying one step ahead of suddenly emerging latent issues will be essential ingredients for success.



## Responding to the New Economic Context

Each of these issues represents a fundamental challenge for Australia as a whole. But in Western Australia they are especially serious, for Western Australia shows the national characteristics which give rise to them in a most acute form.

The Western Australian economy is the most heavily resource dependent of all the States. It generates much more than its 'national share' (by GDP) of greenhouse gases. The State's environment is seriously damaged, in some respects more so than in other parts of Australia, and is in many cases more fragile. Given its size, natural endowments, export orientation and proximity to Asia, Western Australia exemplifies to an acute degree the broader issue of Australia's role in a world of changing demographics and social values. But the State also exemplifies those strengths – openness to the world, to new ideas and to emerging technologies; an innovative self-reliant tradition and a willingness to embrace change – which the nation as a whole brings to the challenge of the new global economy.

Thus, how Western Australia responds will be of great importance not only for the State but also for Australia as a whole. This leading role provides real opportunities for the State. By being forced to take early and vigorous action, Western Australia can gain the 'first mover' advantages which can accrue from a prompt response to emerging realities. On the other hand, failure to act decisively may have much greater long-term costs in Western Australia than in other regions.

In this discussion paper we seek to explore some of the strategic options available to the Government and people of Western Australia in coming to terms with these three challenges. Some of our conclusions about these options are summarised below.

### 1. Structural Change and Economic Diversity

As documented in the body of this discussion paper, the structure of the Western Australian economy has a number of adverse characteristics. Most importantly, Western Australia's economy is heavily resource dependent, with long run declining terms of trade that will make it increasingly difficult to maintain, let alone enhance, prosperity. Structural change, building on strengths and increasing diversity will be essential ingredients for further economic development into the 21<sup>st</sup> Century.

Thus a central goal of policy in Western Australia over the next decade or so should be to build a much more diversified economy, with growing capabilities in areas which will thrive in the global knowledge economy. There appear to be many opportunities to do this by, for example:

- *Identifying and building on existing strengths* in engineering and technical services, wine and related lifestyle developments, remote sensing and mapping, shipbuilding and marine engineering, information technology, education and health services;
- *Identifying and pursuing amenity driven development*, such as lifestyle, location and knowledge economy investments, tourism and eco-tourism;
- *Identifying and further developing time zone related opportunities*, by encouraging the operations of global business in the East Asian time zone to locate in Western Australia, Western Australian businesses to operate in those markets, and the intensification of the whole range of trade and services activities;

## Annual Activity Report July 1999 – June 2000

- *Developing environmental industries*, and the production and processing of clean, green food and other products; and
- *Identifying and exploiting emerging technologies*, such as e-commerce and the Internet, biotechnology, nanotechnology, microproducts, new materials and rare earths.

Some of these areas of opportunity for economic diversification are already the subject of Government strategies, but the rapid emergence of the knowledge economy, the consequent need for structural change and the potential significance of environmental drivers suggest that accelerated efforts to broaden the structure of the Western Australian economy are likely to be necessary.

### 2. The Environmental Challenge

The pursuit of sustainable development provides fundamental challenges to the future potential and direction of Western Australia's development. The State needs to ask some hard questions about what it thinks is possible, and desirable, as well as what it thinks is probable at the international level in greenhouse/global warming negotiations.

In both its global and local dimensions, the degradation of the environment will provide a make-or-break challenge for Western Australia over the coming decades. Indeed, as noted above, this challenge arises directly from the very nature of the State's success over the last 40 years, founded as it was on the growth of energy intensive industries and on more extensive use of the land. Both changing realities, such as increasing signs of global warming and growing degradation within the State, and changing values both at home and abroad mean that this challenge cannot be avoided.

The options available to Western Australia in responding to this challenge depend heavily on the national and international responses to the Kyoto Protocol, and on the stance the Western Australian Government itself takes to this agreement. The Kyoto Protocol represents a far from optimal response to the problem of global warming, its deficiencies being particularly relevant to the position of Western Australia. Nevertheless, given the growing awareness around the world of the reality of global warming, it is quite likely that the Kyoto Protocol, and successor agreements, will indeed be enforced.

From an environmental perspective, the deficiencies of the Kyoto Protocol derive from two aspects. One is that the greenhouse gas emissions (GHGE) targets relate to emissions resulting from productive activities within a country, rather than to the more fundamental issue of the level of emissions implicit in the country's consumption patterns (ie. are production-based rather than consumption-based). The other is that, for historical reasons, they relate only to developed countries (ie. Annex 1 countries).

Taken together, these aspects imply – to the extent the targets are met by shifting production to other countries, rather than by changing consumption patterns or improving the environmental efficiency of production – that no reduction in global emissions need occur from the achievement of the Kyoto targets. Indeed, in some cases production in the new country (an Annex 2 country) may generate more emissions than would be the case were production allowed to continue in the old country (an Annex 1 country), thereby worsening the global environmental problem that they are supposed to alleviate. This deficiency may be particularly relevant for Western Australia, which could come under pressure to close, or not to permit the expansion of, plants which are the most efficient, in environmental terms, of their type in the world.

In responding to the two issues – increasing signs of global warming and environmental degradation within the State – there are a number of paths that the State might take. Three such paths are distinguished in this discussion paper.

*(i) Business as Usual, with Some Adjustments*

In a modern democracy faced with major economic change, the initial reaction is nearly always inertia, combined with responses more or less at the margin. This is a likely response in Western Australia also. Uncertainty about climate change projections, and conflicting scientific views, provide some justification for delaying major immediate action.

Many businesses in Western Australia have become environmentally efficient, and many valuable environmental programmes are in place. Some international companies operating in Western Australia have achieved international best practice in environmental terms, and there is pressure on others to follow suit. Issues of salinity have been the subject of much discussion, and substantial plans to address salinity are underway. Programmes to address biodiversity, river pollution and other issues are all underway or under development.

These programmes are important, but in our view not adequate to the scale of the problem. Even with enhanced programmes in a business as usual context, GHG emissions generated in Western Australia will continue to increase, salinity will be a growing economic problem, biodiversity will decline further and pollution of ground water will probably increase. What is needed is a strategic, structural approach to change, not more of the same.

*(ii) Forced Adjustment to Kyoto Targets*

The future is difficult to predict, and it may be the case that business as usual, with adjustments, might be sufficient for Western Australia to get through in terms of climate change, if not for the environment more generally. But it is more likely that the reality of global warming, and the increasing determination of many individuals and countries to ensure that it is addressed, will force rapid adjustment in Australia to achieve the Kyoto targets. This could have a devastating effect on Western Australia.

Australia's Kyoto target is for GHG emissions to be no more than 8 per cent higher than 1990 levels by 2008-2012, and this target is regarded by many nations as a concessional one, agreed to reluctantly. But on current trends Australian emissions would be 28 per cent above 1990 levels by 2010, and increase 40 per cent in the energy sector. If Australia is forced even to approximate its Kyoto targets by 2010, much of the burden will inevitably fall on Western Australia – and on firms and industries which lie at the heart of the State's current prosperity. Thus global insistence on real responses to climate change hangs as a very real threat over the State's future, unless addressed by positive action.

*(iii) Environmental Excellence, with Growth in Best Practice Industries*

The principle behind the third path is that Western Australia pursues environmental leadership in all areas, not only in energy intensive industries but also in terms of land protection and reclamation, biodiversity and so on. But, as the environmentally best producer of products linked to GHG emissions, it would also seek to expand its share of global markets for such products.

## **Annual Activity Report July 1999 – June 2000**

Thus this option would involve:

- vigorous action to achieve and maintain environmental leadership in selected mining, resource and energy intensive industries (eg. phasing out of coal generation, extensive use of natural gas, and serious attention being given to the potential for the development of a hydrogen economy, etc.);
- continued expansion of high GHGE industries, but only where they are at world best practice in environmental terms;
- strong action on land salinisation, with a major sequestration programme; and
- heavy Government focus on advanced environmental programmes more generally – including a central focus on advanced environmental technologies and ‘green’ industries.

Because of continued expansion of GHG emission intensive industries, this option may not be consistent with meeting the Kyoto targets by 2010. But, if pursued in a sufficiently vigorous manner, it would be a responsible and defensible environmental strategy, contributing significantly to the reduction of global GHG emissions over the longer term.

### *(iv) Avenues for Investigation*

Fundamental issues concerning the State’s future are involved in determining which of these paths Western Australia should follow over the next decade. In the meantime, and as part of that consideration, there are several avenues for investigation that the State Government might consider. They include:

- looking urgently and seriously at the potential environmental and economic impact of climate change in Western Australia, and at the requirements of an adaptation strategy;
- investigating the potential for stricter and/or more imaginative application of Environmental Impact Assessment regulations relating to greenhouse gas emissions in major project approvals;
- investigating the potential for pushing the Commonwealth Government to consider seriously the establishment of a differentiated ‘bubble’ of GHGE targets between the Australian States, with due recognition being given to Western Australia’s greater dependence on GHGE;
- looking at a similar bubble philosophy within Western Australia, with attention to industry shares of GHGE;
- investigating more deeply the implications of the various flexibility mechanisms of the Kyoto Protocol with a view to educating Western Australian industry and influencing Australia’s negotiating position concerning these mechanisms;
- exploring the benefits of arguing strongly for ecological factors (rather than trade and development) to take priority in climate change negotiations, and for policy measures which ensure a better environmental outcome on a global basis in relation to GHGE;
- looking dispassionately at the relative merits of a global carbon tax or emissions trading scheme, compared to proposed flexibility mechanisms which may penalise energy efficient Annex 1 producers;

- considering the potential of the flexibility mechanisms from the point of view of technology transfer and economic diversification, rather than simply as carbon credit mechanisms;
- exploring in greater detail the potential of the hydrogen economy in Western Australia as a long-term option to the current GHG constrained minerals and processing activities; and
- analysing the potential for green industries and jobs in the Western Australian economy, particularly those with a GHGE benefit.

### 3. Western Australia in the World of the New Millennium

Like Australia as a whole, Western Australia enters the new millennium as a small, rich society occupying a vast land mass within reasonable proximity of half of the world's population. The world of which it is part is being globalised, is undergoing very rapid technological change and is becoming increasingly unequal, both within and between nations. With such massive change comes realignment in social structures and values: the decline of family structures, awareness of different lifestyles, increased mobility, greater individualism, reduced willingness to tolerate unacceptable outcomes, and so on.

It is not possible to respond to the emerging global knowledge economy without being aware of, and also responding to, the changes in social structures and in values that it carries with it. The new technologies may themselves provide a central means of providing this response. In the case of Western Australia, particularly important issues include:

- the integration of various groups within society – rural and city, indigenous and non-indigenous, young and old – into genuine participation in the emerging economy;
- the development of forms of integration with Asia which make use of the State's skills and resources to contribute to Asian development, while preserving the State's integrity;
- the development of an acceptable basis for increased migration to Western Australia, striking an agreed balance between different types of migrants – lifestyle and knowledge workers, business migrants, family reunion and refugees – and securing the environmental base for an increased population; and
- the creation of coalitions of support, which bring together different social and geographical groups, for the changes which Western Australia faces.

It is impossible to predict how Western Australia, or indeed Australia as a whole, will be placed in the global knowledge economy of 2025. But what is clear is that the technological and commercial challenges cannot be addressed in isolation from changing social structures and value systems. For example, strong and demonstrable progress in terms of the economic position of aboriginal people will be necessary if Western Australia is to have a secure place in the economy of the 21<sup>st</sup> Century.

### Future Study Options

In addition to the specific study questions outlined above, there are a number of broader issues that require greater understanding if we are to develop an integrated, long-term strategy. We need:

## **Annual Activity Report July 1999 – June 2000**

- Greater understanding of the mechanisms for, and implications of, shifting the structure of production in Western Australia towards higher growth, higher value-adding activities, be it through building on history and strengths or developing new activities from scratch.
- Greater understanding of regional inequality, exploring its dynamics, causes and possible solutions.
- Greater understanding of the mobility of human capital, including the importance of lifestyle for location, services ‘trade’ by telecommuting, and fly-in/fly-out employment.
- Greater appreciation of the real opportunities available to Western Australia through increased linkages, cooperation and partnering with Asian countries (esp. China), and of the potential risks involved.
- Greater understanding of the importance and current effectiveness of local, state, national and sectoral innovation systems – focusing on potential mechanisms for building institutions, capabilities, organisations and linkages.
- Greater understanding of the nature of the current phase of globalisation, and the implications of investment location decisions, global competition and the death of distance.
- Greater understanding of education and skills development needs for the knowledge-based economy.
- Greater understanding and awareness of emerging business models for the knowledge economy.

All provide fertile ground for further study, and the opportunity to develop greater understanding of the dynamics and wealth creating potential of the emerging global knowledge-based economy in the 21<sup>st</sup> Century.

## **Conclusion**

The central argument of this discussion paper is that Western Australia is at a critical point in its economic history, arising from the unsustainability of its historic pattern of development in the global knowledge economy. Three issues – the narrowness of the State’s economic structure, the inevitability of responses to climate change and to environmental degradation, and the challenge of changing social structures and value systems – drive the need for urgent action. In these ways Western Australia exemplifies in an acute form the challenges facing Australia as a whole.

This is meant to be a realistic but not a pessimistic message. The issues facing Western Australia are indeed serious, as is the need for a profound change in economic structure. Failure to act quickly and on an adequate scale may have very adverse consequences. But every nation and region has to find its own way of adjusting to the ‘brave new world’ of knowledge intensity, globalisation and environmental sustainability. Given the State’s assets – its rich human and physical resources, vitality and openness to change – Western Australia remains a privileged place from which to address that common challenge.



# **Technology, Skills and the Changing Nature of Work**

**A Report by**

**Professor Ron Johnston FTSE, Executive Director  
Australian Centre for Innovation  
University of Sydney**

**to the**

**Western Australian Technology & Industry Advisory Council  
(TIAC)**

**Based on a Series of Science and Technology Forums  
in the Regions of Western Australia 1998-99**

## **Table of Contents**

Preface		i
Executive Summary		ii
1	Science and Technology Forums	1
1.1	Introduction – The Technology & Industry Advisory Council	1
1.2	Objectives of the Industry & Technology Development Act 1998	1
1.3	Functions of the Western Australian Technology & Industry Advisory Council	1
2	Technology, Skills and the Changing Nature of Work – Issues Presented	3
2.1	The challenge of Employment	3
2.2	The Emergence of the Global Knowledge Economy	4
2.3	The Defining Features of the Global Knowledge Economy	6
2.4	The Changing Nature of Work	12
2.5	Changing Patters of Skill Demand	15
2.6	Implications for Policy	16
3	Technology, Skills and the Changing Nature of Work – The Regional Perspective	18
3.1	Introduction	18
3.2	Overseas Initiatives to address the Regional Perspective in the Global Knowledge Economy	19
3.3	Regional Development Policy in Western Australia	23
4	The Regional Forums	25
4.1	Metro Region, Perth, 26 May 1998	25
4.2	Mid West Region, Geraldton, 19 May 1998	29
4.3	South West Region, Bunbury, 20 May 1998	31
4.4	Peel Region, Mandurah, 12 October 1998	33
4.5	Goldfields-Esperance Region, Kalgoorlie, 13 October 1998	36
4.6	Pilbara Region, Karratha, 17 May 1999	38
4.7	Wheatbelt Region, Northam, 18 May 1999	41
4.8	Great Southern Region, Albany, 19 May 1999	43
4.9	Gascoyne Region, Carnarvon, 16 August 1999	46
4.10	Kimberley Region, Broome, 17 August 1999	49
5	Conclusions	52
5.1	The Central Role of Community Cohesion	52
5.2	Connectivity and the Electronic Infrastructure	52
5.3	Knowledge Enablers	53
5.4	Enhancing Learning Capacity	54
5.5	Technologies for Economic Growth – Biotechnology and Natural Resource Management Technology	54
	<b>APPENDIX 1 – SCIENCE &amp; TECHNOLOGY FORUM PARTICIPANTS</b>	<b>56</b>



## Preface

It is almost 5am, barely a glimmer in the sky, and most of Perth still sleeping soundly. But as you get closer to the airport the pace increases. The roar of warming aero engines, the pungent smell of aviation fuel, signal that the giant and far-flung economy of Western Australia is stirring into renewed life on a gargantuan scale.

At 0530 its departure time for the Pilbara mining towns of Newman and Paraburdoo.

At 0540, early morning tourists, pastoralists, pearlers and cotton growers leave for the Kimberleys - Broome, Derby and Kununurra.

At 0600 it is the closer gold mining destinations – Kalgoorlie, Leonora, Laverton and Leinster to the west, Mt Magnet, Meekatharra and Wiluna to the north.

At 0620, it's to the gas fields off Exmouth and Karratha, and the agricultural regions in the south at Albany and Esperance.

By 7am, calm has returned, interrupted only by the occasional interstate arrival. The vastly distributed economy of Western Australia is, once more, on the move.

It was to ascertain what were the aspirations of the people in this widely distributed economy that prompted the format and theme of this series of Science and Technology Forums.

How the people of this State decide to harness the appropriate technology and skills will in turn decide both the sustainability and continued growth of this economy. It was in this context that the Science and Technology Forums, with the support of the Regional Development Commissions, asked them to take time out to consider the issue of "Technology, Skills and the Changing Nature of Work".

## **Executive Summary**

This report is based on the one metropolitan and nine regional Science and Technology Forums that were conducted by TIAC under the theme of “Technology Skills and the Changing Nature of Work”.

The response to the regional Science and Technology Forums, in which a cross-section of the community participated, is evidence of the strong interest in regional development, and of the roles of science and technology in contributing to that development. The contributions of the participants reflect a high level of awareness of the changing economic environment, a strong desire to be able to access the new services, and recognition that changes are needed to address the new challenges.

### **The Emergence of the Global Knowledge Economy**

As the 20<sup>th</sup> Century draws to its close, the world economy is being reshaped in a fundamental manner as at no other time in human history. At the heart of these changes lie two related forces. One is the explosion and convergence of computing, communications and media technologies. The other is the process of international deregulation.

While there are many inter-related characteristics of the global knowledge economy, three emerge as defining features: the *increased knowledge intensity* of the processes of creation, production and distribution of goods and services, the *increasing globalisation* of economic activity, and the *level of electronic connectivity*.

The changes which are beginning to emerge in the nature of work, in the arrangements within which work is undertaken, and in the skill requirements for successful involvement in the labour market, are comparable to those which took place during the early stages of the Industrial Revolution. The challenge is to create institutions and structures that allow individuals and communities to prosper while the benefits of economic change are realised.

Among the many complex developments three major trends in the organisation of work in the global knowledge economy can be distinguished. These are a shift in employment patterns by industry, a change in the type of firms providing employment, and the emergence of a new division of labour, in which a few work a great deal, and many work little.

In this context, the state of the telecommunications infrastructure is likely to be the most significant shaper of economic activity in the 21<sup>st</sup> Century. The emerging global knowledge economy will produce a new wave of disparities between the regions. It is clear the degree of ‘connectedness’ will have a big impact on the ability of a region to extract economic value, and receive services.

But it is precisely in regional and rural Australia that the potential of online services can have the greatest impact. Online services in rural Australia can build stronger local communities and provide a major boost to the competitiveness of rural industry. A capacity building approach may provide the most effective means for addressing the challenges of the global knowledge economy, in the context of regional development in Western Australia.

A **small number of themes** recurred through almost all the Forums, which also have a strong resonance with the analysis of the characteristics of the emerging global knowledge economy, and the changing skill and work requirements.

### **Community Cohesion and Leadership**

In every region, great emphasis was placed on developing a higher level of community cohesion about their future, and of the need for strong but appropriate leadership to achieve it. The development of a stronger capacity in the regions to pursue these objectives would appear to be important.

One important challenge to address is the building of a higher level of self-reliance. Arguments along the lines of "it is the Government's responsibility" and "someone ought to invest in downstream processing" are still commonly heard. However, in the global knowledge economy, it is clear that the jobs, and economic rewards, are far more likely to be developed by small local companies that have developed a niche advantage, and are oriented towards competing, unassisted other than by their own capabilities, in taking it to the world.

### **Connectivity and the Electronic Infrastructure**

The central role of effective telecommunications infrastructure in surviving and thriving in the global knowledge economy is evident, and widely recognised in the regions. Issues of access, cost, reliability and adequacy of bandwidth were raised in every region. Beyond simple access, there are issues such as the potential of dramatically improving the delivery of government (and private) services to the regions and of reduction in isolation and increase in social amenity.

The establishment of 'Knowledge and Innovation' networks across the regions may assist in promoting this kind of future.

### **Knowledge Enablers**

The critical role of knowledge in the new economy is becoming increasingly understood. The traditional 'knowledge organisations' – universities and public research institutions, are largely concentrated in major cities, the consequence of historical decisions, access to infrastructure, and lifestyle choices of professional staff. However, the creative and effective use of the capacity for electronic communication can go a long way to overcome these traditional geographical limitations.

However, the creative and effective use of the capacity for electronic communication can go a long way to overcoming these traditional limitations. Moreover, it can provide the basis for an interaction between 'professional' and 'local' knowledge that can vastly improve the transfer of the professional knowledge into application, and the understanding and interpretation of local problems by the professionals. This can reduce two major blockages in the transformation of knowledge into outcomes.

## **Enhancing Learning Capacity**

The ability to learn, both individually and organisationally, is the central dynamic of a successful economy and society, particularly under the conditions of the global knowledge economy. This central role of learning is matched by a much enhanced capability to engage in, and to deliver learning. Electronic connectivity allows distance learning to become the norm, rather than the exception.

There is a substantial challenge to examine and evaluate all the logistic limitations on the delivery of education to determine the extent to which they can be overcome or reduced through electronic learning. This electronic learning also provides the basis for re-examining the structural educational assumptions that most learning should be provided in the early stages of life.

The increased access to educational material, and interest in learning, is providing a ready and willing market for learning at all ages. The infrastructure provided for youth learning is exactly what is required also for community learning, tourism learning, skill upgrade, and so on.

## **Technologies for Economic Growth**

In every region there was an awareness of, and a desire to engage in what was seen as technologies for future economic growth. Particular emphasis was placed on biotechnology applied to aquaculture and natural resource management. These technologies are classic examples of global knowledge-based industries.

Comparative advantages, however, will be found in better knowledge of all the aspects affecting the processes, and hence underpinning research, and high levels of training in all aspects of these industries. There is a firm belief that these technologies, along with information and communications technologies, can be used as 'enablers' for the development of a whole range of regional industries which in turn will provide economic sustainability to regional communities.

## Western Australian Technology and Industry Advisory Council Membership

□

<p><b><i>Mr John Thompson</i></b> <i>TIAC Chairman</i></p> <p>Managing Director Scientific Services Ltd</p>	<p><b><i>Mr Paul Piercy</i></b></p> <p>Managing Director WesTrac Equipment Pty Ltd</p>
<p><b><i>Mr Rex Baker</i></b></p> <p>General Manager Human Resources Alcoa of Australia Ltd</p>	<p><b><i>Dr Nigel Radford</i></b></p> <p>Chief Geochemist Normandy Group</p>
<p><b><i>Dr Lesley Borowitzka</i></b></p> <p>Manager Technical Marketing COGNIS</p>	<p><b><i>Mr Bruce Sutherland</i></b></p> <p>Managing Director Gunn Sutherland Corporate Pty Ltd</p>
<p><b><i>Ms Leslie Chalmers</i></b></p> <p>Senior Consultant Management Consulting Service PricewaterhouseCoopers</p>	<p><b><i>Professor Tony Tate</i></b></p> <p>Executive Dean Science and Engineering Murdoch University</p>
<p><b><i>Mr Rob Meecham</i></b></p> <p>Director of the Business Development Unit South Metropolitan of TAFE</p>	<p><b><i>Professor Lance Twomey</i></b></p> <p>Vice Chancellor Curtin University</p>
<p><b><i>Mr Richard Muirhead</i></b></p> <p>Chief Executive Officer Department of Commerce &amp; Trade</p>	<p><b><i>Mr Lloyd Zampatti</i></b></p> <p>Chairman Bretts Limited Group</p>

## APPENDIX 4

PUBLICATION TITLE	DATE
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	March 1989
The Case for a New Branch of Manufacturing to Provide <u>Smart</u> Equipment for the Mining Industry	March 1990
The Export Debate	May 1990
Tomorrow's People in Science & Technology	March 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
Telework 2000: Making the Future work for Western Australia	July 1993
R&D and the State's Economic Development: What is the best fit?	April 1994
Medical Research Infrastructure Funding in Western Australia	April 1995
Towards an Information Infrastructure Policy for Western Australia – the Business Aspect	Feb 1996
Financing Options for Regional Infrastructure in Western Australia	Nov 1996
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
Research & Development: Role of the State Government in attracting External Funding	May 1998
From Mines to Minds: Western Australia in the Global Information Economy	Feb 1999
Western Australia's Minerals and Energy Expertise: How can it be optimised? – <i>Growing the R&amp;D Sector</i>	June 1999
Technology, Skills and the Changing Nature of Work	April 2000
Drivers and Shapers of Economic Development in Western Australian in the 21 <sup>st</sup> Century	Sept 2000