



EcoInsights

Scenario Planning for Sustainable Land Use in the Namoi Catchment

ENVIRONMENTAL SCAN

Notes on some past, current and possibly-emerging
trends as source material for participants in the
Scenario Planning Workshops
October 2007 - June 2008

Steven Cork and Kate Delaney

September, 2007

TABLE OF CONTENTS

TABLE OF CONTENTS	2
INTRODUCTION	4
Aims of the scenario workshops	4
Links with Namoi 2030 Regional Resources Strategy.....	4
Purpose of this document.....	4
How the document is organised	5
Having your say	5
CATCHMENT FUTURES	6
Previous studies in the Namoi	6
Goulburn Broken catchment (Victoria)	7
Wet Tropics Nth Queensland	8
Avon catchment (Western Australia)	9
CSIRO Scenarios	9
Some global sustainability scenarios.....	10
SOCIETY	12
Cultural orientation towards future thinking	12
Demography.....	12
Aboriginal people in the Namoi	13
Generational change	14
Health and medicine	15
Diseases	16
The rich-poor divide	17
Ethics.....	17
Social wellbeing and happiness.....	17
From bush culture to coastal culture?	18
Urbanisation.....	18
The future of work	19
TECHNOLOGY	22
A technological tipping point?.....	22
Power and energy.....	23
Science and technology	25
Mobility (transport).....	26
ECONOMY	28
The "bottleneck"	28
Economy of the Namoi.....	28
Wealth generation	29
Food production	30
Tourism	33

Infrastructure	34
ENVIRONMENT	37
Biodiversity	37
Climate change	37
A World Environment Organisation?	40
Water scarcity	41
POLITICS AND GOVERNANCE	42
Politics	42
Geopolitics	44
New sources of conflict?	44
Governance	44
Global catchment alliances?	45
REFERENCES	46
APPENDIX 1: FORESEEABLE FUTURE SHOCKS	59
APPENDIX 2: CLIMATE TIPPING POINTS	62

INTRODUCTION

If you want to teach people a new way of thinking, don't bother to teach them. Instead, give them a tool, the use of which will lead to a new way of thinking."

- Buckminster Fuller¹

Aims of the scenario workshops

The Namoi scenario planning project aims to bring together key decision-makers and decision influencers to think deeply and broadly about the sorts of challenges and opportunities that the catchment and its people might face in the future. To do that, we need people with knowledge of decision-making processes, of the way the catchment works socially, politically, economically, and environmentally, and who are willing and able to take part in this sort of process.

You have been invited because you have those skills and have expressed willingness to take part. You don't need to have a huge amount of knowledge beyond what is already in your head, and we recognised that you don't have the time to acquire it. However there will be times during the process when you will want to delve into further information about relevant topics, and we will be encouraging you to think beyond the limits of what occupies your attention on a day to day basis.

Links with Namoi 2030 Regional Resources Strategy

The Namoi Scenario Planning project is intimately linked with the Namoi 2030 Regional Resources Strategy being implemented by Parsons Brinckerhoff, EDGE Land Planning and the Centre for Agriculture and Resource Economics (CARE). As part of the latter project, a discussion paper is being produced which will inform workshop participants of key strategic issues for the catchment, especially in the areas of:

- Agriculture
- Water resources
- Minerals
- Forestry
- Biodiversity
- Social issues

Therefore, this environmental scan a document will not address Namoi-specific issues in any depth.

Purpose of this document

This document has been developed as a source of ideas for you and, after this project, for decision-makers into the future. It does not attempt to be an exhaustive or comprehensive review of the literature, but rather to alert participants to doubt and opinions about trends that may exist or may be emerging in a range of areas that participants may not normally think about. As it can take up to 30 years for ideas and trends to be recognised by the scientific literature, politicians, the media, and other decision-influencers, if we were to focus simply on peer reviewed publications (for an example, from the scientific literature) we

Introduction

would miss many ideas and trends that could be major drivers of change over the next 30 years. The art of environmental scanning involves searching for ideas and trends in a range of places so that they can be detected early (see Gordon and Glenn² or Saffo³ for a further explanation of environmental scanning).

How the document is organised

One important role of futurists facilitating scenario planning projects is to encourage participants to think beyond the boundaries of the issues that confront them on a day to day basis. One simple acronym commonly used to remind people of the range of issues that might influence the future is STEEP (Social, Technological, Economic, Environmental, Political). This document begins with a brief summary of issues raised by other futures and strategic thinking projects in catchments around Australia and then summarises a range of global, national, and local issues under the headings of STEEP.

In addition, Appendix 1 lists a series of potential shocks that could hit Australia in the next few decades. Once a set of scenarios is developed, we consider what the impacts of these and other shocks might be in the different possible futures.

It is not expected that you read this whole document before the first workshop. We recommend that you scan through it to get a flavour for the information contained. You will find it useful to dip back into it at various stages in the workshops.

Having your say

We encourage participants in the workshops to contribute additional material to this document, which we will include in later versions as the scenario process unfolds. In this way decision-makers in the catchment will have a resource that they can refer to that will keep the scenario planning process alive beyond this immediate project.

CATCHMENTFUTURES

This section summarises some of the issues identified in scenario planning or other strategic thinking exercises in other catchments around Australia and in previous projects in the Namoi. We have not tried to be comprehensive, as many of the same issues recur in several reports.

Previous studies in the Namoi

Vision

The Namoi Catchment Management Authority has articulated the vision and action framework shown in Figure 1.

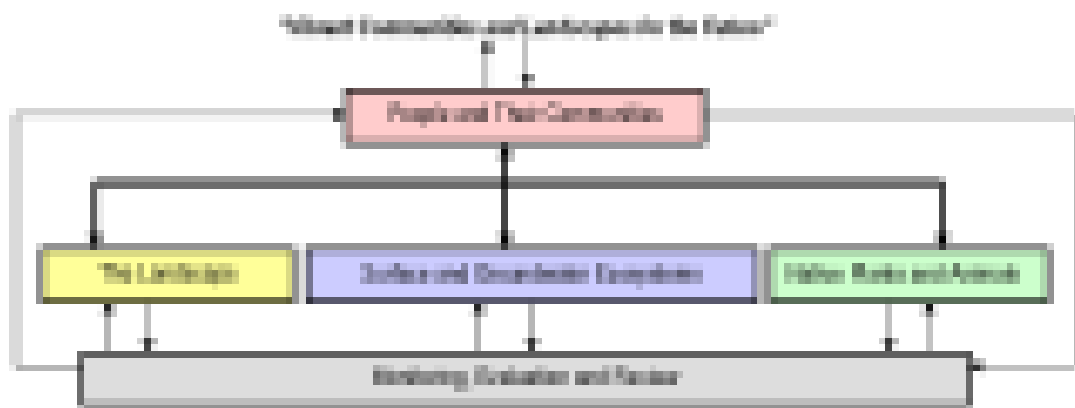


Figure 1: The Namoi Catchment Action Plan in a nutshell⁴

Key socio-economic groups

Key socio-economic groups identified in the Namoi Catchment Action Plan include⁴:

- Rural operators
- Business and industrial managers
- Urban and rural residential community
- Indigenous people (Kamilaroi people)
- Socially disadvantaged people

Key issues

Some of the key issues that have arisen from dialogue about the future in the Namoi catchment (summarised from the Catchment Action Plan)⁴ include:

- Improving the capacity of, and opportunities for, community members to participate in catchment planning
- Improving economic stability and well being of people in the catchment
- Maintaining and developing appropriate skills and knowledge for the future
- Maintaining landscape processes, including:

Catchment Futures

- Soils
- Geo-morphology
- Topography
- Surface and ground water
- Biodiversity and mineral resources
- Water, nutrient and energy cycling
- Habitat functions

Key resource issues

Initial environmental, social and economic impact analysis by the Namoi 2030 team identified the following key issues currently affecting the region:

- | | |
|--------------------------------|--|
| • Water quality | • Weak and sorghum |
| • Salinity | • Cotton farms |
| • Groundwater | • Cattle and feed lots |
| • Forests and biodiversity | • Cattle and sheep |
| • Road and rail infrastructure | • Economic development in towns and villages |
| • Mining | |

Goulburn Broken catchment (Victoria)

The key issues identified in four scenarios⁵ include:

- The cost price squeeze
- Pressure to increase farm size and invest in technology
- Lifestyle properties
- Clean and green food
- Unwillingness to pay for clean and green food
- Climate change (warmer and drier winters and hotter and wetter summers)
- New diseases of crops
- Genetically modified crops
- Privatisation of water delivery and infrastructure
- Phasing in of free trade agreements with the USA and ASEAN
- New export opportunities but also strong competition
- Niche bush products
- Communication technology
- Demographic and attitudinal change
- Amenity, environmental flows, and water quality
- Movement of people from urban areas to live in rural areas
- Government purchase of land for recreation, aesthetic and environmental purposes
- International conflict over oil
- Technological innovation
- Synthetic food products
- Limitations on energy supply
- Salinity and possible new desalination systems (for example solar powered ones)
- Rise of environmental issues in politics
- Decline in rural communities and economies
- Influence of multinationals

Catchment Futures

- Political change
- Developments with China
- Terrorism
- Decline in agricultural production
- Increased regulation
- Free trade agreements

In summary, stakeholders aspired to having a balanced social, economic and environment outcome, and to having active community participation in future decision making processes.

Four scenarios were developed:

Moving on. This scenario is based on the cost-price squeeze, increasing lifestyle properties, “clean-green” food, climate change, disease outbreaks, greater use of genetically modified (GM) varieties, privatisation of water delivery systems, free trade agreements with the US and ASEAN, and high quality “bush” niche products.

New frontiers. This scenario is based on communication technological developments, demographic and attitudinal changes leading to a new wave of exodus of urban population to live and work in rural areas. It considers amenity, including improved environmental flows and water quality, declining agricultural production, regulation, free trade agreements, climate changes and diseases.

Pendulum. This scenario considers a greening of government, environmental flows, water entitlements, decline in rural areas, unmatched expectations, reduced availability of water, influence of multinational monopolies of the food industry, major flooding events, and the influence of the growing Chinese economy.

Drying up. This scenario considers the influence if the war on terror expands, a major world recession, reduced exporting by Australia, some interesting impacts of the growth of the Chinese economy, severe drought, growing demand from affluent consumers for “natural” food. Australia is one of the few countries in the world which still largely remain GM-free.

Wet Tropics Nth Queensland

Issues of concern for the future included:

- Concepts of and attitudes to landscape management
- Changing visions for the future landscapes
- Whether current industries and land uses will persist into the future and for how long
- Diversification options
- Alternative land management practices
- Water quality and quantity
- Protection of the natural environment and landscape
- Tourism
- Rural residential development
- Localisation of food production
- Pollution
- Local employment opportunities
- Declining commodity prices;

The two major alternative visions were: (1) Diversified landscapes still retaining sugar cane and other existing industries; (2) Post sugar cane landscapes with very different land-uses to the present.

Catchment Futures

Avon catchment (Western Australia)

Twenty two critical drivers of change were identified⁶:

- Land
- Water
- Biodiversity
- Climate
- Demographics
- Plant production
- Animal production
- Manufacturers and other industries
- Minerals and energy
- Infrastructure
- Service industries
- Society and culture
- Policy+ Governance
- Perth - metro-centricity
- Emerging industries
- Tourism
- New large-scale industry
- Marketing the catchment
- Education
- Nature of work
- Alternate fuels
- Capacity Building

The most uncertain and important were: (1) Access to new markets, and (2) Environmental change.

These two clusters were used to define four plausible scenarios for the Basin:

1. SALINE GROWTH	2. GRAIN AND DRAIN
4. LANDCARE BOUNTY	3. HARMONY WITH PROSPERITY

CSIRO Scenarios

The following table and the one in the section after this are excerpts from "Thinking About the Future of Australia's Landscapes⁷ available on-line at:

http://downloads.lwa2.com/downloads/publications_pdf/PK040780_full_report.pdf

Table 1: Summary of uncertainties and insights from the CSIRO scenarios for land and water futures in Australia

Source	Uncertainties	Scenarios	Insights for NRM
Decision points for land and water futures ⁸	How Australia chooses to manage globalisation and intensification Changing perceptions of alternative values and uses of Australian landscapes How water is used	Water, water everywhere: dryland agriculture Give and take: irrigation Brave new regions: post agriculture	Land degradation can plausibly be slowed with a combination of better conservation practices, more intensive management of less land, and more efficient use of water for both industry and the environment. But the most optimistic outcomes involve reinvention of Australian agriculture based on understanding of how Australian ecosystems function and the development of new services and manufacturing industries.

Some global sustainability scenarios

Table 2: Summary of uncertainties and insights from several scenarios for Australia's future sustainability⁷.

Source	Uncertainties	Scenarios	Insights for NRM
⁹	How resilient are ecosystems? How will humans respond to the challenges of sustainable development?	FROG (First Raise Our Growth) GEO Polity Jazz	Markets are a potentially powerful way to achieve sustainability, but a narrow focus on economic growth is unbalanced and will not achieve sustainability without incorporating elements of cooperation and a greater inclusion of broader environmental and social values that are currently in evidence.
The Global Scenario Group ¹⁰	The adequacy of conventional policy reforms and markets to achieve equity and sustainability	Conventional worlds Barbarisation Great transition	This group argues that incremental policy change and market forces will not bring about equity and sustainability fast enough and that breakdown of social cohesion is more likely unless social and political attitudes towards the environment change drastically.
Alternative Futures and Policy ¹¹	Whether technological optimism is justified or not Whether technological optimists or sceptics dominate policy	"Star Trek" Big government "Mad Max" "Ecotopia"	Considering all plausible outcomes, the adverse consequences of assuming ecosystems are robust and that technology will be able to repair all essential services and being wrong are far greater than assuming fragility and managing to minimise environmental impacts.
Millennium Ecosystem Assessment ^{12 13}	Connectedness of the world Reactive versus proactive environmental policies	Global orchestration "TechnoGarden" Adapting mosaic Order from strength	Although the greatest economic, social and environmental problems are likely in a disconnected and environmentally reactive world, all other combinations of connectedness and focus on the environment can produce undesirable impacts on ecosystem services if we are not alert to the potential for adverse environmental feedbacks. It is important to understand the nature of interactions between alternative policy approaches and the types of ecological processes that could be overlooked and create problems. The relationship between ecosystem services and human well-being remains poorly understood but is a key to moving toward sustainable management.

SustainAbility¹⁴ employs a simple and familiar grid in which the environment wins or loses and society wins or loses (Table 3) and applies the metaphor of a card game seeking '21' for surviving the 21st century, without going "bust". They assume that current globalisation continues to at least 2010 after which the scenarios diverge according to nations' (and corporations') ability to balance their hand of social and environmental priorities, requiring entrepreneurship in both areas. Key drivers are demographics, new economic players, climate change, terrorism, disease outbreaks, resource availability. (see <http://www.sustainability.com/raising-our-game/>)

Catchment Futures

Table 3: SustainAbility (2007) Future Scenarios "Raising Our Game"

	Society loses	Society wins
Environment wins	Clubs - elites dominate access to resources using sustainability as an excuse to exclude, social tension, even insurrection, results from the unfairness.	Hearts - the Brundtland ideal, but rough in early years as global trade is lost (e.g. after a pandemic). Seeking shared solutions and inclusiveness. New Renaissance.
Environment loses	Diamonds - Western lifestyles spread. Ecosystems collapse under the demand. Decision-makers overwhelmed by new challenges and fearful. Creativity retreats.	Spades - Resources becoming priced out of reach but Governments not brave enough, soon enough, in seeking lifestyle sacrifices for the common good.

SOCIETY

If you want to know about your past, look at your present conditions. If you want to know about your future, look into your present actions.

- Buddhist saying¹⁵

Cultural orientation towards future thinking

The GLOBE project has investigated how cultures vary in relation to a set of factors important to organizational management and leadership, by surveying over 17,000 middle managers in 61 societies over the past 15 years¹⁶. It revealed clear differences in 19 key areas, including “future orientation” (the extent to which a culture encourages and rewards such behaviour as delaying gratification, planning, and investing in the future) (Figure 2). It also suggested that the greater a society’s future orientation, the higher its average GDP per capita and its levels of innovativeness, happiness, confidence, and competitiveness.



Figure 2: Future orientation of countries versus their competitiveness as measured by the World Economic Forum 1998-2005¹⁶

As discussed later in this document, there are a range of other views about drivers of happiness and satisfaction in society, so this study should not be seen as definitive in this area.

Demography

Population is generally considered a reliable factor of change. However, over long time periods it may not be wise to trust population projections in the same way that you might over

Catchment Futures

forecasts for only a decade. In the mid-1970's the world's population growth was considered 'exponential'; demographic models lead many analysts to argue about resources depletion and the population 'explosion.' It has been argued that long term demographic models from the UN have previously over or underestimated growth¹⁷. Nonetheless, many people base their long term decision making on population projections.

Global population ageing is unprecedented¹⁸. The planet's population continues to explode: from 1 billion in 1820, to 2 billion in 1930, 3 billion in 1960, 4 billion in 1974, 5 billion in 1988, and 6 billion in 2000. Population ageing results mainly from reductions of fertility that have become universal. Globally, the proportion of older persons has been growing steadily. It is expected to reach 22 per cent in 2050 and to exceed the number of children for the first time in 2047. (In the more developed regions, the number of children dropped below that of older persons in 1998).

The United States is one of the few western countries still growing (mainly through immigration). There will be 400 million Americans in 2043, climbing to 420 million by mid-century. The US will be on the verge of becoming a "majority of minorities"¹⁹.

Ageing has major consequences and implications for economies (economic growth, savings, investment, consumption, labour markets, pensions, taxation and intergenerational transfers); social systems (family composition, living arrangements, housing demand, migration trends, and epidemiology and health-care services) and political systems (voting patterns and political representation).

- Harvard economists David Bloom and David Canning attribute at least one-third of a nation's economic success to the dependency ratio^{20, 21}. For example, they credit Ireland's economic success in part to a greatly-improved dependency ratio along with other more commonly-cited factors such as a strong emphasis on education. They suggest that China's dependency ratio will peak at about one dependent to 2.6 workers in the next few years. After that, the effects of encouraged reductions in the birth rate will mean that fewer workers will be supporting more retirees in the coming years, placing a burden on the Chinese economy. India, on the other hand, with slower declines in the birth rate, will see its dependency ratio improve as larger numbers of children grow up and enter the work force, where they can support their elders and non-working children.
- The *Intergenerational Report 2007*²² suggests we will be hearing more about dependency ratios here.

The pace of population ageing is faster in developing countries than in developed countries. Consequently, developing countries will have less time to adjust to the consequences of population ageing. Moreover, population ageing in developing countries is taking place at lower levels of socio-economic development than has been the case for developed countries. The countries with the youngest populations will likely be Burundi and Uganda, with median ages of 20 years each, whereas the oldest populations are expected to be in Macao SAR China and in the Republic of Korea whose median ages are projected to be 54 years in each. A few countries are on the cusp of hyper-ageing, like China and Mexico; in these cases they may well get old before they become rich.²³

Aboriginal people in the Namoi

The 2006 report "Two Ways Together"²⁴ summarised many aspects of the status and future needs of aboriginal people in the New England/ North-West region, which includes, but stretches beyond, the Namoi catchment. This region covers the traditional lands of a number of Aboriginal nations or language groups, the largest of which is the Kamilaroi nation. The Anaiwan, Ngarrabul and the Guyambal also fall within the borders of the region.

Catchment Futures

The Two Ways Together report recognises that in order to affect real and sustainable improvements in the wellbeing of Aboriginal people a whole-of-government approach is required and that effective partnerships with Aboriginal communities must underpin government action if policies and programs are to be relevant to Aboriginal people.

The Aboriginal population has a very large cohort of young people, with 58.5% under the age of 25 years. By way of contrast, the older age group is very small, with only 2.9% of the Aboriginal population aged 65 years and over.

Aboriginal people are particularly disadvantaged in the New England/North-West region, particularly in relation to health, income, justice, housing and education. Rates of low birth weight babies, cardiovascular disease, diabetes, alcohol-related hospitalisations and environmental health problems are much higher than the state average for Aboriginal people. Rates of sexual assault, domestic violence and child protection reports are also disturbingly high, while rates of literacy and numeracy within the primary school population and levels of tertiary education in the adult population are much lower than the state averages.

The report targets seven priority areas to positively improve the lives of Aboriginal people:

- Justice
- Health
- Housing and infrastructure
- Education
- Culture and heritage
- Economic development, and
- Families and young people.

Generational change

The following section is taken from our previous review of emerging trends and their impact on natural resources management⁷.

Our analysis of past trends in attitudes to the environment revealed an increasing sophistication in understanding about environmental issues among the public over the past 50 years. The coming generations are much better informed about the environment than previous ones. While this understanding is still rudimentary, no longer will our stakeholders accept simple and single-issue research and development to address what they now know to be complex social-ecological issues. Research needs to build on the early advances made in fields like complex adaptive systems to move to a new generation of understanding of linked social-ecological systems that takes account of non-linear change in both the ecological and the social systems. Integral to this is understanding of how people's attitudes and decisions are influenced by information and other external influences.

If what has been written about Generation X is true, then there are many implications for natural resource management and associated research and development. Increased concern about the environment is a positive, but will it turn into concerted action for better environmental management? Concerted efforts are needed to solve environmental problems, and some of this effort will require some long-term and painstaking collection of data (or are we writing like Baby Boomers?). We are told that Generation Xers will be impatient and will rush to try new ideas and quick fixes. Progress will be faster but mistakes will be made. The fate of the Australian environment may depend on the mechanisms put in place to monitor progress and learn from mistakes. This will be a key area for research and development in the near-term.

A likely implication of the ascendancy of Generation X is growing impatience with research and development that does not acknowledge policy and management goals. Research and

Catchment Futures

development in recent years has been getting much better at identifying these objectives and what they mean for research design, but many high profile projects have highlighted the gaps in knowledge that become apparent when decision making and policy are placed at the core of the research framework.

Several scenarios⁷ explore instances in which education could be given more or less prominence in Australia. They highlight the potentially negative impacts of skill and ingenuity gaps in the near future but also contemplate the possibility that Generation Xers will put priority on education across society, with new and exciting ways of funding and delivering learning.

The workforce of the future will focus more on casual and short-term employment; specialists will be less common. How will long-term studies be initiated and maintained? Will we risk losing intellectual capital as older scientists feel disenfranchised?

It also is very likely that the role of science in society will change, although how and by how much are uncertainties. Society is likely to be better educated, both in Australia and globally, but its members will be more individualistic. Will the interdisciplinarity and integrated team work that still are struggling to become part of mainstream science be affected? And along with changes in family structures and declining nationalism, there is likely to be decreasing trust in authority organisations, including science, and more interest in alternative ways to interpret the world, some of which will be ideologically driven. A major challenge for science will be how to make its insights about the world understandable and useful to society in this changing environment.

Generation Xers are likely to place an even higher priority on user-pays approaches to environmental management and to be less tolerant of individuals or groups that do not deliver on promised outputs and outcomes. At the same time, there is likely to be a shift away from income as the sole measure of success. Developing understanding and tools for measurement of impacts on both tangible and intangible societal benefits will be a priority for research and development. A critical question is “what is the resilience of Australian social and ecological systems to anticipated stresses?” We currently have few ideas about the answer to that question.

The brain drain of some of our best young minds is likely to be a continuing issue, especially if the focus is drawn even further away from research and development in Australia (see below).

Health and medicine

While not definitive, a growing body of evidence suggests that baby boomers may be the first generation to enter retirement in worse health than their parents. The data sketch a startlingly different picture than the popular image of health-obsessed, workout fanatics who know twat to eat (and look 10 years younger than their age). While boomers are healthier in some important ways (e.g. less likely to smoke), large surveys are consistently finding they are more likely to report difficulty climbing stairs, getting up from a chair and doing other routine activities, as well as more chronic problems such as high cholesterol, blood pressure and diabetes²⁵.

Medical technology is estimated to have contributed to 36 per cent of the average annual growth in real healthcare expenditure in Australia over the last decade. The desire to cut health costs, extend life and increase quality of life is often cited as drivers for technology developments in health. In recent years and for the foreseeable future, genomics and the new biotechnologies have become important focus areas for health innovation, followed closely by nanotechnologies and robotics. Many believe that these new technologies could totally revolutionise healthcare²⁶.

Ways in which science and technology appear likely to contribute to better health include:

Catchment Futures

- Genetic technologies (although it is likely that controversy will accompany these technologies for some time)
- Ecosystem services – better understanding of synergies between nature and agriculture to improve human welfare
- Next Generation Environmental Technologies (NGETs) that focus on the redesign, at the molecular level, of manufacturing processes and products, with the aim of reducing or eliminating the use of hazardous materials
- Medical contributions to food safety such as development of vaccines for the food-borne diseases like *Listeria* (a vaccine has recently been developed for it), *Salmonella* and Tuberculosis that can be sprayed onto carcasses
- Medicine in general and biotechnology in particular will be skewed more toward the concerns of the elderly. Research on ways to increase mental alacrity, decrease memory loss, suppress cancers, and treat heart disease will intensify.
- Demand will rise for wireless sensors embedded within people's bodies and ad hoc wireless networks that provide early warnings about internal medical problems. Such invited bodily invasions will fare a lot better if there are concomitant improvements in privacy and security as personal information is increasingly shuttled around²⁶.

Diseases

The way we live makes us more vulnerable to rapidly emerging diseases. According to Margaret Chan, the director general of the WHO "Profound changes have occurred in the way humanity inhabits the planet. Population growth, incursion into previously uninhabited areas, rapid urbanisation, intensive farming practices, environmental degradation, and the misuse of anti-microbials, have disrupted the equilibrium of the microbial world". The rate of emergence of new diseases, in one year, was 'historically unprecedented'. *The World Health Report 2007*²⁷ includes a bleak picture of future health threats and a vision of science struggling to keep up as disease increasingly become drug resistant. .

Travel, overpopulation and climate change are fuelling disease outbreaks²⁸. We're in the midst of a resurgence of old diseases and new diseases on a global scale. Infectious diseases will still be a major burden, none more so than HIV/AIDS and possibly tuberculosis (XDR-TB)²⁹. Diseases carried by insects and ticks are likely to be affected by environmental changes: another change could be the flu season. Extreme weather events might also lead to more disease, as water supplies become more at risk³⁰

As well, more than 106 million people worldwide will develop Alzheimer's disease by 2050—four times as many people as have the condition now³¹

The incidence of diseases of affluence, sometimes called 'lifestyle diseases,' such as heart disease, allergies, and adult-onset diabetes, alcoholism and depression is also growing³². More than two-thirds of Australians living outside major cities are overweight or obese, and extremely obese corpses are creating a safety hazard at mortuaries. Nearly three quarters of men and 64 percent of women were overweight in a study of people in rural areas, while only 30 percent recorded a healthy weight^{33 34}.

Chronic disease management will be a cornerstone of future health care in Australia. There have, however, been substantial advances in understanding the mechanisms underlying some chronic diseases and increasing development of strategies designed to limit disability arising from them. In addition to new primary and secondary preventive methods, symptomatic management of chronic conditions will reach a high level of sophistication, with attention focussed not only on quality of life but also quality of death²⁶. A key uncertainty in this area is the ability

Catchment Futures

of the health services to provide adequate access to health care to people living in remote and rural areas of Australia. The promise of improved information technology, including the ability to diagnose and treat people remotely, holds some hope but to gain the extent and timing of the availability of such technology is an important consideration^{35, 36}

The rich-poor divide

Much has been written about the growing gap between rich and poor. Most scenarios about the future contemplate the possibility of this gap getting larger or smaller and it seems both are possible. An interesting, if frightening, illustration of the rich poor divide is that the wealthy in Sao Paulo, Brazil, now avoid poor areas by taking helicopters directly from their compounds to their offices. There are now 240 helicopter landing pads in Sao Paulo compared with just 10 in New York¹⁵.

Ethics

Ethical fairness is expected to increasingly guide corporate sustainability as well as the purchasing choices of conscientious consumers (but you might like to consider the conditions under which this trend might be reversed, for example if the world became more strongly focused on the individual self-interests of countries or elite groups within countries). Society is increasingly displaying ethical choices in a range of ways. Conscientious consumers are choosing what corporate brands they wish to be aligned with through various decision processes, such as choosing an employer for their corporate sustainability and cultural credentials rather than just based on salary or status. Ethical consumerism refers to “personal consumption where choice has been informed by a particular ethical issue—be it human rights, social justice, the environment, or animal welfare”³⁷.

Ethical products are a rapidly growing market. Trends in the USA and Europe show annual double digit growth figures for organic, animal friendly, fair trade, biodegradable and sustainable labelled products. In a 2007 report on *Conscientious Consumerism*, Market Research.com posed this question “As ethical products and brands are increasingly mainstreamed, the question arises: what will happen to values as this business becomes controlled by companies that may have no interest in it beyond relatively short-term gain?”

Social wellbeing and happiness

Declining optimism about the future

There is now an extensive literature on the nature and determinants of happiness, one that has stimulated considerable public debate. The research to date has focused mainly on the personal rather than the policy aspects of happiness and well-being.

Australian surveys suggest that above a certain level, increases in income have little or no effect on well-being³⁸. Interestingly, public opinion in most poor countries and Central Europe is generally significantly more optimistic about future living conditions for their children than in wealthy, developed nations³⁹.

Several recent reports^{40, 41, 42, 43, 44} suggest there is growing concern about the state of Australian society - rougher, tougher, more competitive, less compassionate – that is producing stress, edginess and a feeling of personal vulnerability. The 2005 Ipsos Mackay survey found that the proportion of Australians saying quality life in about 15 years' time would be better fell from 30 per cent in 1988 to 23 per cent in 2005; the proportion that said it would be worse rose from 40 to 46 per cent.

Catchment Futures

Optimism about the future of world has slumped. Asked to choose between two statements about the world in the 21st century, only 23 per cent thought it was likely to be 'a new age of peace and prosperity'; 66 per cent opted for 'a bad time of crisis and trouble'.

The results suggest a profound loss of faith in a future constructed around notions of material progress, economic growth and scientific and technological fixes to the challenges of this century. People no longer believe in the 'official story' of the future on which governments base their policies. History and legend show that when the gap between the ideal and real becomes too wide, the system eventually breaks down⁴⁵.

Responses to fear of the future

One factor behind these trends is that our perceptions of the future are increasingly shaped by the images of global or distant threat and disaster to which people are exposed: earthquakes, hurricanes, floods, disease pandemics, terrorist attacks, genocide, and famine. Surveys suggest that people are being drawn in at least three directions by the prospects of dramatic, even catastrophic, social, economic and environmental changes:

- Nihilism (the abandonment of belief; decadence rules)
- Fundamentalism (retreat to certain belief, whether secular or religious; dogma rules), or
- Activism (transformation of belief; hope rules)⁴³.

Eckersley argues that all three responses are growing in social intensity and it is not clear which one will come to dominate. Cork, Eckersley and Walker ⁴⁶ argue that there is a need to provide young people with hopeful strategies for achieving a better future to avoid nihilism or fundamentalism dominating.

From bush culture to coastal culture?

Given Australia's natural landscape attributes, intensive settlement has been possible over only a modest fraction of the country. Just as the bush culture in 19th century gave way to the suburban culture in 20th century, this will possibly give way to a coastal culture in Australia in the 21st Century⁴⁷.

Urbanisation

Much of the earth's surface is now cities, industrialised zones and farmland. Migration to cities is increasing. The sheer scale and speed of the current urban expansion make it unlike any of the big changes that have punctuated urban history. *"It mostly consists of poor people migrating in unprecedented numbers, and then producing babies on a similarly unprecedented scale"*⁴⁸.

Urbanisation is increasing, significantly in Asia Pacific and Africa. The migration to cities around the globe is partly driven by unemployment in rural areas (and the perception that there are more economic opportunities in the cities). Many governments have been unprepared for this migration and there is inadequate infrastructure (sanitation, power, health, education). Shantytowns have grown around cities. In many cities a parallel 'shantytown economy' has developed alongside the formal economy⁴⁹. According to UN predictions by 2050, 2 billion more people will live in shantytowns⁵⁰.

Urbanisation can affect the built environment, the natural environment and human populations. The impacts of urbanisation are highly interrelated⁵¹. For example, land-use patterns within urban areas can influence transportation options, while the mode of transportation chosen by residents can affect air quality and noise levels⁵². In places like Australia and New Zealand, urban planners are challenging "the quarter acre mindset". All of the councils in the Auckland

Catchment Futures

region are taking a “compact city” approach to urban growth⁵³. A key principle of this approach is that quality of life, sense of community and choice of lifestyles can be improved by having vibrant town centres within the city, which are easy to get around by foot. In fact, a new suburban model may be emerging. The cost of commuting more than 12 miles often nullifies the savings of cheaper suburban housing, says a new study by the (US) Center for Housing Policy⁵⁴. Australian research studies similarly indicate a new model of suburbanisation might emerge because of oil prices, interest rates and the sustainability of the suburbs; one no longer dependant on cheap fuel and debt⁵⁵.

While (social and cultural) diversity has usually been considered a positive aspect of many urban areas, new research by Harvard Professor Robert Putnam⁵⁶ suggests that increasing diversity leads to decreased levels of civic engagement and cooperation. The study, the largest ever on civic engagement in America, found that virtually all measures of civic health are lower in more diverse settings.

Sea-change, tree-change and peri-urban growth

Recent analyses of peri-urban expansion have focused on development around settlements and whose population has grown by more than 10% annually⁵⁷. This mostly includes coastal settlements, many of which are growing at a disturbingly rapid rate^{47 58}. Peri-urban regions in the five mainland States produce almost 25% of Australia's total gross value of agricultural production⁵⁷. Although will the focus of population growth is currently on the coasts, could this change in coming decades making the Namoi a focus for periurban growth? Under what circumstances might this occur?

Buxton and colleagues⁵⁹ list the following drivers of change in peri-urban development in Australia:

- Socio-economic, political, technological, natural and cultural
- Globalisation and economic restructuring, climate change
- Interactive impacts (e.g. market-based land use policies increase land supply and lead to decentralisation and spatial fragmentation; economic liberalisation affects population migration and growth)
- Population increase and distribution (strong social and economic connections with dominant urban area)
- Dispersed urban development/sprawl
- Infrastructure, such as road construction
- Lifestyle and environmental attractiveness, linked to retirement or dispersed work patterns
- Relocations decisions by firms (Europe and US); neo-liberal governance arrangements

The future of work

Globally

There are many different views about the future of work; they generally fall into two categories. At the extremes, pessimists paint haunting portraits of mass unemployment, growing insecurity and widening social divisions, while optimists claim that the emerging 'new' economy (usually a bio economy or a knowledge economy) will free many employees from routine or labour intensive jobs. For instance, a pilot study⁶⁰ by the US National Research Council's Centre for Education predicts 60 percent of today's workforce will be displaced by 2030, as advances in the abilities of computers meet or exceed the abilities of humans. While 2030 may seem a long time away, the children that are born today and graduate from college will be entering the workforce for the first time around that date. Any substantial shift in the supply and demand of

Catchment Futures

the skills needed for the future workforce will require a shift in the education and training of the public.

The nature of work has been changing around the globe. In 2006 the service sector's share of global employment overtook agriculture for the first time, increasing from 39.5 per cent to 40 per cent.⁶¹ The services sector now accounts for over 70% of total employment and value-added in OECD economies. And it accounts for almost all employment growth in the OECD area; in fact the service sector having quantitatively become the most important sector in all OECD economies. This is particularly true in Australia.⁶²

Services dominate economic activity in Australia, including national output and they account for four out of every five jobs. The Productivity Commission notes "Over the past few decades, service output and employment growth has outpaced that for the economy as a whole, so the relative importance of the sector has increased."⁶³

Unemployment remains a global problem. Unemployment hits young people (aged 15 to 24) the hardest, with "86.3 million young people representing 44 per cent of the world's total unemployed in 2006." For the late decade "economic growth has been reflected more in rising levels of productivity and less in growing employment. While world productivity increased by 26 per cent the global number of those in employment rose by only 16.6 per cent."⁶¹

In Australia

"In 1960 the average Australian worked 15 hours a week ... expressed in 2005 dollars, real GDP per capita was \$343.50 a week. In 2006, the average Australian worked 17.1 hours a week and an average hour of work generated \$56.77 of GDP. Hence, in 2006, real GDP per capita was (multiplying the two numbers together) \$970.77 a week."⁶⁴ The budget statement also includes the following figure:

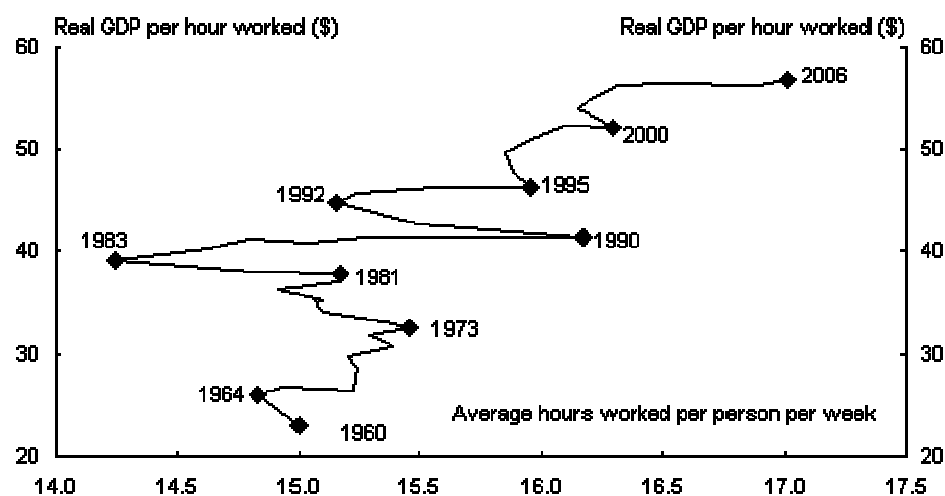


Figure 3: Path of economic growth — Australia

Not everyone sees this sort of economic growth in a positive light, Fred Argy argues that employment opportunities have become more polarised within households and regions, with a rise in the incidence of long-term unemployment, casual work and jobless households^{65 66}. If these trends continue the need to re-think and re-conceptualise work will grow. If future work is more fragmented, disjointed, unpredictable and/or associated with life-long learning and training, these developments potentially pose a bigger challenge to the fiscal system than ageing.

Catchment Futures

In the past year, there have been interesting anomalies in the job market with full-time positions and participation of older workers both increasing, where most new jobs advertised used to be part-time. Another emerging trend as we approach full employment is a decline in early retirement. According to new research, “older workers account for around 40 per cent of the employment growth over the past five years compared to 20 per cent in the 1990s and next to none in the eighties”⁶⁷.

At work

Four dimensions to national value systems that account for a substantial portion of the work-related patterns of different nations have been identified in a study of the national value systems of 53 countries and regions⁶⁸. These were:

- The degree to which unequal distribution of power is socially accepted
- The degree to which achievement, material success, and assertiveness are valued over relationships, the quality of life, and modesty
- The degree to which members of a society are expected to be responsible for others
- The degree to which a society protects conformity to counter ambiguity and uncertainty

These four characteristics form a useful background to thinking about the broad work-related culture in the Namoi catchment. In the workplace, effective managers, “tap into people’s values as a way of motivating them”⁶⁹. Clearly, if managers operate on the belief that the majority of people still hold the same values priorities held in 1988, then they will not be effective in motivating their people⁶⁹.

The changing nature of Australian national values has been documented. These suggest that a paradigm shift has occurred since 1988 as follows:

- In 1988 people felt compelled to work in order to live as they desired – any work would do, so long as it generated the revenue necessary to create the desired life style.
- In 1998 people are firstly looking at who they are as a person, and are then seeking to create a life around this – some may view their activities as work, others may not. The 2001 update shows these trends continuing.

Table 4: The top ten values in the Australian Workforce in 1988, 1998, 2001⁶⁹

1988	1998	2001
Management	(Self) competence/confidence	Relaxation
Collaboration	Relaxation	(Self) competence/confidence
Productivity	Being self	Being self
Decision/initiation	Decision/initiation	Generosity/service
Responsibility	Family/belonging	Synergy
Rights/respect	Life/self-actualisation	Decision/initiation
(Self) competence/confidence	Synergy	Life/self-actualisation
Family/belonging	Generosity/service	Creativity/ideation
Sharing/listening/trust	Loyalty/fidelity	Loyalty/fidelity
Being self	Sharing/listening/trust	

TECHNOLOGY

We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology.

-Carl Sagan¹⁵

A technological tipping point?

The literature on technological change all points towards very major and rapid, and often surprising, developments in coming decades. These changes involve existing technologies, like genetic technology, and nanotechnology, and also the likelihood of totally new technologies not currently apparent.

For some time there has been speculation about a technological “singularity” – a time when the rate of increase in technological innovation and human power to manipulate ourselves and our environment is so fast that society cannot assimilate the change or deal with it in a planned and rational way^{70,71,72}.

A prime example of the sort of technological change that could bring on a singularity is computing technology. Since the advent of computers, computing power has been doubling every 18 months and this shows no sign of slowing. At this rate, the power of an affordable computer could exceed that of the human brain between 2030 and 2050 (Figure 4). It is even suggested that by the middle of this century it may be possible to download the contents of a human brain into a computer¹⁵.

This would raise ethical, moral and logistical questions⁷¹ like:

- Could or should humans enhance their brains with computer implants?
- If the contents of a human brain could be downloaded to a computer for storage or use in a new body, should it be?
- If computers can outperform humans in some spheres of endeavour what roles can, or should, humans play in future societies?
- Could or should humans, regulate the development and application of advanced computer systems for peaceful or other purposes?
- What could happen to government, social norms, belief systems, morals and ethics during a period of rapid and uncontrollable increases in information generation and circulation?

Other components of a technological singularity, with their own moral, ethical and logistical challenges, might include:

- Medical science eliminating all life-threatening diseases and delaying the ageing process
- Environmental technologies capable of repairing and redesigning ecosystems
- Genetic and nanotechnologies capable of use to design offspring and “renovate” existing people
- The ability to generate food and water from the molecules existing in the air, freeing humans from any reliance on natural resources

Technology

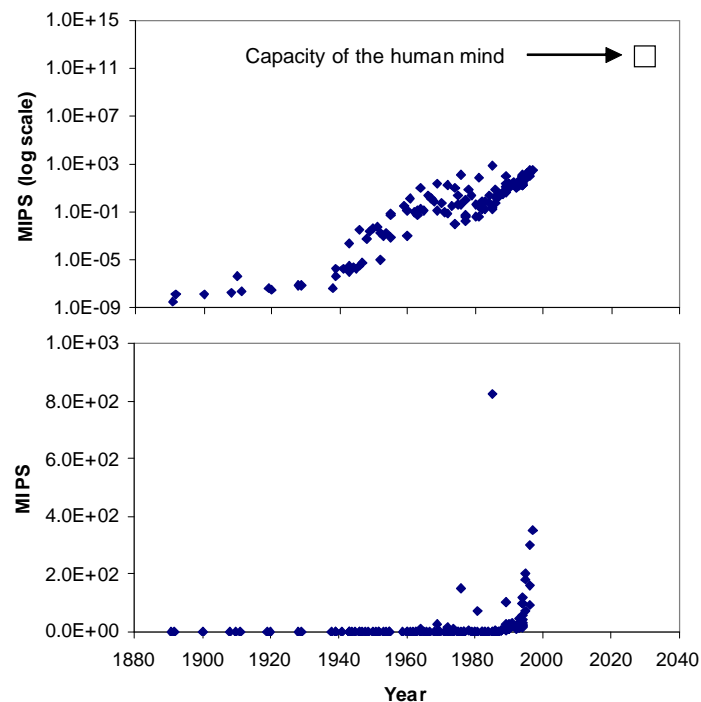


Figure 4: Changing computing power. The points on the graph relate to a wide range of different calculating devices, including many models of computers over the past 40 years. By about 2030 it is expected that computers will have computational capacity equal to the human brain. Source: Moravec ⁷⁰.

While many aspects of a technological singularity might sound fanciful, reputable scientists believe many of the developments listed above are plausible in the next 20-40 years. What is more important is that if even a few of these developments begin to emerge at even a fraction of the rate suggested by the singularity-watchers then societies around the world will be facing major tensions in adapting to new possibilities in orderly ways using increasingly outmoded institutional arrangements. Within this environment of societies struggling with technological change, Australia needs to not only be resilient, adapt or transform but also remain competitive with other nations (if indeed existing national boundaries and governments persist).

While human kind struggles with out of control technological change, western societies will be facing the challenge of ageing populations, developing countries will face the scourges of diseases of excess, such as obesity and diabetes, and some believe that human civilisations in general will start to decline as do all species that come to dominate their environment and over exploit resources⁷³.

What makes all of this especially troubling is the limited ability of human societies to look at themselves in a detached way to diagnose their challenges objectively. It appears that the human brain is prone to interpreting facts to support what it already believes^{74, 75}.

Power and energy

The future pattern of (energy) resources use might be very different within a few decades. Resources depletion, peak oil and costly petrol are creating a basis for moving the energy debate forward and changing the investment climate, making it more amenable to other energy

Technology

sources for power and mobility. The world's major energy consumers are seriously searching for ways to reduce their dependence on fossil fuels and guarantee energy supplies.

There appears to be a growing consensus that a more diverse energy mix, including more alternative renewable resources (solar and wind), will be achieved although the timing of transitions remains unclear. A portfolio of technologies now exists to meet the world's energy needs over the next 50 years and limit atmospheric CO₂ to a trajectory that avoids a doubling of the pre-industrial concentration; the portfolio as a whole is large enough that not every element has to be used^{76 77}.

However, a revolutionary change might have to wait until alternate energy sources become cheaper than oil/fossil fuels. Some of these alternate energy sources will have adverse environmental and health impacts: nuclear energy is likely to be adopted globally, even though there are broad environmental and security concerns; and oil and fossil fuels will continue to meet a large part of global power and mobility needs for the next few decades⁷⁸.

In a report on the impact of emissions trading in Australia, The Climate Institute said electricity prices could rise 20 percent in the next 20 years if the government acted decisively, but a soft response and a low carbon price would mean a greater shock from 2020 (as much as a 75% rise)⁷⁹. Concern about the number of low income people who are under able to afford adequate electricity and gas is rising⁸⁰.

An oil price shock might be a global risk. The World Economic Forum 'Global Risks 2006' report models four key risk scenarios: a severe oil price shock, influenza pandemic, terrorism and climate change⁸¹. However, the amount of accessible oil worldwide could eventually increase by roughly 30 percent with the help of new drilling, imaging, and oil extraction technologies, including the use of microbes, say MIT researchers. Theoretically, this number could be even higher; in a best-case scenario, the amount of oil would double⁸².

Overall global rising energy demand might not be curbed as emerging nations grow. The IEA's *World Energy Outlook 2006* predicted that demand for crude oil would break through the 100 million barrel a day mark before 2020, compared to nearly 85 million barrels per day at the moment⁸³. The U.S. Energy Information Administration has made similar forecasts; in fact, the US might be the worst offender. The demand for electricity in the USA is increasing three times faster than power plants and lines are being built⁸⁴.

Huge and coordinated international investments in new technologies and infrastructure will be needed if the world wants to reverse unsustainable energy trends.⁸⁵ Looking ahead to 2040, a study by the *Foresight Energy Futures Task Force* focuses on what needs to be done to develop a mix of energy sources and infrastructure that will ensure a competitive future for the UK⁸⁶. It may be more realistic in the long-term to turn coal reserves into gas and then oil according to some expert views. China is leading the way and others may follow; according to this thinking the world may have ample coal for a couple of hundred years if it can be converted to clean fuels cheaply enough⁸⁷.

There is some movement towards a different energy economy already: distributed energy generation systems – networking many technologies – are being introduced globally⁸⁸; and, biofuels production is growing – but leading to environmental and economic consequences^{89 90}; seed and biotechnology companies see a big new opportunity in developing corn and other crops tailored for use in ethanol and other biofuels⁹¹.

The future of nuclear power is unclear. There are differences in perspective as to the current and future fortunes of nuclear industries, particularly on the state of nuclear power generation. Some are proponents of its use⁸⁵ or predict increases in its use⁹². However, nuclear power is likely to be between 20 and 50 per cent more costly to produce than power from a new coal-

Technology

fired plant at current fossil fuel prices in Australia. This gap may close in the decades ahead, but nuclear power, and renewable energy sources, are only likely to become competitive in Australia in a system where the costs of greenhouse gas emissions are explicitly recognised. Even then, private investment in the first-built nuclear reactors may require some form of government support or directive⁹³.

Science and technology

There are suggestions that science is at a crossroads and that its role in society may be changing. The philosopher John Ralston Saul, for example, argues that Western society has reached the end of a long period of reliance on scientific reasoning and is about to enter an era in which ideology will become increasingly important along with "soft science", spirituality and other ways of viewing the world⁹⁴. Commentators are starting to debate whether more science actually improves decision making⁹⁵. The availability of new information often adds complexity to events and is frequently not used to make decisions according to Malcolm Gladwell, the author of *Blink: The Power of Thinking Without Thinking*⁹⁶.

Futurist Kevin Kelly⁹⁷ defines science as the process of changing how we know things. Kelly's observations on the next 100 years in science include these speculations:

- There will be more change in the next 50 years of science than in the last 400 years
- This will be a century of biology. It is the domain with the most scientists, the most new results, the most economic value, the most ethical importance, and the most to learn
- Computers will keep leading to new ways of science. The Internet already is approaching the level of the human brain and is doubling every year, while the brain is not.

Science is strongly globalising. Globalisation allows science to move from 'closed' innovation, where knowledge is scarce and confined to a particular organisation, to an 'open' model, where it is readily available and easily shared. A good example of this occurred when the U.S. Department of Energy signed an agreement with the British Library (July 2007), called 'Science.world'; other countries have been invited to participate in this international effort.

- However, science globalisation has some bad points. For instance, the growth of patenting in biotechnology and of genes and gene sequences has been the source of considerable debate and controversy^{98,99}. This information is valuable because it is often useful in subsequent research. Patents on these research tools could hinder downstream research and product development^{99,100}.

Areas of particular importance for technology trends will include biotechnology, nanotechnology, materials technology, and information technology¹⁰¹. Generally scientifically advanced countries such as the United States, Germany, and Japan will be able to implement all key technology applications. But, they might not. Public policy issues in certain areas will engender public debate and strongly influence technology adoption and implementation. Less scientifically advanced countries might catch up quickly, as leapfrogging (in technology adoption) might occur¹⁰². For example, mobile phones are apparently becoming the dominant form of Internet access devices in the developing markets.

At a local level, multiple and often contradictory, societal values are at the core of many emerging scientific debates. For example the energy debate is often polarised to nuclear and fossil fuel energy vs. bio-fuels, wind, wave, hot rocks and solar energy. The water debate has similar dichotomies - the "commodification of water recognises price, markets, growth, profit, efficiency, costs of production and redistribution", which can be in conflict with broader community values for water, including spiritual, aesthetic and environmental dimensions, such as water for religious and recreational needs and for biodiversity¹⁰³.

Technology

Mobility (transport)

Today transport (and energy) systems typically are developed manufactured and operated by private industry. Hence these systems must be capable of generating a profit. Even where governments assume an active role in producing and distributing energy or in operating transport networks, these operations cannot ignore commercial realities. New transport technologies are possible. Figure 5 shows the expected availability of innovative technology as a Foresight Vehicle Technology Roadmap.

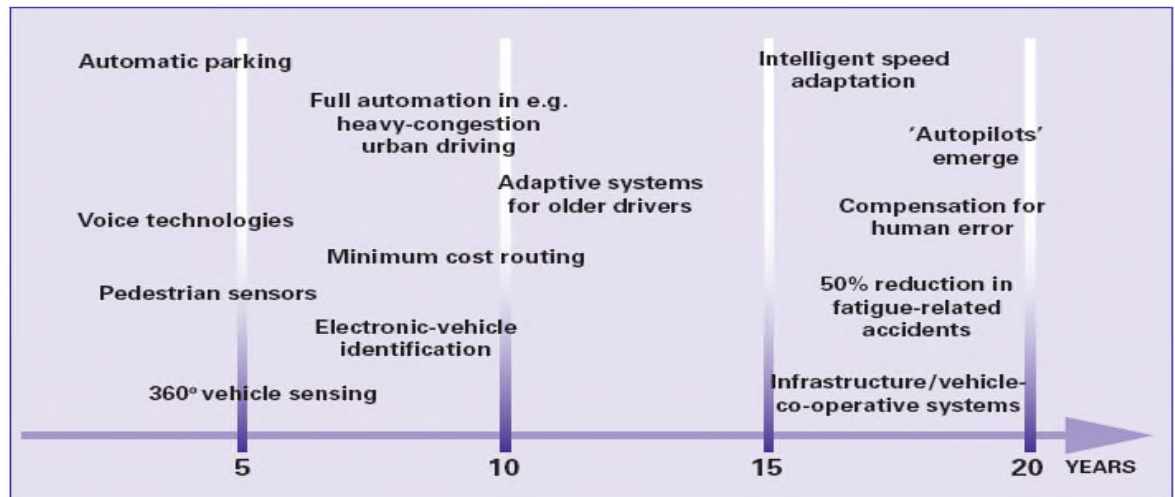


Figure 5: Anticipated vehicle technologies¹⁰⁴

At the same time, there are many technologies that can be retro fitted to the existing fleet in order to improve the efficiency and / or reduce negative externalities. In terms of the impact of transport technology, the following factors need to be considered:

- Technology will continue to change – it is just the rate of change and rate of adoption that is not certain.
- The interaction between transport technology and the energy system will be vitally important.

For most vehicles gasoline will continue to be the primary fuel. It is unlikely that a radical change in fleet fuel technology will occur within the next 10 years given that it takes fifteen years to update the national vehicle fleet. Any technologies that require step change in vehicle technology will take at least that long to become the norm. Figure 6 shows the range of primary energy sources, energy carriers, and power trains that either are used today in road vehicles or that are being investigated for possible future use.

Technology

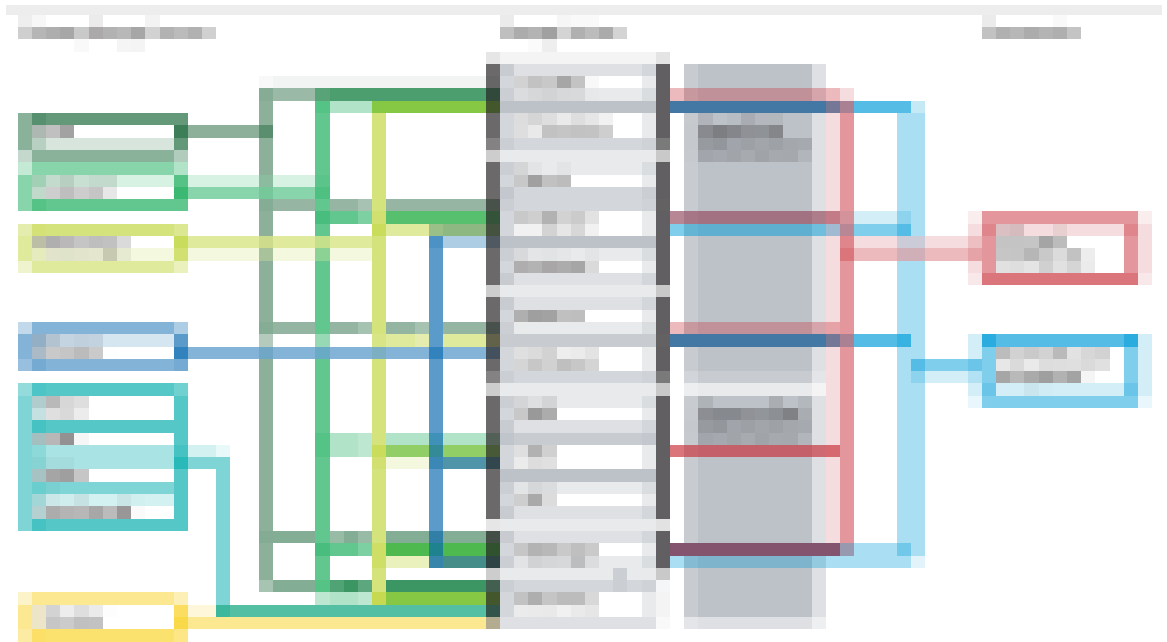


Figure 6: Possible Transport Fuel Pathways¹⁰⁵

ECONOMY

The "bottleneck"

Many experts believe that the world is entering a critical period in which a wide range of resources (including oil, water, other fuels, and food resources) are running up against increasing demand due to population growth, economic development and declining environmental function^{15, 106}. Most studies predict that oil production will peak by 2015 to 2020, but there is considerable debate about what will happen after that (especially if and how quickly the world will move to alternative energy sources). Among the implications suggested are major slumps in Western economies and even a worldwide economic depression¹⁵.

Economy of the Namoi

The Namoi regional economy was reported on in 2006¹⁰⁷. The principal conclusions of this report included:

- Agriculture has always been the core of the Namoi economy
- Agriculture supports a well-developed agriculture processing industry along with the handling and marketing operations.
- Since 2001, there appears to be growth in employment (38,000 to 41,000) and population (93,000 to 100,000) at around one per cent per year. The increase has its origins in an inflow of investment, rising capital values, higher consumer spending, improving agricultural conditions, a resumption of coal mining and development, and gaining a share of overall national growth.
- The population had a more pronounced ageing profile than NSW and has the future prospect that accessions to the workforce from the local area will be less than retirements from the workforce.
- In the decades to 2001, the Namoi experienced little growth due to local and other factors. There was restructuring of coal mining, meat processing, electricity distribution, transport and communications and banking that resulted in job losses.
- Agriculture was subjected to periodic drought, poor commodity prices and more recently, the uncertainty associated with a range of policy proposals for natural resource management.
- The region economy in 2006 was estimated to generate a Gross Regional Product (GRP) estimated at \$3.1b, or one per cent of the NSW economy. Agriculture generated 16 per cent of GRP and 60 per cent of exports from the region.
- The Namoi region economy is very open having a high dependence on external markets and external sources of supply. Agriculture and forestry together with their downstream handling, marketing and processing activities and associated flow-on activities account for over 40 per cent of the region economy, and possibly more in reasonable agricultural years.
- With the redevelopment of coal mining and its flow-on activities, it seems likely that primary industries and their related activities will account for more than 50 per cent of the economy.

Economy

The high dependence on agriculture of the Namoi economy poses two substantive strategy issues¹⁰⁷:

- The key agricultural activities have to be nurtured and improved to support economic growth as alternative activities are not able to be developed quickly.
- Regional economic development strategies need to focus on building the diversity of the economy.

Wealth generation

Geography and natural resources are likely to become even less important as a source of wealth and economic advantage – not irrelevant, but less important¹⁰⁸. Being in a community of talented people may be more important than being located close to natural resources or easy transportation¹⁰⁹. The availability of cheaper labour will probably continue to be advantageous, but only temporarily. Jobs are likely to move across borders faster than ever before¹¹⁰. In fact, the literature suggests that several major forces are acting to encourage a new wave of global mass migration:

- The huge cross-national inequalities in wages and standards of living
- Differences in labour demand across countries
- Population growth imbalances and ageing populations of wealthy countries needing younger workers to help support national pension plans
- The growing interconnectedness of the world^{111, 112}

If we assume that the elements of national power today are: gross domestic product (GDP), population, defence spending, and innovation in technology¹¹³, then, taking this view, the United States is not the only major world power. The United States holds about 20 percent of total global power. The European Union and China hold about 14 percent each. India holds about 9 percent. Brazil, South Korea, and Russia hold about 2 percent each. The United States is predicted to end up at about where it is now in 2015. The EU, however, is predicted to lose power, as are all other members of the G-8. China and India are predicted to gain power¹¹³

- Other analyses conclude that the E7 economies (China, India, Brazil, Russia, Indonesia, Mexico and Turkey) will by 2050 be around 25% larger than the current G7 when measured in dollar terms at market exchange rates, or around 75% larger in purchasing power parity terms¹¹⁴.
- A set of benchmarks, developed to assess the international standing of the United States in education, science and engineering, workforce, scientific knowledge, innovation, investment and high-tech economic output, reveal: "The United States still leads the world in research and discovery, but our advantage is rapidly eroding, and our global competitors may soon overtake us."¹¹⁵

While many commentators describe the relationship between China and India in competitive terms, India's strong service and consumption dynamic may work as a complement to China's heavy industries and manufacturing. Together – *Chindia* (as they have been labelled in some quarters) could create a new global super power. Paradoxically this could erode the Communist Party base in China. Changes in the natural environment, international conflict, civil unrest, outbreaks of disease and terrorism are all factors that could affect both of them^{116 117 118 119 120 121 122}. China's ability to sustain its current pace is more tenuous than is India's; if China's growth slows, India could emerge as the world's fastest-growing economy as we approach 2020. An abrupt slow down in Chinese growth could stem from pandemics, the inability of cities to absorb huge influxes from the countryside, the spread of regional poverty and the inability to put in place an effective system of governance. We note that the Chinese market is one-tenth the size

Economy

of that of the US and has less international significance. Right now China's economy is characterised by velocity, not mass^{116 117 118 119 120 121 122}.

There are untapped markets. Economists assert there are wealth opportunities in emerging markets and amongst the less affluent. Globally, the four billion people who live on less than \$2 a day make up a sizeable, underserved market¹²³. Prahalad calculates that the purchasing power of nine large developing countries – China, India, Brazil, Mexico, Russia, Indonesia, Turkey, South Africa and Thailand – is already equivalent to \$12.5 trillion.

- The transition of many former communist countries to market-based economies is also likely to fuel entrepreneurial growth in a different way^{124 125}. It is estimated that \$9.3 trillion worth of buildings and land is locked up in developing and former communist countries because poor people cannot legally hold title to it. Acknowledging these property rights and allowing people to use their property as collateral could liberate an very large amount of capital to fuel enterprise and wealth creation in both those countries and other countries that service their markets.
- Key questions for the future of the Namoi and other catchments around Australia include whether and how to access some of these "sleeping" market opportunities globally.

Food production

For the last 40 years, there was more food produced than needed, theoretically, to feed the world's population. The problem has been that food production has not always occurred where the demand for food is highest. In coming decades it is likely that supply will be much more balanced with demand so that small perturbations can cause a significant impact on food supply¹²⁶. Furthermore, future food production is even less likely to occur in the same areas as food consumption (distribution becomes an even bigger issue). Food prices may become inflated (and unaffordable to some people). However, new approaches to meeting local demands for food production are being trialled (e.g. urban farming)¹²⁷.

Climate change brings new stresses to the world food supply system. Shortages in food supply could generate distortions in international trade at regional and global levels, and disparities and disputes could become more pronounced over time. By the end of the century, oceans may no longer be liveable habitat for coral and other organisms with calcified exoskeletons (such as plankton and marine snails), due to increased acidity as the world's oceans absorb about a third of the atmosphere's carbon dioxide; as the base of the marine food chain, their fortunes reverberate outward^{128 129}.

There are signs climate change has already 'arrived': crops are already being planted in new regions – wine in England for example⁶⁰; ocean systems and 'fisheries' sectors are of significant ecological and economic concern: all currently fished taxa might collapse by 2048¹³⁰; five deep-sea species might disappear by 2030¹³¹; conservation measures may be making things worse by altering the age structure of fish populations¹³².

Farmed fish now equal wild catch as a seafood¹³³; future aquaculture might fall behind demand by 2030¹³³; and, there are a large number of ocean dead zones, likely to get worse after a rise of more than a third over the past two years¹³⁴. Dead zones currently occur off the coasts of the U.S., Scandinavia, South America, Ghana, China, Japan, Australia, New Zealand, Portugal, and Britain.

Globally, the potential for food production is projected to increase with increases in local average temperature over a range of 1-3°C, but above this range it is projected to decrease. More frequent droughts and floods might affect local crop production negatively, especially in subsistence sectors at low latitudes. Altered crops and planting times might allow basic yields of cereals to be maintained, at modest warming. Climate change impacts on commercial timber productivity are projected to have large regional variability around a the modest overall global

Economy

productivity rise. For different fish species regional changes in the distribution and production are expected, with adverse affects projected for aquaculture and fisheries³⁰. In addition:

- At higher temperature ranges, major changes in ecosystem structure and function, species' ecological interactions, and species' geographical ranges will have predominantly negative consequences for biodiversity, and ecosystem goods and services e.g., water and food supply
- Crop production is expected to increase slightly in mid to high latitudes when temperature ranges between 1-3°C, then decrease in some regions. Crop productivity is similarly projected to increase depending on the crop, and then decrease beyond that in some regions.
- "At lower latitudes, especially seasonally dry and tropical regions, crop productivity is projected to decrease for even small local temperature increases (1-2°C), which would increase the risk of hunger"³⁰.

Disease outbreaks could take an enormous toll in developing nations, and overuse of pesticides could breed widespread resistance among pests and the virtual elimination of protective predators¹³⁵. Increased population growth of insects as climate warms, especially in the tropics, is likely to increase use of pesticides and costs of food production¹³⁶.

High commodity prices likely for foreseeable future. World prices for many agricultural commodities may remain at historical highs over the next decade, as the increase in demand for biofuels continues to shape agricultural markets¹³⁷. As well as biofuels, the recent price increases can in part be explained by temporary factors, such as drought and low stocks. Long-term shifts, including increased feedstock demand for biofuel production and the reduction of surpluses due to past policy reforms, could keep commodity prices above historic equilibrium levels. The report provides various examples:

- The United States, annual maize-based ethanol output is expected to double between 2006 and 2016
- The European Union, the amount of oilseeds (mainly rapeseed) used for biofuels is set to grow from just over 10 million tons to 21 million tons over the same period
- Brazil, annual ethanol production is projected to reach some 44 billion litres by 2016 from around 21 billion today. Chinese ethanol output is expected to rise to an annual 3.8 billion litres, a 2 billion litres increase from current levels.
- Other demands that are expected to impact on commodity prices are expanding food demand in developing countries and increasing demand in these countries for high meat and other developed world foods¹³⁸

High food prices could lead to social unrest in developing countries. In the developed world, low-income families who spend higher proportion of disposable income on food will feel the impact. In Mexico in 2007 there have been riots as the price of wheat has meant many people are unable to afford tortillas, a basic staple on which the average consumer spends 12 per cent of their food budget¹³⁹. The fact that a price spike can create widespread hunger suggests that food supply systems in many parts of the world are close to "tipping points"¹⁴⁰. In addition, expected shifts in rain patterns and temperatures over the next 50 years could lead to an extra 50 million people struggling to get enough food, especially in Africa¹⁴¹. This might affect world hunger which is increasing at the rate of 4 million a year¹⁴². See also the [World Hunger Map](http://www.wfp.org/country_brief/hunger_map/facts.asp?section=9&sub_section=hunger):

(http://www.wfp.org/country_brief/hunger_map/facts.asp?section=9&sub_section=hunger).

Global drives to improve livestock products' safety may affect small-scale, poor producers most. Safety concerns regarding human and animal disease associated with livestock products are increasing. There is concern, that measures to regulate these standards internationally may marginalise small-scale poor producers¹⁴³. This is a concern because agriculture investment in Asia Pacific better addresses poverty than (economic) growth in other sectors. Medium to long-

Economy

term trends in poverty, vulnerability to natural hazards and the effects of trade liberalisation on food security in Asia Pacific emphasise the importance of agriculture to the macro economy, the labour force and the poor¹⁴⁴.

The general public in Europe seems to have lost its confidence in food safety. One remedy for this, as proposed by the Commission of the EU, is the creation of an independent scientific Food Authority. However, an independent scientific advice alone is unlikely to re-establish public confidence. It is much more important to make the scientific advice transparent. Risk assessments are based on a rather narrow, but well-defined notion of risk. However, the public is concerned with a broader value context that comprises both benefits and risks¹⁴⁵. As well, food safety systems in the US cannot enforce additional regulations. Facing a loss of consumer confidence because of repeated outbreaks of food-borne illness, three major US produce industry groups have for the first time called for government regulation in an industry that until now has had none¹⁴⁶.

Paradoxically, nanotech food and food products have already entered the market. First generation nanotechnology-based food industry products, including synthetic food colouring, frying oil preservatives and packaging coated with antimicrobial agents, have quietly entered the market^{147 148}.

- Separate reports note the processed-food giant Kraft and a group of research laboratories are busy working towards 'programmable food'. One product they are working on is a colourless, tasteless drink that you, the consumer, will design after you've bought it. You'll decide what colour and flavour you'd like the drink to be, and what nutrients it will have in it, once you get home.

In both Australia and other Western countries, including the USA, market-based approaches to funding conservation and protection of environmental function on private land are becoming very popular^{149 150 151 152 153}. Approaches such as reverse auctions are seen as ways to bring new financial capital into land management, and to recognise the totality of environmental processes, the benefits from them, and where responsibilities and rights exist^{154 153}.

Interest in urban agriculture is growing¹⁵⁵. We see many examples around the world of local communities investing in more production of food in their own neighbourhood¹⁵⁶. An interesting example of this trend in developing countries involves a three-city collaboration between Colombo, Sri Lanka; Kampala, Uganda; and Rosario, Argentina¹⁵⁷. A Dutch report has proposed development of giant 'agro-production parks', located in cities near the end-users of the products. These 'parks' would theoretically be complete ecological systems, with clustering of many different types of agricultural production so that one activity feeds another and everything is recycled¹⁵⁸.

The social licence to produce food is changing.

- In Australia, as elsewhere around the world, there is increasing interest in local food production, as evidenced by patronage of farmer's markets. There are global trends towards young people boycotting national and global brands in favour of locally grown produce that supports local livelihoods and is believed to be more sustainable¹⁵.
- The livestock sector may come under increasing pressure to reduce production of greenhouse gases. The United Nations Food and Agriculture Organization say the livestock sector generates more greenhouse gas emissions as measured in CO2 equivalent – 18 percent – than transport¹⁵⁹.
- In Europe, consumers are paying greater attention to how far food has been transported (so called 'food miles') and the associated use of fuel and other resources. A recent UK report estimates costs of food miles at £9billion each year, half of which is down to road congestion¹⁶⁰. There is considerable debate in Europe between those who wish to see food miles minimised and those who believe that consumers should be able to purchase food from wherever they wish. This debate may well become an issue for Australia in the

Economy

future. On a broader level countries are beginning to talk about ecological debt – when they start using the resources of other countries to maintain their lifestyles.

- The ethical food market is growing. People are increasingly asking where their products were made and how far they have come. The fair trade movement has also gained considerable momentum, with consumers increasingly prepared to pay more for guarantees of fair labour practices and sustainable sourcing. Food companies not tuned into current ethical demands will increasingly lose out as consumers become better informed and more discerning when it comes to ethical shopping. Issues such as sustainable sourcing, fair trade, humane treatment and genetic modification are clearly here to stay¹⁶¹.

An interesting dimension of the environmental ethics component of agricultural production is the increasing involvement of religious groups in environmental debates. In Australia we have seen the major Christian churches make commentary about environmental issues and this is said to have a particularly strong influence on the thinking of many in rural populations¹⁶². Similar trends are evident in other parts of the world. Some churches in Canada, for example, have started to urge congregants to boycott bottled water, citing ethical, theological and social justice reasons. Bottled water, they argue, is morally tainted and should be avoided¹⁶³.

Our understanding of food production might be diminishing. More than 50 business leaders, politicians, and activists have formed a national partnership to get America's kids the hell outside. Inspired by recent concerns that too much fun with video games, computers, and TV can lead to obesity and depression, the National Forum on Children and Nature is launching a \$20 million campaign to fund 20 demonstrations¹⁶⁴.

Tourism

International tourism competition may “heat up”. The growing number of senior citizens in Australia, and other industrialised countries such as the USA and Japan, looks to become one of the major marketing challenges for the tourism industry. The 2007 World Economic Forum Travel and Tourism Competitiveness Report places Australia 13th overall:

Table 5: The travel and tourism competitiveness index¹⁶⁵

Country/Economy	OVERALL INDEX		Regulatory framework		Business environment and infrastructure		Human, cultural, and natural resources	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Switzerland	1	5.66	2	5.80	2	5.36	2	5.81
Austria	2	5.54	3	5.79	12	4.97	1	5.86
Germany	3	5.48	6	5.62	3	5.23	6	5.61
Iceland	4	5.45	5	5.69	8	5.04	5	5.61
United States	5	5.43	33	5.06	1	5.74	12	5.50
Hong Kong SAR	6	5.33	4	5.75	14	4.81	14	5.44
Canada	7	5.31	15	5.31	4	5.22	16	5.40
Singapore	8	5.31	1	5.81	11	5.01	42	5.11
Luxembourg	9	5.31	17	5.28	9	5.04	8	5.60
United Kingdom	10	5.28	21	5.20	6	5.08	10	5.58
Denmark	11	5.27	8	5.46	16	4.76	9	5.59

Economy

France	12	5.23	13	5.34	5	5.10	28	5.27
Australia	13	5.21	16	5.28	10	5.04	26	5.30
New Zealand	14	5.20	10	5.44	20	4.57	7	5.60
Spain	15	5.18	25	5.15	7	5.05	19	5.34
Finland	16	5.16	7	5.61	18	4.68	33	5.18
Sweden	17	5.13	19	5.25	13	4.88	27	5.27
United Arab Emirates	18	5.09	18	5.28	19	4.68	24	5.31
Netherlands	19	5.08	22	5.17	15	4.77	25	5.30
Cyprus	20	5.07	29	5.09	23	4.50	3	5.62

Worldwide trends show that holidays are being combined with personal passions. Another worldwide trend, is for holidays to be combined with personal passions – food and wine, golf, gardening, and the like. In fact, experts predict there will be a huge growth in these type of activities.

Infrastructure

An issue that recurs in various scenarios for Australia's futures as a significant constraint on progress is the state of infrastructure. A 2001 report by the Australian Infrastructure Report Card Alliance¹⁶⁶ raises substantial concerns (Table 6).

Table 6: Analysis of Australia's infrastructure based on fitness for purpose (A is the highest rating; infrastructure rated as D or D– is in a “disturbing state”)

Category	Rating	Category	Rating
Electricity	B	Airports	B
Gas	C	Roads (National)	C
Telecommunications	B	Roads (State)	C–
Rail	D–	Roads (Local)	D
Ports	B	Potable Water	C
Irrigation	D–	Stormwater	D
Wastewater	C–		

The report argues that the efforts of past generations in setting up this infrastructure are not being continued by recent and present generations. Particular issues raised include the following:

There are examples of both under and over-investment in infrastructure, irrigation being an example of the latter because it “requires excessive subsidisation, and brings with it substantial environmental costs”.

Greenhouse gas emissions and non-renewable energy consumption are serious issues, largely caused by deficiencies in transport and energy infrastructure and, so far, inadequate

Economy

commitment by government to reducing greenhouse gas emissions, developing alternative energy sources, encouraging demand reduction, and encouraging public transport use.

Waterway systems continue to degrade, due particularly to salinity but also water pollution resulting from inadequate stormwater and sewerage systems

A balanced approach is recommended, recognising that it is not the sole responsibility of government to fix these problems, acknowledging changing community expectations and choices, and taking account of the full social costs of degrading infrastructure.

The Australian Council for Infrastructure Development suggests that "a rough estimate of the cost of making good the under-performing infrastructure identified in the National Report Card is \$150 billion"¹⁶⁷.

Although the above reports are now a few years old, the infrastructure debate is still a major one. One of the scenarios developed by the Business Council of Australia in 2005¹⁶⁸ focused on concerns about what could happen in only a decade if infrastructure decline was not addressed.

Smart infrastructure?

The Australian Business Foundation has coined the term "smart infrastructure" to denote what it believes is required for economic development of regions in Australia for the future^{169 170}. It is argued that the old approach of regions seeking to be self sustainable will not work in the future, and smart infrastructure should seek to link regions with other regions to seek resources that they need and to overcome what used to be called the "tyranny of distance" but which in the future will be little more than a relative inconvenience. This style of thinking is very relevant to the Namoi because of its potential access to major centres around Sydney and Brisbane if transport infrastructure were to improve.

Key issues to be addressed in achieving smart infrastructure in the future include:

- Regional identity and control of infrastructure choices.
- New and better ways of paying for and managing infrastructure.
- The mismatch between local community expectations and processes for political and bureaucratic decision making.

Four key areas for achieving smart infrastructure are:

- Investment in 'knowledge' infrastructure, like technology parks, industry clusters and education/business linkages that turn regions into hubs of high performance industries.
- Attention to infrastructure that connects people and places in and between regions, particularly transport and telecommunications, because of their role in stronger business and economic performance.
- Better and more imaginative alignment of State and regional responsibilities for infrastructure planning and use.
- Actions to build more effective partnerships between the public and private sectors for managing and financing infrastructure.

The elements of Smart Infrastructure are:

- Factors that reduce investment and operating uncertainty, such as transparency in government processes, leadership directions and economic management.
- Infrastructure to support basic production processes such as transport, labour, communications, power, and the like.
- Workforce skills and accessibility to quality education institutions for ongoing skills development.

Economy

- Infrastructures/programs that underpin the development and commercialisation of new ideas (i.e. innovations).
- Business cultures that promote competition, collaboration, entrepreneurship, risk taking, and openness to new ideas.
- Connectedness to other members of the value chain, including relevant research institutions and brokers of market intelligence, capital, etc., a characteristic that can be summed up by the term 'clustering'.
- Quality living environments that offer the necessary services for attracting and retaining knowledge workers.
- A strong cultural economy which helps to power the industrial economy with new ideas and keeps knowledge workers engaged with their local community.
- Social cohesion, whereby the various economic and other agents in the community have a strong sense of shared future and a willingness to support each other's ultimate competitiveness.

ENVIRONMENT

Farming irrigation uses 60% of all water taken from rivers and aquifers globally, and while the world grows twice as much food as it did a generation ago, we use three times as much water to do it.

Richard Watson¹⁵

Biodiversity

In Australia

Decision makers in the Namoi will be well aware of concerns about how to balance land-use for food production and other industrial uses with protection of biodiversity. The recent State of the Environment report¹⁷¹ highlighted the limited amount of information on which to judge impacts of land use on biodiversity and the need to pay closer attention to economic and social benefits to humans from functioning ecological systems, but also noted the progress that has been made in recent years towards better institutional arrangements for balancing different land uses. Michael Archer¹⁷² has recently provided graphic information on the change in biodiversity in Australia in geological time. The key message for scenario planning in the Namoi, is that there will be uncertainty about how much political interest there will be in biodiversity conservation, what role regulation might play in protecting biodiversity, and what will be learned in coming decades about the functional interactions between biodiversity, ecosystem and social resilience, and economic development.

Globally

The international literature talks about the likelihood of massive global biodiversity of declines, the possibility of 'tipping points' that could lead to irreversible declines in our ability to feed ourselves and trigger feedback mechanisms such as increases in vulnerability to new diseases and climate change. There is talk of a "sixth extinction crisis" in which upwards of half all species could functionally vanish in next century. It is argued that 'human selection' is becoming the driving force behind evolution rather than 'natural selection'^{173 174}. Therefore, there could be intense international pressure to conserve biodiversity in coming decades, although the strength of this pressure is uncertain and could fluctuate.

The FAO, in collaboration with the International Livestock Research Institute (ILRI) and other groups, surveyed farm animals in 169 countries, to produce a report of global livestock. This report shows that many local varieties of livestock are declining due to the promotion of common varieties. About 20 percent of farm animal breeds have been brought to the brink of extinction as world agriculture narrows its focus to just the most productive livestock¹⁷⁵.

Climate change

In Australia

Climate change science is evolving rapidly, with an emphasis on local impacts. The models produced by the International Panel on Climate Change (IPCC) are conservative and there are some alarming indicators around the possibility that impacts at the upper limits of the IPCC models are already in train or might occur sooner than anticipated.

Possible impacts of climate change on Australia in coming decades include¹⁷⁶:

Environment

- Increased severity of droughts
- Greater frequency of extreme events, including heavy rains, floods, storm surges, tropical cyclones, mid-latitude storms and heavy rain events
- Increase in temperatures by 0.4 to 2.0 °C by 2030, and 1.0 to 6.0 °C by 2070, relative to 1990 (greater increases inland than near the coasts) with associated increases in potential evaporation and heatwaves, and fewer frosts
- Changes of rainfall in the south-west in the range of –20% to +5% by 2030, and –60% to +10% by 2070, with changes of –10% to +5% by 2030 and –35% to +10% by 2070 in parts of south-eastern Australia.
- Projections for impacts of climate change on crop yield in Australia¹⁷⁷ are uncertain with both increases and decreases possible.

The latest report from the International Panel on Climate Change³⁰ draws the following conclusions: *"Water security problems are projected to grow by 2030 in southern and eastern Australia; and, significant loss of biodiversity is projected to occur by 2020 in some ecologically rich sites including the Great Barrier Reef and Queensland Wet Tropics. Population growth and coastal development in south-east Queensland and in Cairns are expected to compound risks from sea-level rises and from increases in the severity and frequency of storms and coastal flooding by 2050".*

The key message with respect to scenario planning is that land managers need to prepare for a wide range of potentially extreme possibilities and planning to deal with the average predictions of climate change models is not a useful risk management strategy.

Worldwide, most people consider climate change a serious problem (see below). Recent events indicate this is occurring in Australia as well (e.g. **Error! Reference source not found.**).

Box 1: Ten steps to rapid change

The Climate Institute (Australia)¹⁷⁸ suggests that the following trends will cause a "tipping" point in attitudes towards, and action about, climate change in the very near future:

- 1 Science: The scientific evidence is now strong and still growing
- 2 The USA: The USA is now taking concerted action on climate change despite its government previously being reluctant
- 3 Business: Global business is driving the establishment of a global economy that controls carbon
- 4 Media: A global spike in the quantity and quality of media coverage has brought climate change to the front of public awareness
- 5 Energy security and oil prices: Oil and gas over-dependencies have created new impetus to reduce fossil fuel consumption. This widespread concern has ushered in a new group of advocates for energy security and climate change action
- 6 International policy: Kyoto, the G-8 and other international forums are establishing tougher parameters for global action to reduce greenhouse gas emissions and address climate change
- 7 Carbon profits: International carbon trading markets have exploded and are projected to become major commodity markets
- 8 Clean energy: Renewable energy is now mainstream and booming
- 9 Pop culture: Climate change is now part of popular culture
- 10 Moral issue: Climate change has been embraced as a moral issue by churches, faiths and spiritual leaders

Environment

Global trends and attitudes towards climate change

Worldwide, most people consider climate change a serious problem. A majority of the public in many countries now believes that they will see the impacts of climate change in their lifetimes and that adaptation will be essential for limiting the damages (even in the US).

- In a poll of 33,237 people from all major regions of the world conducted by GlobeScan Incorporated between October 2005 and January 2006, an average 90% of respondents said that “climate change or global warming, due to the greenhouse effect” is a serious problem¹⁷⁹.

As well as these impacts of gradual climate change, there is the possibility of several climatic rapid and surprising changes -called “large-scale singular events” by the International Panel on Climate Change¹⁸⁰. These plausible, abrupt and likely irreversible Earth system events could take more than a century to come about some could occur within decades. McCarthy et al¹⁸⁰ state: *“Human-induced climate change has the potential to trigger large-scale changes in Earth systems that could have severe consequences at regional or global scales. The probabilities of triggering such events are poorly understood but should not be ignored, given the severity of the consequences.”*

Climatic rapid and surprising changes include complete or partial shutdown of the North Atlantic and Antarctic Deep Water formation, disintegration and melting of the West Antarctic and Greenland Ice Sheets, and major changes in the carbon cycle due to biospheric effects (Appendix 2)

Climate change impacts might be occurring at an ever faster rate, according to several recent studies. A series of studies has suggested that global warming is accelerating three times more quickly than feared. They have found that emissions of carbon dioxide have been rising at thrice the predicted rate in the 1990s. The Arctic ice cap is melting three times as fast - and the seas are rising twice as rapidly - as had been predicted. It is suggested that another decade of business-as-usual carbon emissions will make it too late to prevent the ecosystems of the north from triggering runaway climate change^{181 182}

- Warming and shifting in seasonal patterns in the northern hemisphere is seeing many of the world's mountain glaciers melting at a faster rate than at any time in the past 150 years¹⁸³.
- It is expected that levels of the greenhouse gas methane will rise sharply in the next few years, warming the planet faster than previously expected¹⁸⁴.

The idea that forests are going to combat the rise of CO₂ in the atmosphere has, probably been overstated. For five years, multiple studies by leading centres for climate modelling suggest that while forests have strong cooling effects in the tropics, they have an equally strong warming effect at high latitudes¹⁸⁵. The accelerating destruction of the rainforests that form a cooling band around the Earth's equator is now being recognised as one of the main causes of climate change (it contributes about 20% of greenhouse gases)¹⁸⁶. Carbon emissions from deforestation far outstrip damage caused by planes and automobiles and factories¹⁸⁷. The global effort to stem climate change could soon include paying countries in the tropical belt to not cut down their rain forests, beginning with a World Bank pilot project¹⁸⁸

- Indonesia is among the world's top three greenhouse gas emitters because of deforestation, peatland degradation and forest fires, according to a 2007 World Bank and British government climate change report¹⁸⁹. Indonesia's rainforests are being stripped so rapidly because of illegal logging and palm oil plantations for bio-fuels; they could be wiped out altogether within the next 15 years¹⁹⁰.

The extent to which security risks are exacerbated by climate change processes has been underestimated¹⁹¹. There could be as many as 50 million environmental refugees in the world in five

Environment

years time. This is likely to include eco-refugees from Pacific islands as sea level rises and other 'eco-refugees' displaced by ecological disasters caused by natural forces and wars¹⁹². Already environmental degradation forces as many people away from their homes as political and social unrest. Other movements of people, for example from rural areas to coastal cities, is likely to become an increasing problem when combined with climate change¹⁹³.

As well, concern is being voiced about the loss of diversity in agricultural genotypes due to the focusing of breeding technologies in a few large corporations. For example, 20 percent of animal breeds are said to be at risk of extinction¹⁷⁵.

Late action will cost more than early action on climate change. The 2006 Stern Review said that without new preventative measures, the overall cost of climate change could be equivalent to losing 5% of global GDP each year. A (2006) Tufts University study agreed, noting failure to fight global warming could cost \$20 trillion a year by the end of the century; not including costs of biodiversity loss or unpredictable events like the shutdown of the Gulf Stream. (That is equal to about 6 to 8 percent of projected world economic output at century's end). The World Economic Forum (WEF) upped its assessment of the risk posed by climate change, estimating that it could cause up to \$250 billion of economic losses over the next 10 years. WEF's assessment of the risk of water shortages, tropical storms and inland flooding was also increased, along with a rash of other potential disasters such as a global pandemic, international terrorism and civil war. Although there is some disagreement about the magnitude of these figures, there is broad agreement that costs will be substantial and that action needs to be taken to protect the standard of living for future generations¹⁹⁴ - although interestingly some argue that the actions should be aimed at building human capital now and addressing carbon emissions later¹⁹⁵.

Countries that have not signed Kyoto might face trade barriers and penalties. It has been suggested by some that the World Trade Organization (WTO) should impose duties on exports of steel and other energy-intensive products from the USA because that country benefits unfairly from its refusal to join the Kyoto Protocol limiting carbon dioxide emissions and other greenhouse gasses¹⁹⁶. The ways in which the post-Kyoto processes play out could have a range of implications for Australia and this remains an area of significant uncertainty.

Some novel and "science fiction" approaches to climate change are emerging. Many of these will go nowhere but they are worth keeping an eye on because history has shown that many of the technological advances that take us by surprise start out as "science fiction". Future climate change may be reduced through mitigation (reductions in greenhouse gas emissions) or through geo-engineering. A number of scientists say it would be foolhardy to rule out the most ambitious projects^{197 198}.

- The latest climate modelling hints that shading the globe by spewing megatons of sulphurous debris into the stratosphere to counteract greenhouse warming could actually work. This action could substantially offset future warming and provide additional time to reduce human dependence on fossil fuels and stabilize CO₂ concentrations cost-effectively at an acceptable level¹⁹⁹.

Contention and debate around climate change is increasing and is likely to continue to be a feature of the media in coming years. According to Nina Utne, between 1993 and 2003, not a single peer reviewed article published in a scientific journal cast doubt on global warming. However, over a similar 10-year period, more than 53 percent of mainstream news articles covering the topic did^{200 201}.

A World Environment Organisation?

There is a debate about whether a World Environment Organization should be set up. Under a WEO, partial centralisation of international environmental affairs is possible; however, if

Environment

properly designed, A WEO has the potential of making an important improvement in the environmental governance of our planet²⁰².

Water scarcity

Freshwater shortages are likely to trigger increased environmental damage and social unrest over the next 15 years. The number of failed states may rise significantly; especially in Asia-Pacific – this means they are vulnerable to violent internal conflict²⁰³. Demand for water is rising while supplies are declining; aquifers worldwide are being run dry (hence rainwater becomes a primary water source); and, the percentage of food produced from irrigated cropland is increasing (about 40%) now. The *2006 Global International Waters Assessment*¹³⁴ indicates that agriculture poses the biggest threat to the world's freshwater resources, while over-fishing threatens the oceans²⁰⁴.

Five flashpoints for potential water wars some experts say are looming: India and Pakistan, India and Bangladesh, Israel, Jordan, Syria, Lebanon and Palestinian Territories, Egypt, Sudan and Ethiopia, Turkey, Syria and Iraq. One-third of the world's population is living in water-scarce areas. Asia has less fresh water - per person - than any other continent outside of Antarctica²⁰⁵.

- China is suffering from water shortages for crops and domestic use²⁰⁶. The Ogallala aquifer, that feeds the USA Great Plains, is running low²⁰⁷. Water conflicts could plague India in the coming decades. Himalayan glaciers melting will affect South Asia's and China's drinking water supply²⁰⁸. Similarly, Mountain glaciers located in equatorial Africa are on their way to disappearing within two decades (on the border between Uganda and the Democratic Republic of Congo). The glaciers will be gone within 20 years if current warming continues.

Water theft is emerging as a new crime globally. Already some major corporations have been implicated¹⁵.

The prospect of water shortages, scarcities, and stresses will have important impacts on businesses. Scenarios from the World Business Council for Sustainable Development in 2006²⁰⁹ suggest that water should be high on the business agenda because all businesses depend on water. More broadly, firms are looking at whether climate change could affect their bottom lines. Some of the insurance industries' largest companies are putting these issues at top of agendas²¹⁰. As global warming's effects play out it is anticipated there will be an increase in litigation against governments and companies in the USA to rival tobacco litigation²¹¹.

It might be wise to include virtual water accounting in any national or regional water and agricultural policy analysis. Virtual water trade between nations can relieve the pressure on scarce water resources and contribute to the mitigation of water scarcity at both local and global levels. For China for instance, relatively dry in the north and relatively wet in the south, domestic virtual water trade is a relevant issue²¹².

POLITICS AND GOVERNANCE

Politics

Recent trends in Australian federalism show a shift from competitive and co-operative federalism to a system of 'pragmatic federalism'²¹³ where the Commonwealth uses its array of financial and legislative powers to intervene selectively in areas of traditional State responsibility to make ideological or political points. In doing so, the Commonwealth undermines the benefits of federalism and exacerbates problems such as duplication and excessive administrative burdens. Commentators indicate there are three main areas in which reform is needed:

- Reallocation of roles between the Commonwealth and State and Territory Governments to reduce duplication and clarify responsibilities (urgent primary care, mental health, acute health service model redesign is required).
- Improvement in the mechanisms for inter-governmental co-operation.
- Reform of federal–state financial relations, both in the operation of specific purpose payments and in the level of vertical fiscal imbalance.

Many of these reforms could be achieved through cooperation and the referral of power where necessary. However, a constitutional convention may be a useful means of reaching consensus on these reforms and proposing any constitutional amendments that could enhance the future operation of the Australian federation²¹⁴.

Globally, interest and engagement in politics is waning. For example, a recent study reported that more people over the age of 18 voted on the TV programme American Idol than in the US election the same year¹⁵.

In a background paper for the Business Council of Australia scenarios in 2004, Patrick Weller²¹⁵ suggested that, while it is exceptionally difficult to predict details of the administrative form and intellectual framework of government in the next few decades, the following outcomes are relatively certain:

- The political scene is likely to continue with the same parties dominant in the House of Representatives and most State lower houses
- The major political parties probably will continue their focus on recruiting and training professional politicians and on highly organised manipulation of the electorate, with members coming into parliament earlier (with less connection to their electorates) and leaving younger, particularly if they do not have the chance to be a minister.
- Party membership will remain small as modern communications do not require a mass party to run campaigns.
- Voters will receive tailored messages at home, based on their interests and demographics.

Politics and Governance

- There will be a fewer safe seats on each side, as economic status and vote become increasingly disconnected, voters become more discriminating and sophisticated, and even apparently popular leaders can face surprising swings if they lose voter confidence.
- What the parties stand for will change according to the economic and international circumstances.
- People will increasingly identify with social movements as much as or more than with political parties and these movements might play increasing roles in the Senate.
- The disconnection between the people and the parties is likely to lead to an even greater sense of alienation.

Interestingly, Weller also thought that an upper house of parliament that has a different composition from the lower houses was likely to persist. Perhaps the current situation is a temporary aberration and governments having a majority in both houses will be unusual?

The "professionalisation of politics" is a global trend¹⁵. It is likely to mean that bringing about change will require getting broad public support before political action is taken rather than the other way around. It brings into question where civic leadership will come from in the future.

According to Weller, there are a number of current tensions for which resolutions in the next decades are unpredictable (Table 7).

Table 7: Tensions leading to uncertainty about the future of Australian politics and governance²¹⁵

The rhetoric to decentralise, to consult and to provide choice,	Versus	A push to centralise, to increase executive power;
Talk of the need for a more substantive parliamentary role	Versus	Complaints that the Senate is obstructive and undemocratic
Alienation from, and declining trust in, government, and resistance to pay more taxes	Versus	Demands that governments do something about issues like the environment, prices, marriage and others
Scepticism about the public service	Versus	A continuing belief in its importance, so it has to do more with less
Popular desire for Australia to become a republic	Versus	Reality that an Australian prime minister has all the advantages of a president and almost none of the restraints
Communication technology and declining confidence in governments gives non-government organisations exposure and a chance to become the new voice of the people	Versus	Communication technology makes prime ministers more powerful than ever before through ability to gain intelligence, communicate issues and control agendas

For some years there has been debate about changes to the Australian Constitution, particularly in the areas of human rights and relative powers and responsibilities of State and Commonwealth governments²¹⁶. The balance between Federal and State powers has become an increasing issue over the past 12 months and has implications for local and regional government. The November 2006 High Court of Australia decision on the Federal Government's WorkChoices legislation has had a major impact on thinking about State-Federal relations. The decision states that the constitution prescribes the existence of the States but says nothing about their functions. It also validates the use of corporations power, which potentially gives the Federal Government wide-ranging opportunities to legislate in areas traditionally consider the provenance of the

Politics and Governance

States. It seems likely that changes in the balance of responsibility between levels of government will occur in small steps rather than wholesale changes to the Constitution, although the latter is still a possibility^{215 216}.

Geopolitics

There has been ongoing discussion for several decades about Australia's role in the Asia-Pacific region. As the implications of Australia's involvement in Iraq and Afghanistan become clearer, there may be increasing the debate about both political and economic alliances.

In its thinking about the future, elements of the Australian business community recently expressed concern about the impacts of political, economic, social, and environmental unrest in the Asia-Pacific region¹⁶⁸. Issues of concern included:

- Conflict between China, Taiwan, and/or Japan
- Failed states in the Pacific requiring financial, law and order, and/or environmental assistance
- Environmental and/or political refugees seeking to enter Australia
- Over enthusiastic investment by Australian businesses in the developing Chinese economy making Australia vulnerable to China shifting its economic alliance (for example to eastern Europe).

Some years ago, Shell developed a scenario considering the different business practices that might be needed if a Western country were to adopt Asian ways of doing business (for example, if negotiations were based much more on relationships than on factual arguments)²¹⁷. This scenario remains pertinent for coming decades because it points out some of the constraints that Australian businesses are likely to face when trying to access Asian markets. Asian markets are likely to be a major and growing opportunity for industries located in the Namoi in coming decades.

New sources of conflict?

It is becoming commonplace now to hear discussion about future wars over oil and water, but it is also suggested that resources such as grain markets, which are currently under the control of a few Western nations, could be the focus for conflict¹⁵. Such conflicts could have major repercussions for catchments like the Namoi.

Governance

Over the past three decades, Australia has seen an unprecedented experiment in regional and catchment governance. The Natural Heritage Trust and the National Action Plan for Salinity and Water Quality arose from this process. Although imperfect¹⁷¹, these initiatives have seen a greater move to wards the devolution of decision-making to those closest to environmental and social trends in regions. Elsewhere in the world, social researchers have worked to understand the way that institutions develop within communities and how alternative institutional arrangements evolve to meet the new challenges^{218 219 220}.

The concept of "resilience", which originally evolved separately in engineering, psychology, and ecology, has received considerable attention and lessons learned from ecosystems have been applied to rule social systems^{221 222 223}. From this concept has

Politics and Governance

emerged the idea that social systems, like ecological systems, go through cycles of increasing complexity followed by partial or total collapse and then re-organisation²²⁴.

Related research has emerged on the reasons for collapse in past societies, which include:

- Climate change
- Hostile neighbours
- Lack of friendly trade partners
- Inappropriate societal responses to challenges
 - Failure to anticipate
 - Failure to perceive
 - Rational bad behaviour
 - Disastrous values^{225 226}

The key message for those contemplating institutional challenges in the future of the Namoi catchment is that societies naturally want to feel comfortable with the institutional arrangements that have and are very good at ignoring the early warning signs of approaching problems and the need to adapt or transform their institutions.

Another conclusion that has arisen from research on social change is that, although we are able to explain in retrospect why change has occurred in the past, there is very little theory that enables researchers to predict when and how social change will occur²²⁷.

Global catchment alliances?

Two major emerging global trends could combine to make life very interesting for catchment managers in future. As communication becomes more and more open, global and non-discriminatory in terms of ethnic or national boundaries^{201 15}, exchange of experiences and information need not be any harder across long distances than it is across catchment boundaries. Many future commentators are suggesting that globalisation might not necessarily continue to grow and that we might see increased focus on local management of a range of environmental, social, and economic issues^{12 15}. The Millennium Assessment scenarios¹² explored the possibility of global alliances among catchments that faced similar challenges in different countries and on different continents.

REFERENCES

1. Senge, P. M. (1994). 'The fifth discipline: The art and practice of the learning organisation.' (Doubleday: New York, USA).
2. Glenn, J. C. and Gordon, T. J. (2003). 'Futures Research Methodology Version 2.0.' (AC/UNU Millennium Project: Tokyo, Japan). <http://www.acunu.org/millennium/FRM-v2.html>
3. Saffo, P. (2007). Six Rules for Effective Forecasting. managing for the long term. *harvard business review* july/august 2007, 122-131.
4. Namoi Catchment Management Authority (2006). 'Namoi Catchment Action Plan. Part B. Natural Resource Management Plan.' (Namoi Catchment Management Authority: Tamworth, Australia). <http://www.namoi.cma.nsw.gov.au/pages/thecatchmentactionplan.htm>
5. Wang, Q.J., Soste, L., Robertson, D., Handley, S., and Chaffe, R. (2006). Scenario planning for irrigation futures of the Goulburn Broken Region. In 'Practice change for sustainable communities: Exploring footprints, pathways and possibilities: APEN 2006 International Conference, La Trobe University, Breechworth, Victoria, Australia, 6 – 8 March 2006. (Eds Petheram R.J. and Johnson R.C.) (La Trobe University: Victoria, Australia.). Published online at: www.regional.org.au/au/apen/2006
6. O'Connor, M. H., McFarlane, M., MacRae, D., and Lefroy, E. C. (2004). 'Avon River Basin 2050: four regional scenarios for the next half-century. A report prepared for the partners of the ARB2050 project.' (CSIRO Sustainable Ecosystems: Canberra, Australia). <http://www.csiro.au/resources/pfhr.html>
7. Cork, S. and Delaney, K. (2005). 'Thinking about the future of Australia's landscapes.' (Land & Water Australia: Canberra, Australia). http://downloads.lwa2.com/downloads/publications_pdf/PK040780_full_report.pdf
8. Dunlop, M., Turner, G., Foran, B., and Poldy, F. (2002). 'Decision points for land and water futures. Resource Futures Program Working Document 2002/08.' (CSIRO Sustainable Ecosystems: Canberra, Australia). http://www.lwa.gov.au/sirp/research_current.asp
9. World Business Council for Sustainable Development. The Wizard of Us. Sustainable Scenarios Project. 2000 'World Business Council for Sustainable Development. The Wizard of Us. Sustainable Scenarios Project. 2000.' (World Business Council for Sustainable Development. The Wizard of Us. Sustainable Scenarios Project. 2000: <http://www.wbcsd.ch/DocRoot/9FgNXFBcLUWt3jPW9ram/wizardofus.pdf>
10. Raskin, P., Gallopin, G., Gutman, P., Hammond, A., and Swart, R. (1998). 'Bending the Curve: Toward Global Sustainability.' (The Stockholm Environment Institute: Stockholm, Sweden). <http://www.gsg.org/index.html>
11. Costanza, R. (2000). Visions of alternative (unpredictable) futures and their use in policy analysis. *Conservation Ecology* 4, 5 [on line]. <http://www.consecol.org/vol4/iss1/art5>
12. MA (Millennium Ecosystem Assessment) (2005). 'Ecosystems and Human Well-Being: Volume 2. Scenarios.' (Island Press: Washington DC, USA). <http://www.maweb.org>
13. Cork, S. J., Peterson, G. D., Bennett, E. M., Petschel-Held, G., and Zurek, M. (2006). Synthesis of the storylines. *Ecology and Society* 11, [online] URL: <http://www.ecologyandsociety.org/vol11/iss2/art11/>.
14. SustainAbility Ltd (2007). 'Raising Our Game: Can We Sustain Globalization? First Edition 2007.'

References

- (SustainAbility Ltd: London, UK). <http://www.sustainability.com/raising-our-game/>
15. Watson, R. (2007). 'Future files. A History of the next 50 years.' (Scribe: Melbourne, Australia).
 16. Javidan, M. (2007). Forward-Thinking Cultures . *harvard business review* july-august, 1.
 17. Duncan, R. and Wilson, C. (2004). 'Global population projections - Is the UN getting it wrong? A report for the Rural Industries Research and Development Corporation.' (Rural Industries Research and Development Corporation: Canberra, Australia).
 18. UN. World Population Ageing. 2007. United Nations, Population Division.
 19. Roberts, S. Minorities Now Form Majority in One-Third of Most-Populous Counties. August 9, 2007.
 20. Bloom, David E and Canning, David. Contraception and the Celtic Tiger. 34(3), 229-247. 2003.
 21. Bloom, D. E. and Canning, D. (2005). 'Global Demographic Change: Dimensions and Economic Significance. Harvard Initiative for Global Health Working Paper Series, Program on the Global Demography of Aging, Working Paper No. 1.' (Harvard School of Public Health: Boston, USA).
 22. Commonwealth of Australia (2007). 'Intergenerational Report 2007.' (Commonwealth of Australia: Canberra).
 23. :Yeoh, B. S. A., Lutz, W., Prachuabmoh, V., and Arifin, E. N. G. E. (2003). Fertility Decline in Asia: Trends, Implications and Futures. *Journal of Population Research* 20, 1-142. <http://www.jpr.org.au/index/jpr201>
 24. New England/ North West Region (2006). 'Two Ways Together. Regional Report.' (New England / North-West Region: Tamworth, NSW, Australia).
 25. Stein, Rob. Baby Boomers Appear to Be Less Healthy Than Parents. Washington Post. 2007. Washington
 26. Slucki, Lidia Department of Human Services Victoria. Personal communication. 2007.
 27. WHO2007. The World Health Report 2007. A safer future: global public health security in the 21st century. World Health Organisation.
 28. Saker, L., Lee, K., Cannito, B., Gilmore, A., and Campbell-Lendrum, D. (2004). 'Globalization and Infectious Diseases: A Review of the Linkages.' (World Health Organisation (WHO): Geneva, Switzerland).
 29. Nutt, Amy Ellis. Tracking a killer that knows no borders. The Star Ledger. 2006. New Jersey
 30. UN(IPCC)2007. Climate Change 2007 . Fourth Assessment Report (AR4). New York, United Nations Intergovernmental Panel on Climate Change.
 31. Wenner, Melinda. Anger Fuels Better Decisions. Livescience.com , http://www.livescience.com/health/070611_anger_rational.html. 2007.
 32. Majid Ezzati, M., Vander Hoorn, S., Lawes, C. M. M., Leach, R., James, W. P. T., Lopez, A. D., Rodgers, A., and Murray, C. J. L. Rethinking the "Diseases of Affluence" Paradigm: Global Patterns of Nutritional Risks in Relation to Economic Development. *PLoS Med* 2[5], e133 doi:10.1371/journal.pmed.0020133. 2005.
 33. Ring IT and Brown N (2002). Indigenous health: chronically inadequate responses to damning statistics. *Medical Journal of Australia* 177, 629-631.
 34. Australian Institute of Health and Welfare (2006). 'Chronic diseases and associated risk factors in Australia.' (Australian Institute of Health and Welfare: Canberra).

References

- <http://www.aihw.gov.au/publications/phe/cdarfa06/cdarfa06.pdf>
35. Best, J. (2007). NSW gets AU\$4m remote diagnosis tech boost. *ZDNet Australia* 20 July 2007, <http://www.zdnet.com.au/news/communications/soa/NSW-gets-AU-4m-remote-diagnosis-tech-boost/0,130061791,339280307,00.htm>.
 36. Chen, Z., Yu, X., and Feng, D. A Telemedicine System over the Internet. Paper presented at Visualisation 2000, Pan-Sydney Workshop on Visual Information Processing. Conferences in Research and Practice in Information Technology. Vol. 2. 2001. Sydney, Australia, The University of Sydney, Biomedical and Information Technology Group, Basser Department of Computer Science
 37. Co-operative Bank (2005). 'Ethical Consumerism Report.' (The Co-operative Bank : Manchester, U.K.). <http://www.co-operativebank.co.uk/servlet/Satellite?c=Page&cid=1177658000641&pagename=CB%2FPage%2FplStandard&loc=1>
 38. Hamilton, C. and Rush, E. (2006). 'The Attitudes of Australians to Happiness and Social Well-being.' (The Australia Institute: Canberra. Australia).
 39. Pew Research Center. Pew Global Attitudes Project. 22 September 2007. Pew Research Center. <http://pewglobal.org/>
 40. Ipsos Mackay (2005). 'Where are we headed as a community? National Omnibus Poll, November.' (Ipsos Mackay Public Affairs: Sydney).
 41. Ipsos Mackay (2005). 'Mind & Mood. The Ipsos Mackay Report no. 116.' (Ipsos Mackay Public Affairs: Sydney).
 42. Eckersley, R. (2005). 'Well & Good: Morality, Meaning and Happiness.' (Text Publishing: Melbourne).
 43. Eckersley, R. What's wrong with the official future? Hassan, G. After Blair: Politics After the New Labour Decade. 2006. London, U.K., Lawrence and Wishart
 44. Eckersley, R. (2006). Losing faith in the official future. *Australia Institute newsletter* June.
 45. Tuchman, B. (1989). 'A Distant Mirror the Calamitous 14th Century.' (Papermac: London, U.K.).
 46. Cork, S, Stoneham, G, and Lowe, K2007. Ecosystem Services and Australian NRM Futures. Draft Paper to NRPPC (May 2007). Prepared by the Ecosystem Services Working Group (Steven Cork (DEW, Canberra), Gary Stoneham (DSE, Victoria) Kim Lowe (DSE, Victoria).
 47. Salt, B. (2001). 'The Big Shift: Welcome to the Third Australian Culture.' (Hardie Grant Books : Sydney, Australia).
 48. Peralta, Christina. Urbanization Continuing Rapidly Across The Globe. 2007. Planetizen. <http://www.planetizen.com/node/24330>
 49. Slater, E. Shantytown: Livelihood and World Economy. Paper presented at the annual meeting of the American Sociological Association, Aug 14, 2004. Online .PDF. 2006-10-05, http://www.allacademic.com/meta/p109333_index.html. 2004. San Francisco, California
 50. UNFPA (United Nations Population Fund) (2007). 'Urbanization: A Majority in Cities .' (United Nations Population Fund: New York,). <http://www.unfpa.org/goals/urbanization.htm>
 51. Grimm, N. B., Morgan-Grove, J, Pickett, S, and Redman, CL. Integrated Approaches to Long-Term Studies of Urban Ecological Systems. 50(7), 571-584. 2000.
 52. Hoehn, John P., Lupi, Frank, and Kaplowitz, Michael D. Untying a Lancastrian bundle: valuing ecosystems and ecosystem services for wetland mitigation. *Journal of Environmental Management* 68[3], 263. 2003/07//. <http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=10117115&site=ehost-live>

References

53. Auckland City Council (2003). 'Auckland City's Growth Management Strategy. Part 2 What is Auckland City aiming for?' (Auckland City Council: Auckland, New Zealand).
54. Weiss, E. M. Around D.C., a Cheaper House May Cost You Longer Commutes Outweigh Savings of Living in Outer Suburbs, Study Shows. A01. October 12, 2006.
<http://www.washingtonpost.com/wp-dyn/content/article/2006/10/11/AR2006101101883.html>
55. Dodson, J. and Sipe, N. (2007). Cracks in the veneer . *Griffith REVIEW* 15 .
56. Putnam, Robert D. E Pluribus Unum: Diversity and Community in the Twenty-first Century The 2006 Johan Skytte Prize Lecture. *Scandinavian Political Studies* 30[2], 137-174. 2007.
57. Houston, P. (2005). Re-valuing the Fringe: Some Findings on the Value of Agricultural Production in Australia's Peri-Urban Regions. *Geographical Research* 43, 209-223.
58. Gurrán, N., Squires, C., and Blakely, E. (2005). 'Meeting the Sea Change Challenge: Best Practice Models of Local and Regional Planning for Sea Change Communities in Coastal Australia. Executive Summary: Sea Change Communities in Coastal Australia.' (Planning Research Centre, University of Sydney: Sydney, Australia).
<http://www.seachangetaskforce.org.au/Publications/Meeting%20the%20Challenge.pdf>
59. Buxton, M., Goodman, R., and Tieman, G. Change and Continuity on the urban fringe: an analysis of international trends in peri-urban development. Presentation to World Planning Schools Congress Mexico City. 2006. Change and Continuity in Peri-urban Australia project.
<http://www.periurban.org.au/publications.htm>
60. Elliott, Stuart W. Projecting the Impact of Computers on Work in 2030. Prepared for the Workshop on Research Evidence Related to Future Skill Demands, May 31-June 1, 2007. 2007. Center for Education, National Research Council
61. ILO (International Labor Organisation) (2007). 'Global Employment Trends Brief, January 2007.' (The International Labor Organisation: Geneva, Switzerland).
<http://www.ilo.org/public/english/employment/strat/download/getb07en.pdf>
62. OECD (2006). The Service Economy in OECD Countries. *OECD Industry, Services & Trade* 2005, 28-63. <http://www.ingentaconnect.com/content/oecd/16080203>
63. McLachlan, R., Clark, C., and Monday, I. (2002). 'Australia's Service Sector: A Study in Diversity. Productivity Commission Staff Research Paper.' (AusInfo: Canberra, Australia).
64. Australian Government (2007). 'Statement 4, Australia's Labour Force Utilisation, Budget 2007-08.' (Australian Government: Canberra, Australia). http://www.ato.gov.au/budget/2007-08/bp1/html/bp1_bst4-01.htm#TopOfPage
65. Argy, F. (2003). In 'Where to from here? Australian egalitarianism under threat. (Allen & Unwin: Sydney.).
66. Argy, F. (2006). 'Equality of opportunity in Australia, Myth and reality. Discussion Paper Number 85.' (The Australia institute: Canberra. Australia).
67. Reserve Bank of Australia. Statement on Monetary Policy November 2006 . Reserve Bank of Australia.
http://www.rba.gov.au/PublicationsAndResearch/StatementsOnMonetaryPolicy/Nov2006/domestic_economic_conditions.html
68. Furnham, A. The Psychology of Change Management. Woodhead, A., Jenkins, A., and Packham, R. OECD CRP Workshop on "An Interdisciplinary Dialogue: Agriculture and Ecosystems Management" . 34-45. 2003. Australia, NSW Agriculture, Australia
69. Chippendale, P. 2002. Values of the Australian Workforce 2001. MineEssence group . 2002. MineEssence group. http://www.minessence.net/articles/oz_wk_val_shift.htm

References

70. Moravec, H. (1998). When will computer hardware match the human brain? *Journal of Evolution and Technology* 1. <http://www.transhumanist.com/volume1/moravec.htm>
71. Broderick, D. (2001). 'The Spike: How Our Lives Are Being Transformed by Rapidly Advancing Technologies.' (Tom Doherty Associates: New York).
72. Vinge, V. (2003). The Singularity. *Whole Earth Magazine* Reprinted Spring 2003. <http://www.wholeearthmag.com>
73. Morrison, R. (1999). 'The Spirit in the Gene: Humanity's Proud Illusion and the Laws of Nature.' (Cornell University Press: Ithaca, New York and London, England).
74. Kluger, J. How Americans Are Living Dangerously. *Time* . Saturday, Nov. 25, 2006.
75. Kaufman, S. Investigating the role of reflexivity in intentionally achieving social change for sustainability: Social Learning and Social Marketing compared. Presented at *Environment, Knowledge and Democracy*, hosted by RC 24 of the International Sociological Association, the University of the Mediterranean, Department of Human Sciences. 2005. Marseille, France, DESMID-UMR Espace and the SHADYC (EHESS-CNRS)
76. Pacala, S. and Socolow, R. (2004). Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies. *Science* 305, 968-972.
77. Socolow, R. (2005). Can we bury global warming? *Scientific American* 293, 49-55.
78. Energy Futures Forum (2006). 'The Heat Is On.' (Commonwealth Scientific and Industrial Research Organisation ('CSIRO') Australia: Canberra, Australia). <http://www.csiro.au/files/files/pbew.pdf>
79. Grubel, J. (2007). Climate To Push Up Australian Power Costs, Study Shows. *ENN News* May 28, 2007, [on line]. <http://www.enn.com/today.html?id=12843>
80. Romeril, B. (2003). 'Testimony to the Senate Community Affairs References Committee: Thursday, 1 May 2003, Melbourne. Reference: Poverty and financial hardship.' (Australian Senate: Canberra, Australia).
81. WEF. Global Risks 2006. 2006. Geneva, Switzerland, World Economic Forum. http://www.weforum.org/pdf/CSI/Global_Risk_Report.pdf.
82. Bullis, K. (2006). 'Increasing Oil Supply.' (MIT Technology Review (online): Boston, USA). www.technologyreview.com/read/article.aspx?id=16767&ch=biztech
83. International Energy Agency (2006). 'World Energy Outlook 2006.' (International Energy Agency: Paris). <http://www.iea.org/Textbase/npsum/WEO2006SUM.pdf>
84. North American Electric Reliability Council (2006). 'Long-Term Reliability Assessment The Reliability of the Bulk Power Systems in North America .' (North American Electric Reliability Council: USA). ftp://www.nerc.com/pub/sys/all_updl/docs/pubs/LTRA2006.pdf
85. International Energy Agency (2006). 'Energy Technology Perspectives -- Scenarios & Strategies to 2050.' (International Energy Agency: Paris).
86. Energy Futures Task Force (2000). 'Fuelling the Future. A consultation document .' (Department of Trade and Industry, UK: United Kingdom). http://www.foresight.gov.uk/Previous_Rounds/Foresight_1999__2002/Energy_and_Natural_Environment/Reports/Fuelling%20the%20Future/Energy_Futures.web.pdf
87. Chatterjee, Neil. World May Turn Back Clock for Liquid Coal Future. *Daily News Story*. 2006. Planet Ark, Planet Ark. <http://www.planetark.com/dailynewsstory.cfm/newsid/36111/story.htm>
88. European Commission (2006). 'European Smartgrids Technology Platform. Vision and Strategy for Europe's Networks of the Future.' (European Commission: Brussels). http://ec.europa.eu/research/energy/pdf/smartgrids_en.pdf.

References

89. Porteous, James and Mogg, Richard. The new oil barrens; Can palm oil be produced sustainably? *Ecos* 132 (Sep 2006), 21-23. 2006.
90. Webber, Jude. Soya poised for Argentinian Energy Breakthrough. September 7, 2006. Reuters News. <http://www.ft.com/cms/s/c595dcc4-3e83-11db-b4de-0000779e2340.html>
91. Pollack, A. DuPont and Syngenta Join in Modified-Seed Venture. April 11, 2006. http://www.nytimes.com/2006/04/11/business/11place.html?_r=1&oref=slogin
92. International Energy Agency (2007). 'World Energy Outlook 2007.' (International Energy Agency: Paris). <http://www.iea.org/Textbase/npsum/WEO2007SUM.pdf>
93. Australian Government Department of Prime Minister and Cabinet. Uranium Mining, Processing and Nuclear Energy- Opportunities for Australia? 2006. Canberra, Australia, Australian Government
94. Saul, J. R. (1993). 'Voltaire's Bastards. The Dictatorship of Reason in the West.' (Penguin: Melbourne, Australia).
95. Allenby, B. (2006). The ontologies of industrial ecology? *Progress in Industrial Ecology* 3, 28-40.
96. Gladwell, M. (2005). 'Blink: The Power of Thinking Without Thinking .' (Little, Brown and Co.: New York, USA).
97. Kelly, K. Speculations on the future of science. 2006. Edge: the third culture. http://www.edge.org/3rd_culture/kelly06/kelly06_index.html
98. Nuffield Council on Bioethics (2002). 'The ethics of patenting DNA a discussion paper July .' (Nuffield Council on Bioethics: London).
99. Eisenberg, R. (2002). How Can You Patent Genes? *American Journal of Bioethics* 2, 3-11.
100. Heller, M. and Eisenberg, R. (1998). Can patents deter innovation? The anticommons in biomedical research. *Science* 280, 698-701.
101. Silbergliitt, Richard and Others () T. . , USA RAND. 2006. The Global Technology Revolution 2020, In-Depth Analyses Bio/Nano/Materials/Information Trends, Drivers, Barriers, and Social Implications. Technical Report. Santa Monica, California, RAND.
102. DCDC (The Development, C. a. D. C. U. M. o. D. (2007). 'The DCDC Strategic Trends Programme, 3rd ed.' (The Development, Concepts and Doctrine Centre (DCDC), UK Ministry of Defence: London).
103. Syme, G. J., Kals, E., Nancarrow, B. E., and Montada, L. Ecological Risks and Community Perceptions of Fairness and Justice: A cross-cultural model. 12, 905-916. 2000.
104. Sharpe, B. and Hodgson, T. (2005). 'Intelligent Infrastructure Futures, Technology Forward Look, Towards a Cyber-Urban Ecology.' (Office of Science and Technology: United Kingdom).
105. WBCSD (World Business council for Sustainable Development) (2004). 'Mobility 2030. Overview.' (World Business council for Sustainable Development:<http://www.wbcsd.org/web/publications/mobility/mobility-full.pdf>
106. Wilson, E. O. (2002). 'The Future of Life.' (Alfred A. Knopf (Random House, Inc.): New York).
107. Powell, R., Chalmers, L., and Bentham, A. (2006). 'The Namoi Economy. Socio-Economic assessment of Namoi catchment action plan. Report to the: Namoi Catchment Management Authority.' (Centre for Agricultural and Regional Economics Pty Ltd: Armidale, NSW, Australia).
108. Ligenfelter, Paul. The World is Flat: Implications for Higher Education Planners and Leaders, May 29, 2006. Keynote address for "Higher Education Facilities: Issues and Trends". An international seminar organized by the OECD Programme on Educational Building (PEB). 2006. Zacatecas, Zacatecas, Mexico

References

109. Bradford, N. (2004). 'Creative Cities Structured Policy Dialogue Backgrounder. Background Paper F/46 Family Network.' (Canadian Policy Research Network: Ottawa, Canada).
110. Pritchett, L. The Future of Migration - Part One & Part Two. YaleGlobal Online . 2003.
111. Castles, S. and Miller, M. J. (2003). 'The Age of Migration: International Population Movements in the Modern World.' (Guilford Press: New York).
112. Williamson, Jeffrey G. Global Migration. Finance & Development, A quarterly magazine of the IMF 43[3]. 2006.
113. Treverton, G. F. and Jones, S. G. (2005). 'Measuring National Power.' (RAND Corporation: Santa Monica, California).
114. Hawksorth, J. (2006). 'The World in 2050, How big will the major emerging market economies get and how can the OECD compete?' (PriceWaterhouseCoopers: United Kingdom).
115. Task Force on the Future of American Innovation (2005). 'The knowledge economy: Is the United States losing its competitive edge? Benchmarks of our innovation future.' (Task Force on the Future of American Innovation:<http://www.futureofinnovation.org/PDF/Benchmarks.pdf>)
116. Garten, J. E. China: The Missing Member at the G-8 Table, The Group of Eight should expand to include a key player in the global economy . 3 June 2004 .
117. Gilboy, G. J. (2004). The Myth Behind China's Miracle . *Foreign Affairs* July/August 2004.
118. Khanna, A. and Huang, Y. (2004). Can India Overtake China? *Foreign Policy* July/August 2003.
119. National Intelligence Council (2004). 'Mapping the Global Future, Report of the National Intelligence Council's 2020 Project.' (National Intelligence Council: Washington, DC, USA).
120. The Economist Intelligence Unit (2006). 'CEO Briefing for 2006 and Beyond .' (The Economist: London, UK).
http://a330.g.akamai.net/7/330/2540/20060213195601/graphics.eiu.com/files/ad_pdfs/ceo_Briefing_UKTI_wp.pdf
121. Sheshabalaya, A. Enduring an IT Eclipse. 30 August 2005.
122. Hess, W. Going Outside, Round-Tripping and Dollar Diplomacy: An Introduction to Chinese Outward Direct Investment. Global Insight . 2006. <http://globalinsight.com>
123. Prahalad, C. K. (2004). 'The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profit, Upper Saddle River, NJ.' (Wharton School Publishing: Pennsylvania, USA).
124. Kelly, E. (2007). 'Prospects for the future.' (Global Business Network: California, USA).
125. de Soto, H. (2000). 'The Mystery of Capital: why capitalism triumphs in the west and fails everywhere else.' (Basic Books: New York).
126. Cassman, K. G. (2007). Climate change, biofuels, and global food security. *Environmental Research Letters* 2 , 011002 [on line]. <http://www.iop.org/EJ/abstract/1748-9326/2/1/011002>
127. Pritchard, Carolyn. Climate: The food chain's weakest link. 2007.
<http://www.marketwatch.com/news/story/climate-us-food-chains-weak/story.aspx?guid=%7BF97F4CE0%2D6CC9%2D492C%2D9F84%2DF3DCCA31B27A%7D>
128. The Royal Society (2005). 'Ocean acidification due to increasing atmospheric carbon dioxide. Policy Document Ref: 12/05, June 2005.' (The Royal Society: London).
<http://www.royalsoc.ac.uk/displaypagedoc.asp?id=13539>
129. Kleypas, J. A., Feely, R. A., Fabry, V. J., Langdon, C., Sabine, C. L., and Robbins, L. L. Impacts of Ocean Acidification on Coral Reefs and Other Marine Calcifiers: A Guide for Future Research. Report of a workshop held 18-20 April 2005 sponsored by NSF, NOAA, and the U.S. Geological Survey. 2006. St. Petersburg, FL, USA, NSF, NOAA, and the U.S. Geological Survey

References

130. Worm, Boris, Barbier, Edward B., Beaumont, Nicola, Duffy, J. Emmett, Folke, Carl, Halpern, Benjamin S., Jackson, Jeremy B. C., Lotze, Heike K., Micheli, Fiorenza, Palumbi, Stephen R., Sala, Enric, Selkoe, Kimberley A., Stachowicz, John J., and Watson, Reg. Impacts of Biodiversity Loss on Ocean Ecosystem Services. *Science* 314[5800], 787-790. 2006.
<http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=23126138&site=ehost-live>
131. MacKenzie, D. Deep-sea fish species decimated in a generation. *New Scientist* . 2006.
132. Belgrano, A., Scharler, U. M., Dunne, J., and Ulanowicz, R. E. (2005). 'Aquatic Food Webs.' (Oxford University Press: USA).
133. FAO. Nearly half of all fish eaten today farmed, not caught. 4 September, 2006. Rome, New Delhi, Food and Agricultural Organisation, UN.
134. UNEP (2006). 'Challenges to International Waters Regional Assessments in a Global Perspective.' (United Nations Environment Programme: Nairobi, Kenya).
http://www.giwa.net/publications/finalreport/titlepage_and_toc.pdf
135. Epstein, P. R. and Mills, E. e. (2005). 'Climate Change Futures: Health, Ecological and Economic Dimensions .' (The Center for Health and the Global Environment, Harvard Medical School: Boston, USA).
136. Leonard, Abigail W. Global Warming Could Trigger Insect Population Boom. 2006. *LiveScience.com*.
137. OECD. OECD-FAO Agricultural Outlook 2007-2016. 2007. Paris, OECD.
138. Vidal, John. Global rush to energy crops threatens to bring food shortages and increase poverty, says UN. 2007. London. <http://www.guardian.co.uk/frontpage/story/0,,2075458,00.html>
139. Halliday, J. Food prices and the death of the productionist model. *Weekly Comment*. 2007. Food Navigator . <http://www.foodnavigator.com/news/ng.asp?id=79423-food-prices-food-supply-food-policy>
140. Heasman M and Lang, T. (2006). Plotting the Future of Food: putting ecologically driven, community-based food policy at the heart of Canada's food economy. *Making Waves* 17, 2-17.
<http://www.cedworks.com/files/pdf/free/MW170212.pdf>
141. Amos, J. Climate Food Crisis to Deepen, BBC News, 13/09/2005 on.
<http://news.bbc.co.uk/2/hi/science/nature/4217480.stm>, BBC News.
142. FAO (2006). 'The State of Food Insecurity in the World 2006.' (FAO: Rome).
143. Hall, D., Ehui, S., and Delgado, C. The livestock revolution, food safety, and small-scale farmers: why they matter to us all. *Journal of Agricultural and Environmental Ethics* 17[4-5], 425-444. 2004.
144. FAO (2006). 'The state of food and agriculture in Asia and the Pacific 2006.' (FAO regional office for Asia and the Pacific: Bangkok, Thailand).
145. *Journal of Agricultural and Environmental Ethics* and Klint Jensen, Karsten. Food Safety and Ethics: The Interplay Between Science and Values. 15, 245-253. 2002.
146. Burros, Marian. *E. Coli* Fears Inspire a Call for Oversight. December 9, 2006 .
http://www.nytimes.com/2006/12/09/nyregion/09produce.html?_r=1&hp&ex=1165640400&en=fe47e42bb4eb47f4&ei=5094&partner=homepage&oref=slogin
147. Feder, B. J. Nanotech-based synthetic food colorings, frying oil preservatives and packaging coated with antimicrobial agents have quietly entered the market. Oct 11 2006.
<http://www.informationliberation.com/?id=16856>

References

148. feder, B. J. Engineering Food at Level of Molecules. October 10, 2006.
<http://www.nytimes.com/2006/10/10/technology/10nano.htm?ei=5070&en=70af4566bc227b9a&ex=1190174400&pagewanted=print>
149. Abel, N., Cork, S., Gorddard, R., Langridge, J., Langston, A., Plant, R., Proctor, W., Ryan, P., Shelton, D., Walker, B., and Yialeloglou, M. (2003). 'Natural Values: Exploring options for enhancing ecosystem services in the Goulburn Broken Catchment.' (CSIRO: Canberra, Australia).
150. Robertson, G. P. and Swinton, S. M. (2005). Reconciling agricultural productivity and environmental integrity: a grand challenge for agriculture. *Frontiers in Ecology and Environment* 3, 38-36.
151. Masum, H, Zaks, D., and Monfreda, C. Moving Ecosystems Services from Theory to Reality. September 4, 2007. Worldchanging . <http://www.worldchanging.com/archives/007126.html>
152. Hein, L., van Koppen, K., de Groot, R., and van Ierland, E. Classifying and valuing ecosystem services. *Ecological Economics* 58, 209-228. 2007.
153. Eigenraam, M. , Strappazon, L., Lansdell, N., Ha, A., Beverly, C., and Todd, J. (2006). 'EcoTender: Auction for multiple environmental outcome.' (National Action Plan for Salinity and Water Quality, National Market Based Instruments Pilot Program: Canberra, Australia).
<http://www.napswq.gov.au/mbi/round1/pubs/project20.pdf>
154. Cork, S. J., Proctor, W., Shelton, D., Abel, N., and Binning, C. (2002). The ecosystem services project: Exploring the importance of ecosystems to people. *Ecological Management & Restoration* 3, 143-148.
155. Veenhuizen, R. v. e. (2006). 'Cities Farming for the Future - Urban Agriculture for Green and Productive Cities.' (International Institute of Rural Reconstruction, International Development Research Centre: Ottawa, Canada).
156. Halweil, B. (2002). 'Home Grown: The Case for Local Food in a Global Market.' (Worldwatch Institute: Washington).
157. Bhatt, V2006. Edible landscape tools. 10/10/2006. 2006. Eldis Development Reporter .
<http://www.eldis.org/cf/search/disp/DocDisplay.cfm?Doc=DOC22773&Resource=f1agric>
158. E. Annevelink, E., Vink, A., Schouten, W. G. P., Smits, A. C., Hemming, S., Lamaker, E. J. J., and Groot Koerkamp, P. W. G. Food Park, A Case Study Of An Integrated Sustainable Agro Production Park System Designed with Agro Innovation Framework (AIF). EFITA 2003 Conference. 2003.
159. FAO (Food and Agricultural Organisation of the United Nations) (2006). 'FAO Livestock Report.' (Food and Agricultural Organisation of the United Nations: Rome).
<http://www.fao.org/docrep/009/a0255e/a0255e00.htm>
160. Ellis, Hattie. Food Miles. BBC News . 2006.
http://www.bbc.co.uk/food/food_matters/foodmiles.shtml
161. Fletcher, A. Food challenge for 2006: satisfying the ethical consumer. *Foodproductiondaily.com* 05/01/2006, [on line].
<http://www.foodnavigator.com/news/ng.asp?n=64868&m=2ICT112&idP=1&c=ufmqziggolokcdx>
162. Uniting Church in Australia, A. S. C. (2006). 'For the sake of the planet and all its people: A Uniting Church in Australia Statement on Climate Change.' (Uniting Church in Australia: Sydney, Australia).
http://assembly.uca.org.au/unitingjustice/resourcearchive/assemblyresolutions/11_ASC_ClimateChange2006.pdf
163. Mittelstaedt, Martin. The religious war on bottled water. 2006. Toronto.
<http://www.theglobeandmail.com/servlet/story/RTGAM.20060922.wxwater23/BNStory/National/home>

References

164. St. George, Donna. Getting Lost in the Great Indoors . 2007. Washington, D.C.
<http://www.washingtonpost.com/wp-dyn/content/article/2007/06/18/AR2007061801808.html?hpid=artslot>
165. World Economic Forum. The travel and tourism competitiveness index. World Economic Forum.
<http://www.weforum.org/en/initiatives/gcp/TravelandTourismReport/CompetitivenessIndex/index.htm>
166. The Institution of Engineers, A. (2001). '2001 Australian Infrastructure Report Card.' (The Institution of Engineers, Australia:<http://www.InfrastructureReportCard.org.au>).
167. O'Neill, D. (2002). 'The Future for Australian Infrastructure. Speech to the National Infrastructure Summit, 14 August 2002.'<http://auscid.candela.com.au/uploads/NationalInfrastructureSummit-Speech.PDF>
168. BCA (Business Council of Australia) (2004). 'Aspire Australia 2025 Scenarios.' (Business Council of Australia: Melbourne, Australia). www.bca.com.au/content.asp?newsID=94443)
169. Australian Business Foundation (2003). 'Regional Infrastructure: New Economic Development Opportunities for the Hunter, Illawarra and Western Sydney Regions.' (Australian Business Foundation: Sydney).
[http://www.abfoundation.com.au/ext/ABFound.nsf/all/917526EDA4C5392F4A256D4400208FF8/\\$FILE/Infrastructure+Report,+August+2003.pdf](http://www.abfoundation.com.au/ext/ABFound.nsf/all/917526EDA4C5392F4A256D4400208FF8/$FILE/Infrastructure+Report,+August+2003.pdf)
170. Australian Business Foundation (2007). 'A New Angle on Regional Infrastructure.' (Australian Business Foundation: Sydney, Australia).
<http://www.abfoundation.com.au/ext/Frame.nsf/pages/Research>
171. Cork, S., Sattler, P., and Alexandra, J. 'Biodiversity theme commentary prepared for the 2006 Australian State of the Environment Committee.' (Department of the Environment and Heritage: Canberra, Australia). <http://www.deh.gov.au/soe/2006/commentaries/biodiversity/index.html>
172. Archer, M. Sustaining Australia's Land - Time for Action. 2007. Australian Museum.
<http://www.austmus.gov.au/about/archer2.htm>
173. Meyer, Stephen. Weeds shall inherit the Earth, New Scientist. New Scientist . 2006.
174. Tonn, Bruce, English, Mary, and Turner, Robert. Futures of Bioregions. *Futures* 38[4], 379-381. 2006.
175. FAO (2006). Farm animal biodiversity. *Agriculture 21: Spotlight 2006* September 2006.
<http://www.fao.org/AG/magazine/0609sp1.htm>
176. Pittock, B. Climate Change: An Australian Guide to the Science and Potential Impacts. 2003. Canberra, Australia, Australian Greenhouse Office
177. Anwar, M. R., O'Leary, G., McNeil, D., Hossain, H. , and Nelson, R. (2007). Climate change impact on rainfed wheat in south-eastern Australia. *Field Crops Research* 104.
178. Dupont, A. and Pearman, G. 2006. Heating up the planet: Climate Change and Security. Lowy Institute Paper 12. Double Bay, NSW, Australia, Lowy Institute for International Policy.
179. Globescan and Program on International Policy Attitudes (PIPA). 30-Country Poll Finds Worldwide Consensus That Climate Change Is a Serious Problem. Globescan . 2006. Program on International Policy Attitudes (PIPA), Center on Policy Attitudes and the Center for International and Security Studies, University of Maryland USA and Globescan Incorporated, Toronto, Canada.
http://www.globescan.com/news_archives/csr_climatechange.html
180. McCarthy, J. J., Canziani, O. F., Leary, N. A., Dokken, D. J., and White, K. S. Climate Change 2001: Impacts, Adaptation, and Vulnerability Contribution of Working group II to the Third Assessment report of the Intergovernmental Panel on Climate Change. 2001. Cambridge, UK and

References

- New York, USA, Cambridge University Press
181. Hansen, J., Sato, M., Ruedy, R., Lo, K., Lea, D. W., and Medina-Elizade, M. (2006). Global temperature change . *Proceedings of the National Academy of Sciences of the United States of America* 103, 14288-14293. www.pnas.org/cgi/doi/10.1073/pnas.0606291103
 182. Nghiem, S. V. , Chao, Y., Neumann, G., Li, P., Perovich, D. K., Street, T., and Clemente-Colón, P. (2006). Depletion of perennial sea ice in the East Arctic Ocean. *Geophysical Research Letters* 33 , L17501. <http://www.agu.org/pubs/crossref/2006/2006GL027198.shtml>
 183. Menzel, A., Sparks, T. H, and others. European phenological response to climate change matches the warming pattern. *Global Change Biology* 12[10], 1969-1976. 2006.
 184. Bousquet, P. , Ciais, P., Miller, J. B., Dlugokencky, E. J., Hauglustaine, D. A., Prigent, C., Van der Werf, G. R., Peylin, P., Brunke, E.-G., Carouge, C., Langenfelds, R. L., Lathičre, J., Papa, F., Ramonet, M., Schmidt, M., Steele, L. P., Tyler, S. C., and White, J. (2006). Contribution of anthropogenic and natural sources to atmospheric methane variability. *Nature* 443, 439-443.
 185. Pagani, M., Caldeira, K., Archer, D., and Zachos, J. C. (2006). An Ancient Carbon Mystery. *Science* 314, 1556-1557.
 186. Bridges, Tyler. Rapid deforestation poses warming threat. 2007. <http://www.miamiherald.com/416/story/151185.html>
 187. Howden, Daniel. Deforestation: The hidden cause of global warming. 2007 . http://news.independent.co.uk/environment/climate_change/article2539349.ece
 188. Wright, Tom. World Bank Targets Forest Preservation-Climate Link. <http://online.wsj.com/article/SB118150896498230495.html>. 2007.
 189. Arga, Adhityani . Indonesia World's No.3 Greenhouse Gas Emitter . 2007. <http://www.planetark.com/dailynewsstory.cfm/newsid/42376/story.htm>
 190. Liem, M. V. (2007). Indonesia's Forests Threatened by Logging, Palm Oil. *ENN News*. <http://www.enn.com/today.html?id=12889>
 191. Dupont, A. and Pearman, G. 2. (2006). 'Climate Change and Security. Lowy Institute Paper 12.' (Lowy Institute for International Policy: Double Bay, NSW, Australia).
 192. Barnett, J. Climate dangers and atoll countries. 61(3)[321-337]. 2003.
 193. McGranahan, G., Balk, D., and Anderson, B. (2007). The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones. *Environment and Urbanization* 19, 17-37.
 194. Varian, Hal R. Recalculating the Costs of Global Climate Change. 2006. New York. <http://www.nytimes.com/2006/12/14/business/14scene.html>
 195. Dasgupta, P. Recalculating the Costs of Global Climate ChangeComments on the Stern Review's Economics of Climate Change. December 12, 2006. <http://www.econ.cam.ac.uk/faculty/dasgupta/STERN.pdf>
 196. MacDonald, Lawrence. Stiglitz Urges WTO Sanctions on U.S. for Global Warming. 2006. Washington, Center for Global Development, Washington. <http://www.cgdev.org/content/eneews/detail/10882/>.
 197. Kanter, James. Allure of the climate-fixing elixir. 2007. <http://www.iht.com/articles/2007/05/09/business/greencol10.php>
 198. Donnelly, John. Talk of manipulating Earth's climate. 18 November 2006. Boston
 199. Wigley, T. M. L. A Combined Mitigation/Geoengineering Approach to Climate Stabilization.

References

- Science 314.[5798], 452-454. 2006.
200. Iccicle Networks . On Beyond Organic: How Journalists Report Environmental Issues. 02/05/2006. http://www.enn.com/top_stories/article/4172
201. Williams, Alison and Redheffer, Marybeth. Scientists and Journalists: Reporting on Climate Science. 2006. Woodrow Wilson Center. http://www.wilsoncenter.org/index.cfm?fuseaction=news.print&news_id=202694&stoplayout=true
202. Charnovitz, Steve. A World Environment Organization. Columbia Journal of Environmental Law 27[2], 323-362. 2002.
203. Fund for Peace. Failed States Index 2006. 2006. Fund for Peace. <http://www.fundforpeace.org/programs/fsi/fsindex2006.php>
204. Stevenson, M. World's Water Problems, and Solutions, Can Be Found on the Farm. Environmental News Network 21/03/2006. 2006. <http://www.enn.com/today.html?id=10098>.
205. UN (2005). 'The State of the Environment in Asia and the Pacific 2005, economic growth and sustainability.' (UN Economic and Social Commission: New York). <http://www.unescap.org/esd/environment/soe/2005/>
206. Blanchard, Ben. China Grapples with Growing Water Shortages. 04/04/2006. ENN News. <http://www.enn.com/today.html?id=10196>
207. Burke, Garrance . As Underground Water Vanishes, Plains Towns Brace for Costly Future. 13/03/2006 . <http://www.enn.com/today.html?id=9864>
208. Sugita, Katyal. Water Crisis Looms as Himalayan Glaciers Melt. September 7, 2005. http://www.enn.com/top_stories/article/2529
209. WBCSD. Business in the world of water. WBCSD Water Scenarios to 2025. 2006. Geneva, World Business Council for Sustainable Development.
210. Valverde, L. J. (2006). 'Global Climate Change and Extreme Weather: An Exploration of Scientific Uncertainty and the Economics of Insurance. Working Paper Series 23 June 2006.' (Insurance Information Institute: New York).
211. Doyle, A. and Wynn, G. Global warming report may trigger lawsuits-lawyers. Reuters Fri Feb 2, 2007, (on line). 2007. <http://www.reuters.com/article/latestCrisis/idUSL02747236>
212. Hoekstra, A. Y. Virtual water trade: Value of Water Research Report Series No. 12. 2003. Delft, Netherlands, IHE
213. Hollander, Robyn and Patapan, Haig. Pragmatic Federalism: Australian Federalism from Hawke to Howard. Australian Journal of Public Administration 66[3], 280-297. 2007.
214. Twomey, Anne and Withers, Glen. Wanted: best practice federalism. 2007. Evatt Foundation. <http://evatt.org.au/news/453.html>
215. Weller, P. Discussion paper on political change in Australia . Business Council of Australia. Aspire Australia 2025 Scenarios. 2004. Melbourne, Australia, Business Council of Australia. www.bca.com.au/content.asp?newsID=94443)
216. Scott, D. (2007). Rethinking the Australian Constitution. *The University of Melbourne Voice* 1, [on line]. http://uninews.unimelb.edu.au/articleid_4331.html
217. Shell (1995). 'Global Scenarios 1995-2020.' (Shell: Netherlands). http://www.shell.com/home/Framework?siteId=royal-en&FC2=/royal-en/html/iwgen/our_strategy/scenarios/global_scenarios_of_the_1990s/zzz_lhn.html&FC3=/royal

References

- l-en/html/iwgen/our_strategy/scenarios/global_scenarios_of_the_1990s/global_scenarios_of_the_1990s.html
218. Ostrom, E. (1990). 'Governing the commons. The evolution of institutions for collective action.' (Cambridge University Press : Cambridge, UK.).
 219. Ostrom, E., Dietz, T., Dolsak, N., Stern, P. C., Stonich, S., and Weber, E. U. e. (2002). 'The drama of the commons .' (National Academy Press: Washington, D.C., USA).
 220. Berkes, F. (2006). From community-based resource management to complex systems. *Ecology and Society* 11 , 45 [on line]. <http://www.ecologyandsociety.org/vol11/iss1/art45/>
 221. Carl Folke, Steve Carpenter Thomas Elmqvist Lance Gunderson CS, Holling, Brian Walker Jan Bengtsson Fikret Berkes Johan Colding, Kjell Danell, Malin Falkenmark Line Gordon Roger Kasperson Nils, Kautsky, Ann Kinzig Simon Levin Karl-Göran Mäler Fredrik, Moberg, Leif Ohlsson Per Olsson Elinor Ostrom Walter Reid, and Johan Rockström, Hubert Savenije and Uno Svedin. Resilience and Sustainable Development: *Building Adaptive Capacity in a World of Transformations*. 2002. Stockholm , EDITA NORSTEDTS TRYCKERI AB
 222. Anderies, J. M., Walker, B. H., and Kinzig, A. P. (2006). Fifteen weddings and a funeral: case studies and resilience-based management. *Ecology and Society* 11, 21 [on line]. <http://www.ecologyandsociety.org/vol11/iss1/art21/>
 223. Resilience Alliance. Key Concepts . 2007. The Resilience Alliance. <http://www.resalliance.org/564.php>
 224. Holling, C. S. (1996). Surprise for Science, Resilience for Ecosystems, and Incentives for People. *Ecological Applications* 6, 733-735.
 225. Diamond, J. (2005). ' Collapse: How societies choose to fail or succeed.' (Viking Press : New York, USA).
 226. Tainter, J. A. (1988). 'The Collapse of Complex Societies.' (Cambridge University Press: Cambridge).
 227. Cocks, D. (1999). 'Future Makers, Future Takers: Life in Australia 2050.' (UNSW Press: Sydney).
 228. Cork, S., Eckersley, R., and Walker, B. (2007). 'Rapid and Surprising Change in Australia's Future Anticipating and preparing for future challenges and opportunities on the way to a sustainable Australia .' (Australia 21: Canberra, Australia).

APPENDIX 1: FORESEEABLE FUTURE SHOCKS

Table 8: Foreseeable future shocks (Barney Foran, personal communication 2006, cited in Cork et al 2007²²⁸)

Internal/ External	Title	Nature and Effect	Comment
Internal	Oil depletion	The current oil issue is really just an emotion-led price spike. However around 2015 we expect oil production to be physically constrained and Australia's domestic stocks to be very low. The price Australia can adapt to and our trade balance will look simply dreadful. The most important issue is that supply will become erratic and cause breaks in important production chains and therefore widespread disruption	Possible that Australia could make a reasonably quick adaptation to compressed natural gas.
Internal	Population ageing	Around 2030 we expect that approximately 25% of Australia will be over the age of 65 giving increased health and pension costs, but more importantly a stable or slightly declining workforce that does not increase the government coffers through continual growth and expansion of consumption. Tied into lack of investment in all round skills	Several good analyses point to this being a bit of a beat up to frighten the punters, provided Australia gets expected productivity growth and progressively increase social spending by 5%.

References

Internal/ External	Title	Nature and Effect	Comment
Internal	Land and water toxicity	By the mid 2020s many land and water 'sleepers' will be coming home to roost potentially giving saline and acidic rivers that in turn make irrigation agriculture extremely problematical. Once these go past the buffering thresholds it may be difficult to entice rivers and land to return to reasonable ecological function.	A really bad fright in the 2010s may scare us enough to invest heavily enough to repair sufficiently
External	Semi-permanent El Nino	The main of discussions about global change in Australia is higher temperatures and more cyclones. More worrying would be if rainfall patterns move permanently off-land and most of the country's production areas remained in semi-permanent drought	A real possibility with reasonable support for the hypothesis that this has happened to the south west of Western Australia.
Internal	Infrastructure fragility	Lack of substantial investment since the 1970s in widespread 'dull' infrastructure essentials such as water, electricity and transport leads to the widespread co-occurrence of system failures in the 2020s	This is real now but a few mega-failures in the next two decades might wake us from our slumber.
External	US led economic meltdown	The 'shopping mall' economy of the US requires large inflows of capital (mainly Asia) to underpin and sustain growth in most of the world. The US now has large trade deficits, very large debt and a large underclass of deprived peoples. If the US economy cracks it will take most of the developed world with it. Because China had nowhere to send manufactures, our commodities exports would dry up overnight	Recognising this, perhaps the rest of the world would simply not let it happen. However the co-occurrence of a New Orleans and a 9/11 attack would probably do it
External	Large depreciation of Australian dollar	A large downturn in several commodity exports (eg Brazil and Argentina blow us out of the water on iron ore, grains and meats) could rapidly increase our trade deficit (especially when oil is biting hard), cause a flight of capital and make our external private debt (circa \$500 billion now) difficult to pay interest on. Most importantly our superannuation funds will give very little retirement cash flow and cause much social 'grey' anger.	Unlikely that Australia could sink as low as Zimbabwe but Argentina is a reasonable model

References

Internal/ External	Title	Nature and Effect	Comment
External	Human pandemic	The current bird flu issue is the most likely. The key issue is not just the number of people it kills or makes very sick, but the degree to which it could clog up normal social and economic transactions, such that the economy would stall and normal things become physically unworkable	
Internal	Animal-plant pandemic	Possible that a superbug or plant weed from a GE escape or mistake (perhaps with human implications) could emasculate production but more importantly completely stop agricultural exports.'	Continual wind down of practically skilled field operatives would allow the issue to intensify while the 'suits' risk managed
BOTH	Co-occurrence	Take you pick above but any two or three in combination could synergise the unwieldy outcomes of each individual one into untold and unforeseen myriads of truculence	Perhaps too apocalyptic but requires research and role-playing to determine most thoughtful responses

APPENDIX 2 : CLIMATE TIPPING POINTS

Table 9: Plausible biogeochemical tipping points (large-scale singular events). Modified slightly from McCarthy et al¹⁸⁰, who present and discuss the evidence.

Singularity	Causal Process	Impacts
Nonlinear response of thermohaline circulation (THC)	– Changes in water temperature and freshwater input could result in complete shutdown of North Atlantic THC or regional shutdown in the Labrador and Greenland Seas. In the Southern Ocean, formation of Antarctic bottomwater could shut down. Such events are found in the paleoclimatic record, so they are plausible.	– Severe consequences for marine ecosystems and fisheries. Complete shutdown would lead to a stagnant deep ocean. Major change in heat budget and climate of northwestern Europe.
Disintegration of West Antarctic Ice Sheet (WAIS), with subsequent large sea-level rise	– WAIS may be vulnerable to climate change because it is grounded below sea level. Its disintegration could raise global sea level by 4–6 m. Disintegration could be initiated irreversibly in the 21 st century, although it may take much longer to complete.	– Considerable and historically rapid sea-level rise would widely exceed adaptive capacity of most coastal structures and ecosystems.
Runaway carbon dynamics	– Reduced efficiency of absorption of carbon by the ocean and plants on land. Carbon and other greenhouse gases could be released from biological systems on land, which could feed on itself and increase even faster.	– Rapid, largely uncontrollable increases in atmospheric carbon concentrations and subsequent climate change would increase all impacts of climate change and make it difficult for biodiversity of human societies to adapt.

Appendices

Singularity	Causal Process	Impacts
Transformation of continental monsoons	– Intensification of Asian summer monsoon cased by increased greenhouse gases. Likely to be accompanied by increased variation in rainfall between seasons.	– Severe impacts on food production and flood and drought occurrences in Asia.
Changes in the timing and patterns of crucial climate system processes such as ENSO, NAO, AAO, and AO	– ENSO could shift toward a more El Niño-like mean state with eastward shift of precipitation patterns. ENSO's variability could increase.	– Changed drought and flood patterns and changed distribution of tropical cyclones.
Rearrangement of the distribution of plants, animals and other life as a result of rising CO ₂ concentrations and climate change	– Large-scale redistribution of vegetation patterns. Possible rapid dieback of tropical forests and other biomes or more gradual shifts. More frequent fire could accelerate ecosystem changes.	– All models initially simulate an increase in biospheric carbon uptake, which levels out later. Only a few models simulate carbon release.
Destabilization of international order by environmental refugees and emergence of conflicts as a result of multiple climate change impacts	– Climate change—alone or in combination with other environmental pressures—may exacerbate resource scarcities in developing countries. These effects are thought to be highly nonlinear, with potential to exceed critical thresholds along each branch of the causal chain.	– This could have severe social effects, which, in turn, may cause several types of conflict, including scarcity disputes between countries, clashes between ethnic groups, and civil strife and insurgency, each with potentially serious repercussions for the security interests of the developed world.