Dear Jeanette,

Please accept the attachments as ACF's submission to the present Senate Inquiry into food production in Australia. We believe that the Committee will find much that speaks to the Inquiry's terms of reference.

Attached are:

- Campbell, Andrew (2008) *Paddock to Plate: Food, Farming and Victoria's Progress to Sustainability*. The Future Food & Farm Project Background Paper. Australian Conservation Foundation, Melbourne.
- ACF, *Paddock to plate – time to re-think food and farming*, ACF Media Brief, 27 October 2008.

These are also available at http://www.acfonline.org.au/futurefoodfarm where the Committee may find additional links of interest.

We apologise that we are unable to prepare a submission especially tailored for the Inquiry at this time. Also, this report will be followed up by a document outlining more specific policy and strategy propositions to the state and commonwealth governments; although not within the timeframe of the present Inquiry, unfortunately.

We hope this report proves valuable to the Committee. We would be pleased to give evidence to the Inquiry if asked.

Regards,
Corey

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MEDIA BRIEF

27 October 2008

Paddock to plate – time to re-think food and farming

These are challenging times for Victorian food and farming: Cutting carbon pollution, readying farmers for a rapidly changing climate, getting off the oil drip, raising farm returns, keeping food affordable, restoring rivers, soils and bushland, improving public health, and building a world-leading clean, green brand for Victorian food and farming. On the other hand, we have opportunities and options. A sustainable food and farm sector is possible. What is more, Victoria is not starting from scratch. But delay will see choices slip away, a lack of vision will see us fall behind the world and business-as-usual will end in crisis.

ACF is calling on the Premier to build on the state's legacy of leadership and show Australia the way with a Sustainable Food & Farming Strategy; ensuring government – as one – rises to the challenge. A new report – *Paddock to Plate: Food, Farming & Victoria's Progress to Sustainability* – explores the future of Victoria's food system. *Paddock to Plate* has been prepared by Andrew Campbell, an experienced and passionate leader in the field of sustainable food, farming and environmental management, and formerly Executive Director of Land and Water Australia. Rich in information and fresh ideas, *Paddock to Plate* makes the case for a new approach. In the coming months, ACF's Food & Farm Project will deliver a comprehensive set of recommendations for government and industry policy and strategy.

What is ACF's Future Food & Farm Project?

ACF's Future Food & Farm Project aims to inspire a step-change towards food and farming systems that are genuinely sustainable and that contribute to a sustainable world. For the first time in Australia, ACF is exploring the role of governments – and all of us - in shaping a sustainable future for our whole food value chain, from paddock to plate. The Project draws on the experience of many people from diverse backgrounds - including leading farmers, policy specialists, corporate managers, restaurateurs, retailers, scientists, community activists and consumer advocates. The Project is made possible by funding from the William Buckland Foundation.

Why is a fresh approach to food and farming needed?

More and more Australians are feeling the strain of prolonged drought, an end to cheap oil and declining catchment health. Prices have spiralled at the pump and at the checkout in the last year, and farm fertiliser and fuel costs have skyrocketed. Without urgent and sustained action, the situation will get worse. If we're smart though, we can turn crisis into opportunity.

Paddock to Plate finds that the story of food and farming in Victoria is a mixed one:

- Victoria leads the country in the production of top quality produce, with food and farming playing a vital role in the lives and livelihoods of communities around the state. Around 26 per cent of Australia's food and fibre exports, worth more than $6 billion in 2007, are produced here from just three per cent of the country's agricultural land.
- Food manufacturers, wholesalers and retailers collectively turn over around $50 billion per year. This doesn't include thousands of clubs, pubs, restaurants and cafés.
- The food and farm sector generates around 20 per cent of Gross State Product and employs more than 14 per cent of all Victorians, in the bush as well as the city.

But these figures mask the full impact of the food and farm sector, and the challenges we all face. The way we currently produce and consume food leaves a heavy footprint on our rivers, soils, wildlife and the climate, as well as the social fabric:

- Historically, farming is the single biggest cause of environmental degradation. Upwards of 90 per cent of private land – most of it farmland - has been cleared of native wildlife habitat. More than 40 per cent of Victoria's native plants and more than 30 per cent of animal species are already either extinct or threatened with extinction.
- Victoria's catchments and rivers are amongst the most stressed in the country, despite many landholders' good efforts. Nearly half of the state's sub-regions are classified as being in poor landscape condition and suffering stress – the highest proportion of any state or territory. In cleared farmland, only a very small fraction of rivers meet state water quality goals.
- The single largest impact that Australians have on water resources is through the food we consume – about half of total household water use compared to 11 per cent used directly in washing, cleaning and gardens.
- Unless there are fast and deep cuts in global emissions, even the more alarming predictions for a future climate begin to look like underestimates. Regions with a Mediterranean climate, like Victoria, are set to be among the worst affected parts of the world. In the decades ahead, southern Australia is likely to suffer drought conditions over a much greater area and much more often. The Garnaut Report found that irrigated agriculture in the Murray-Darling Basin could fall by as much as 49 per cent in 2050 and all but disappear by 2100 without strong action.
- Agriculture contributes as much as 16 per cent of Australia's greenhouse gas emissions load – with most of this from cattle and sheep. Australians, on average, eat more than their own body weight in meat every year - around 300g per person per day – one of the highest rates of meat consumption in the world.
- The way our food is hauled, packaged, processed, manufactured, stored, prepared and consumed - not just farmed – adds to its real environmental cost. Food is directly responsible for 23 per cent of household carbon pollution in Australia.
- And then there is the fuel we use to till paddocks, synthesise farm chemicals and freight food around the country, around the globe and to our homes. The just-in-time food supply we have come to depend on has been sustained by a steady stream of cheap oil. But world oil production appears to have peaked, even as demand rises. Recent CSIRO research suggests that petrol could reach $8 per litre in ten years. The era of cheap oil is over.
- According to a recent study for the group CERES, the ingredients in a typical Melbournian's weekly shopping basket (excluding packaging) have travelled the equivalent of two round-

the-world trips or three times the length of the Australian coastline. This means 11,000 tonnes of CO_2-e pumped into the air – or the equivalent of almost 3,000 cars on the road for a year[1].

- Food prices have risen dramatically in recent months, but in real terms remain well under half what they were in the 1960s and less than a quarter of the peak during the oil crisis of the 1970s. Even so, many more Victorians are now classed as 'food stressed'.
- Diet is the biggest contributor to rising levels of obesity and associated chronic diseases. In 2005, an estimated 3.24 million Australians were obese, incurring direct and indirect costs to the tune of $21 billion. At current rates, the number of obese Australians will double by 2025, placing our health system and well-being under enormous strain.
- Only the top third of Australian farms have had productivity gains (by gross value) that exceed the decline in their terms of trade, and only the top fifth generate a positive long-term return on capital. Chronic unprofitability and rising indebtedness in the farm sector is leading to increased stress and health risks – including depression and suicide - with consequences for the whole community.

If Victoria is to maintain its impressive productivity and prosperity in a rapidly changing world faced with these sorts of challenges, we need to seriously re-think food and farming.

What does Victoria need to do for sustainable food security?

Paddock to Plate outlines key challenges for Victoria. It finds:

- **Business as usual is not an option.** It is important that governments and industry don't default to their comfort zones. There are many areas where the status quo is patently not good enough. Mere tweaks to our carbon pollution, land & water use or oil dependence will not make the grade.
- **Victoria can position itself as a world leader in the production of premium foods with trusted clean, green credentials.** This means handsome returns, innovation, green jobs, new exports and new regional development opportunities. The alternative will see us falling further behind. Many countries - most prominently the United Kingdom - are already looking again at the performance of their food systems.
- **Clear direction and commitment is needed, right from the top.** Government has a special responsibility to make change possible, and to make sure that progress isn't disjointed or piecemeal. Success means joining the dots between food, farming, environment, planning, climate, health, innovation, energy, urban design, transport and regional development.

What are the opportunities for a sustainable food and farming future?

Paddock to Plate sees numerous opportunities:

- Beyond government, responsibility for shaping sustainable food systems must be shared more equally across the value chain. While some have made a good start, catalytic leadership can and must come from supermarkets, agribusiness, restaurants and other food businesses.

[1] NB: This reference, not cited in *Paddock to Plate*, is included here to illustrate the oil dependence and potentially large carbon footprint of modern food chains. For more information, visit: http://www.ceres.org.au/projects/foodmiles.html To ACF's knowledge, there is no other comparable Australian study on 'food miles'.

- The emergence of carbon and other environmental markets around the world means a new operating environment for agriculture and food businesses, with opportunities for smart and nimble players.
- Agriculture's impacts on land, water and wildlife are immense and ongoing. At the same time, with the right policy and price signals, Victorian farming could be the key to restoring catchment health.
- Finding ways to return a bigger slice of the food price cake back to the producer and ensuring that higher returns are reinvested in cleaner, greener farming systems will help make agriculture genuinely sustainable.
- Healthy environments, healthy farming systems and healthy people are intricately intertwined. Promoting more sustainable diets would yield big dividends for personal and public health - ultimately reducing the burden on the public purse and the hip pocket.
- We need to wean our food and farming systems off fossil fuels and synthetic fertilisers - and soon. Investment in innovative green technologies, low-input farming and energy-efficient infrastructure would drive a green jobs and green export boom.
- Managing climate change means being proactive rather than just crossing our fingers and hoping for the best. Radical changes are needed. It may mean re-thinking how and where we produce food. We have the opportunity to develop a more resilient, intrinsically Australian agriculture.
- There is considerable scope to produce more of our food in cities like Melbourne, and to redesign our transport infrastructure and urban environments to ensure everyone has access to healthy, affordable food at minimal environmental cost.
- Victoria can do much more to cultivate knowledge, innovation and leadership across the board. We also have the chance to craft a new vision and brand for agriculture – one that attracts and retains talented young people.

What are the opportunities for Victorian leadership?

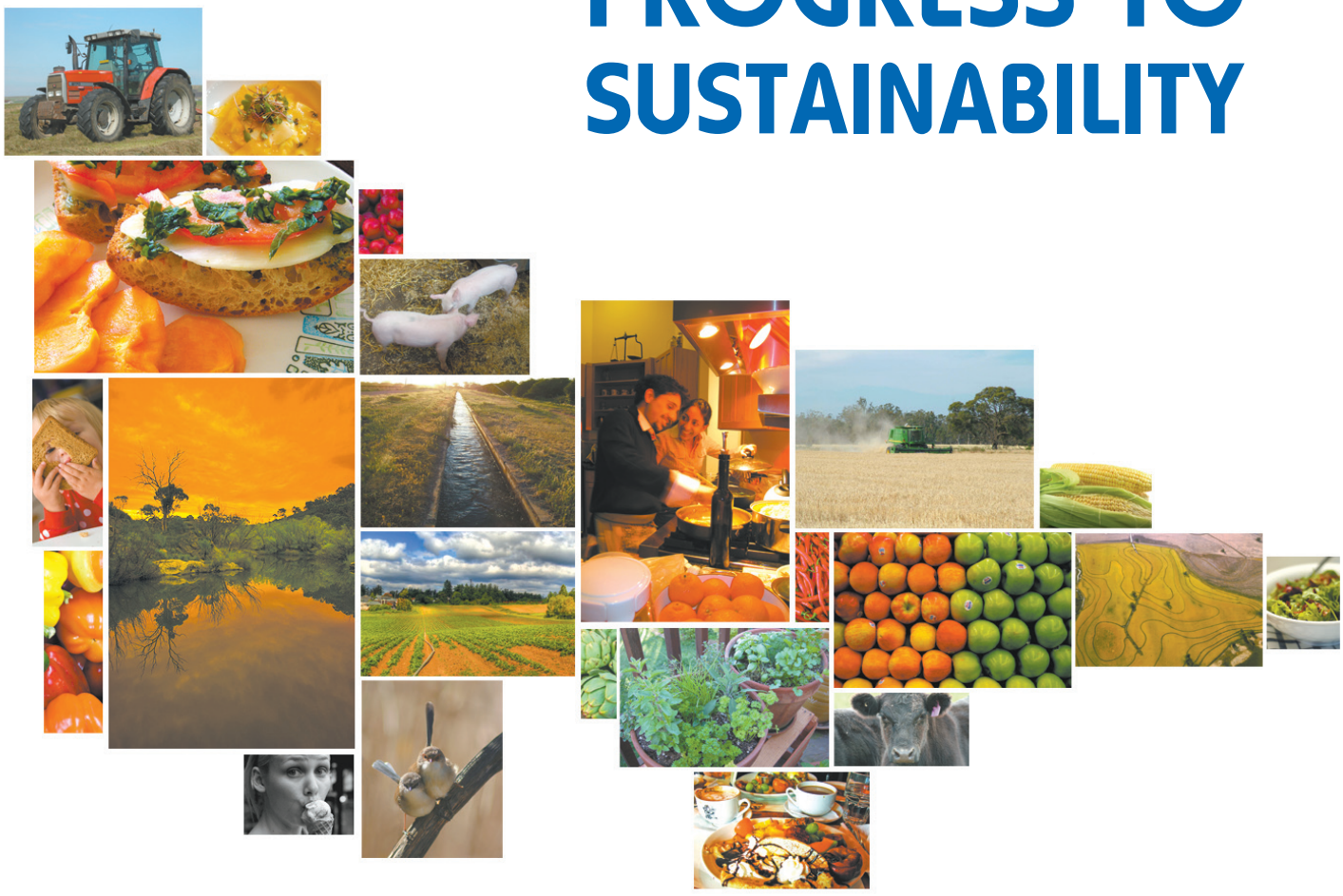
Without foresight and a plan, we will end up lurching from crisis to crisis, armed only with band-aids and stop-gaps. In Britain, Prime Minister Gordon Brown has directed the Cabinet Office to devise a national strategy for sustainable food security. This means a whole-of-government response that cuts across traditional departmental boundaries around issues like obesity, regional development and climate change. There is no reason why Victoria can't meet this world's best practice. So far, no government in Australia has really applied itself to sustainable food and farming. If our kids are to enjoy good food and a healthy environment, then we need our leaders to think at least ten years ahead and commit to sustained action towards agreed milestones. Leadership and commitment is needed at both state and federal levels, with bi-partisan support to ensure a sustained effort. Victoria is well-placed to lead the country to a sustainable food and farming future.

For more information: Corey Watts, ACF Rural Landscapes Campaigner, 0438 547 786

Andrew Campbell's report, *Paddock to Plate: Food, Farming & Victoria's Progress to Sustainability*, is available to download at http://www.acfonline.org.au/futurefoodfarm

PADDOCK TO PLATE

FOOD, FARMING AND VICTORIA'S PROGRESS TO SUSTAINABILITY



A Background Paper prepared by Andrew Campbell
for ACF's Future Food & Farm Project

October 2008

AUSTRALIAN CONSERVATION FOUNDATION

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The information contained in this publication is intended to help improve the sustainability of the Victorian food and farming system. It includes general statements based on scientific and policy research and stakeholder interviews. Readers are advised and need to be aware that this information may be incomplete or unsuitable for use in specific situations. Before taking any action or decision based on the information in this publication, readers should seek expert scientific and technical advice.

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Triple Helix Consulting
Queanbeyan, October 2008.

Triple Helix
CONSULTING

Cover Montage

Irrigation channel and harvester photographs by Corey Watts. Aerial cropping photograph courtesy of David Eastburn. Remaining images are sourced free from http://www.flickr.com/ for this strictly non-commercial use in accordance with the Creative Commons Attribution 2.5 License terms available at http://creativecommons.org/licenses/by/2.5/

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Executive Summary

This study explores the future of the Victorian food and farming system in a rapidly changing and more demanding world, focusing on the period between now and 2020. It explores ideas and tries to anticipate and imagine the sorts of activities and investments that will be needed if Victoria is to equip its food and farming system to produce more healthy foods, more sustainably, in a much more difficult climate, while consuming less water, nutrients and energy.

In contemplating the future, we are in a mental dance between fate and desire. We know that 'what's coming at us' will generate all sorts of possibilities and constraints. For the Victorian food system, such macro forces include the environmental, human health and policy drivers discussed below, and the basket of forces and trends that are captured under globalisation; including market forces and the progress of technology. We have little control over what is coming at us. Irrespective of the tide of events over which we have no control though, we still have choices, as Phillip Adams notes:

"The future is not some place we are going but one we are creating. The paths to it are made, not found."

There are no facts about the future. In envisaging the future, leaps of imagination are as likely to be accurate as scientific extrapolation or deduction. Such leaps of imagination are more likely to be instructive however, if they are grounded in an appreciation of the current situation, forces for change that are likely to affect it, and opportunities to improve it.

The food system is a heavy component of the human environmental footprint on the planet. If current trends in human population and consumption patterns continue, the world will need to produce about twice as much food by 2050, in a rapidly changing climate, with declining production of oil and rising prices for energy, water, fertilisers, and soon, carbon. The era of abundant, cheap fossil fuels is over. Traditional avenues of expanding production though clearing, irrigating and cultivating more land are narrowing, and food is now competing with energy for land and water resources.

Consumers in developed countries are increasingly concerned about the quality, safety, environmental impact, human health and animal welfare aspects of their food. Governments in developed countries are increasingly concerned about levels of obesity and associated chronic diseases and escalating health costs, which are driven in part by increasing consumption of processed foods high in sugars, salts and saturated fats. The role of modern industrial food systems in human health is under question.

Healthy environments, healthy farming systems, healthy foods and healthy people are intricately intertwined.

After a dry decade in southern Australia, it is clear that current conventional farming systems as practised by most farmers are not good enough. They simply don't make enough money in poor seasons to be viable in the long term without extensive and prolonged subsidies, and they run down the resource base in the process. Persistent unprofitability and increasing debt levels have obvious economic consequences for rural communities. They generate insidious and corrosive social impacts, including elevated levels of stress, depression and suicide, deterring talented young people from careers in agriculture.

We are finally beginning to understand the real cost of our food.

The world will always need food — in fact it is demanding more and better food than ever. After declining in real terms for decades, food prices are now rising for many commodities. The emergence of carbon and other ecosystem services markets around the world will generate opportunities for smart and nimble players. The growing size and purchasing power of the discerning consumer base opens up the potential for more sustainable production systems to generate handsome returns.

How can we improve the performance and resilience of the Victorian food system?

This draft background paper analyses drivers for change, looks at international trends, outlines areas for improvement, and explores new ideas that would substantially improve the performance of the Victorian food system in delivering healthier foods and healthier profits. We can do this while making much better use of energy, water and nutrients, substantially reducing greenhouse gas emissions, minimising waste and pollution, improving wildlife habitat, producing renewable energy, reducing reliance on food imports, and reconnecting both rural and urban communities with the production of healthy, safe, delicious food.

Victoria can lead the world in designing sustainable food and farming systems for a warming, drying climate, generating significant know how, innovation, regional development and export income along the way.

The fundamental challenge that emerges from this study is to develop farming systems that are more intrinsically Australian: that are resilient in the face of extreme weather and extreme seasonal variability; that are miserly with water and conserving of energy; that maintain groundcover and are kind to the soil; that sit lightly on the landscape and don't displace native wildlife or habitat; that are highly profitable in good seasons and don't lose money in bad seasons; that preserve and build their natural, human and financial capital; that recover quickly from shocks and stress; that attract and retain young, talented people on the land; that generate jobs and income in regional communities; and that produce things in high demand for good prices.

One of the big policy challenges for industries, communities and governments is to find ways to return a bigger slice of the food price cake back to the producer — and to ensure that higher returns are reinvested in measures that improve the sustainability of the system. Just as climate change writ large represents a colossal market failure, the fact that the price paid for food by consumers does not reflect the full costs of production in terms of agriculture's environmental footprint, is also a market failure that fundamentally constrains the ability of farmers to produce food and fibre more sustainably. Correcting the market failures within the food system so that consumers pay a more realistic price for food (mindful of equity issues), and so that farmers receive their due portion of that price, would be one of the most effective ways of enabling food producers to retool their businesses for much more demanding conditions.

The Victorian Food and Farming System

Victoria is an engine room of the Australian food and farming system, producing around 26% of Australia's food and fibre exports ($6.35 billion in 2007) from just 3% of Australia's agricultural land. However Victoria is also a significant food importer — in early 2008 the value of food imports to Victoria exceeded 50% of the value of food exports. The key food and fibre commodity groups for Victoria's exports continued to be dairy and meat, accounting for over 50% of food and fibre exports. Japan remained the most valuable market for food exports, and the second most valuable market for food and fibre exports overall behind China. Other key markets included the United States, New Zealand, Indonesia, Malaysia and Singapore.

The agricultural and food sector makes a major contribution to economic growth and employment in Victoria, generating around 20% of Gross State Product and employing more than 14% of the Victorian workforce. Food production on-farm was worth around $8 billion in 2004-5, employing around 2.7% of the Victorian workforce, whereas food processing and distribution were each worth around $21b in 2005-6 and employed 2.1% and 5.4% of the workforce respectively. The food consumption sector (fast food outlets, hotels, restaurants, public sector food provision such as hospitals etc.) was worth a further $6b in 2005-6 and employed over 4% of the Victorian workforce. The post-farm components of the Victorian food system include 2,500 food manufacturers, 5,700 wholesalers and 17,000 retail businesses (not including thousands of cafes, restaurants, hotels and clubs), collectively turning over almost $50 billion per year and employing almost 12% of the workforce. Like the farm sector, there has been considerable consolidation over recent decades, and a small proportion of players generate a disproportionate share of the total market.

In rural areas of the state, the proportion of the workforce engaged in food production and processing, and the proportion of businesses dependent on activity in that sector for their turnover, is much higher than in the cities. Outside Melbourne, food and farming account for nearly one in four jobs, and play a vital role in the lives and livelihoods of communities across the state.

In 1900, almost 60 percent of people lived outside Melbourne. By 2006, just 27 percent (1.39 million people) lived in regional Victoria. Victoria's population has increased dramatically over the last century from around 1.21 million in 1900 to 5.13 million people in 2006, and at current growth rates it is estimated that Victoria's population will exceed 6.2 million people by 2020. This will increase local demand for food and for release of significant areas of new land for urban development.

Drivers for Change

There are formidable external drivers for change in the Victorian food and farming system.

Profit

The number of farms in Victoria has halved from almost 70,000 in 1963-64 to around 32,000 in 2004-05, and over the same period the average farm size has grown from 210 hectares to over 430 hectares. While the number of farmers has declined the number of people servicing them has increased. Increases in average farm size and labour unit productivity have been a response to falling farm terms of trade. Only the top third of farms (by gross value of production) have had productivity gains that have exceeded the decline in their terms of trade, and only the top one fifth of Australian farms generate a positive long-term return on capital. The top 10% of Australian farms generate more than 50%, and the bottom 50% generate less than 10%, of Australia's gross value of agricultural production.

This means that most farmers are losing money in most years, increasing their level of debt. Those remaining in agriculture who are not in the top 10% are subject to chronic unprofitability, rising indebtedness, and consequently increased stress levels and health risks, including depression and suicide. These social impacts have consequences well beyond the individual concerned, obviously for their families, but also their communities and the wider society, health system and economy.

These social impacts and associated costs are not costed against the economic returns from the food and farming system, nor are the costs associated with the environmental impacts described below. Consumers have become accustomed to very cheap food, the price of which does not reflect the true costs associated with its production, nor does the majority of food sold in supermarkets allow a sufficient return to food producers to provide for an adequate 'repairs and maintenance' or reinvestment budget line in the balance sheet of natural capital that underpins our food production systems.

We need our food system to make more money, and we need more of that money to find its way back to producers, but we need to do so in ways that ensure that healthy, safe food is accessible and affordable for everyone.

Climate change

Climate change represents the biggest market failure the world has ever seen. Temperate regions with a Mediterranean climate, like Victoria, look like being among the worst affected regions around the world, with strong warming and drying trends, more variable and extreme weather and less reliable seasons. Even ABARE concludes that Australia is one of the countries most affected by climate change, and that agriculture is among the most affected sectors of the Australian economy. Unless there are fast and deep cuts to global greenhouse pollution, the more alarming of the predictions coming from global climate models may turn out to be underestimates. The policy responses to climate change, especially but not only the emergence of a price on carbon and a market for emissions permits, will impose a new operating environment on agriculture, with both costs and opportunities.

The food system is directly responsible for about 23% of Australia's greenhouse pollution. Of that, agriculture is the biggest component with about 16% of total national emissions in 2005 (13% of Victorian emissions). The enteric fermentation of ruminants is the biggest component of agricultural emissions, followed by nitrous oxide lost from nitrogen fertilisers, animal manure and soils. Agriculture accounts for 60% and 85% respectively of Australia's total methane and nitrous oxide emissions, both potent greenhouse gases. It will come under increasing pressure to meet its share of responsibility for reducing carbon pollution. As soil and vegetation are the largest terrestrial carbon stocks, there are potentially significant opportunities for agriculture to assist other sectors to offset their own carbon pollution.

Managing climate risk means being proactive rather than just crossing fingers and hoping for the best. That may mean taking big, uncomfortable decisions about the whole farm enterprise, its location, opportunities to invest off-farm, and whether or not to remain in agriculture. Farming profitably in Australia has always demanded sophisticated risk management. Climate change will force us to get much, much better at farming in the tough and variable Australian environment.

There is considerable room for adaptation at a farm scale, as our best operators are already showing. However systemic changes will also be required — in policies, infrastructure, education and training,

research and innovation — concerning the whole food value chain from paddock to plate in order to bring about widespread, durable gains in the performance and resilience of the Victorian food system.

Environment

Farming practices — clearing, cultivating, irrigating, grazing, spraying, fertilising, cropping and so on — are the single biggest ecological disturbance across Victoria. Their aggregate and cumulative impact, including related impacts such as the introduction of pests and weeds and the downstream impacts of agricultural water use, soil loss and dryland salinity, have profoundly changed Victorian landscapes over the last century and a half. Victoria has the highest proportion (48%) of sub-regions in Australia assessed as being in poor landscape condition and suffering landscape stress. In cleared agricultural country, a very low proportion of rivers meet SEPP water quality objectives.

The enormous wealth, economic activity, export income and employment generated by the on-farm dimension of Victoria's food system has had an extensive and profound environmental impact in rural landscapes. This impact is on-going. However just as farming systems and practices are the largest disturbance on Victorian rural landscapes, so they are the single biggest ecological lever in landscape restoration. Farming systems and practices play a large role in determining soil health, and the amount, type and location of water, vegetation and other organic matter in the landscape.

Moreover, it could be argued that farmers have taken the rap for the environmental impacts of the food system, while agribusinesses and food retailers (and by extension their owners the shareholders) have been the main beneficiaries and have generally avoided opprobrium. Just as we need to ensure reasonable returns to food producers that reflect the full costs of production (with an appropriate margin for reinvestment in human and natural capital), so do we need to recognise the role of agribusiness and the food processing, distribution and retailing sectors in being accountable for and driving improved food system performance and sustainability.

Water

The single largest impact that Australian households have on water use is through the food they consume — about half of total household water use compared with around 11% used directly in washing, cleaning and gardens. Of that, red meat and dairy products consume more than 70% of the water. Rivers, floodplains and wetlands are collateral damage, caught in the crossfire between a drying climate and the water demands of industries and communities. Governments have over-allocated water resources during a series of relatively wet decades, and have yet to face up to the tough choices that have to be made to bring water allocations back within sustainable limits for the much drier conditions that now prevail in southern Australia. Considerable reconfiguration of irrigation systems, and consequent structural adjustment within rural communities, are required.

Energy

World oil production appears to have peaked, while demand continues to increase. The era of abundant cheap fossil fuels is over. The recent spike in oil prices was relatively mild, reaching less than half the real price of crude oil that was reached in the oil shocks of the mid 1970s and early 1980s. Over the next decade, oil prices are likely to rise much further than they have recently. This has strong flow on effects in rising prices for fuel, nutrients and many other inputs throughout the food system. The introduction of a carbon price will further increase energy prices. This will change the relative prices of some foods. Travel costs embodied in food will become more important. Farming systems that are less dependent on external inputs of diesel and synthetic fertilisers will become relatively more competitive.

World food demand and supply

On current population and consumption trends, the world needs to double food production over about the next forty years. This has been achieved relatively easily in the past through clearing, cultivating and irrigating more land, intensifying production through better varieties and more fertilisers, diverting more freshwater resources, and catching more fish. With climate change and with resource constraints, those options are narrowing considerably. The best lands have already been cleared and cultivated — in fact the area of fertile arable land is declining through land degradation. Water

resources in all the world's big food bowls are fully- or over-allocated. We should be re-establishing forests, not clearing those remaining. The world wild harvest fish catch has flat-lined. Aquaculture continues to grow strongly, but is starting to confront resource and environmental challenges analogous to agriculture. Energy crops are now competing with food crops for land and water.

Food prices have risen sharply in recent months, but again in real terms they remain well under half what they were throughout the 1960s and less than quarter of the peak reached after the oil crisis of the early 1970s. Food prices could rise much further yet, world demand for food creates potentially significant opportunities for the Victorian food system, and the biggest growth in world GDP over the next decade is within Asia. Potential opportunities for food exporters are enormous.

However rising concerns about food security and recent food riots have already led to constraints on food exports in several countries. Prospects for freeing up world agricultural trade to allow farmers to respond to market signals look remote. Governments everywhere need to re-invest significantly in agricultural research, technology and education. It is difficult to see how the current rate of expansion in production of 'first generation' biofuels can be sustained without leading to massive resource degradation pressures and food insecurity. So while the rewards are potentially large, so are the levels of uncertainty about world food markets.

Health

The way in which we produce food is changing, as is the way we prepare and eat it.

In Australia, as in much of the developed world, there is an increasing trend towards eating out, take-away food, home deliveries, pre-processed and packaged food. There has been a steady increase in consumption of fast foods, meat, fats and sugars, and a corresponding decrease in the proportion of fresh whole foods, fruit and vegetables. Food portions have also increased in size. We may have replaced some red meat with poultry, but we still have the second highest average meat consumption in the world at 304 grams per person per day, behind only the USA at 342, well in excess of the developed country average of 224 and dwarfing the developing country average of 47g/person/day. Cutting greenhouse pollution and tackling health problems will mean placing more policy and research attention on the livestock sector — especially grain-fed beef[1] and sheep meat — and the role of animal products in our diets. Conversely, grazing industries have a key role to play in landscape restoration.

The steady improvement in human health over recent centuries appears to have peaked. This generation may live shorter and less healthy lives than our parents. More sedentary lifestyles and less exercise are important factors, but it is widely accepted that the biggest contributor to rapidly rising levels of obesity — and associated chronic diseases such as diabetes, cardio-vascular disease, osteo-arthritis and cancer — is diet and nutrition.

In 2005, 3.24 million Australians were estimated to be obese — 15% of males and 17% of females — and at current rates of increase, this will more than double to exceed 7 million people by 2025. This has enormous economic implications. The direct impacts on the health system are obvious — estimated to be around $3.7 billion in 2005. However there are also significant indirect economic impacts through lost well-being, estimated to exceed $17 billion, bringing the total 2005 cost of obesity to $21 billion. The intersection of rising obesity levels with the demographic momentum of an ageing population will impose enormous costs on the Australian economy. Conversely, turning the current trends around would generate significant returns for the economy.

We need to rebuild and strengthen the linkages between the health system, the food system and the farming system — in science, in public policy and in the daily lives of citizens. The food system should

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1 Wendell Berry (ref) describes how the development of modern industrial agriculture in the US has "taken an elegant solution and split it apart to create two wicked problems". In traditional mixed arable farming systems, animals fed on crop wastes and crops were fertilised with animal manure. Now the animals (and the fences) have been removed from the vast US grain belt, and large external inputs of synthetic fertilisers are polluting groundwater and rivers, leading to hypoxia in the Gulf of Mexico and generating greenhouse gas emissions. Animals are now fattened on the grain from those heavily subsidised corn and soybean farms, and many other feed additives including antibiotics and growth hormones, in huge feedlots that generate enormous amounts of manure, which also leads to significant air and water pollution and greenhouse gas emissions. The modern system has enjoyed three enormous subsidies: farm policies aimed at cheap food; cheap, abundant fossil fuels: and not having to account fully for the environmental damage it has caused.

be seen as being central in the front line of preventative health care. Investment in measures that lead to more people eating better food in healthier ways is likely to be more effective and to have a much bigger return than remedial expenditure on health care after people have become obese.

There are very strong synergies between healthy lifestyles and sustainability goals.

Policy

The key national policy settings that impact on the Victorian food and farming system centre around climate change, water and drought relief.

Climate change

Agriculture will not be included in the Carbon Pollution Reduction Scheme (CPRS) before 2015 due to the considerable technical difficulties in measuring agricultural emissions, the huge number of firms involved compared with other sectors, and the dynamic nature of agricultural emissions within and between years. The policy settings with respect to agriculture, if and when it enters the CPRS, will be important in framing the operating environment for Victorian farmers. There is considerable interest within the farming community about the possibility of farmers being paid for their carbon, around soil carbon in particular. There are many good reasons to increase soil carbon in any case, but soil carbon is difficult to account for to the extent required in an emissions trading scheme. It is difficult (and requires significant investment in nutrients) to permanently build soil carbon stocks over time, especially while cropping or grazing the land. The relative prices for carbon, oil, nutrients and farm outputs will determine the profitability of carbon sequestration options for farmers, and it may be that trees remain a more viable carbon offsets option for most Victorian farmers.

There are potentially valuable opportunities from some of the CPRS revenue from agriculture to be re-invested in complementary mitigation and adaptation strategies for new carbon-neutral or carbon-positive farming systems. Similarly, a well-designed emissions trading scheme may create incentives for agribusiness and new investors in low-emissions farming systems and supply chains. It will be crucial to ensure that the design of the CPRS does not lead to perverse incentives that compromise other environmental objectives such as water or biodiversity.

Water

The last decade has seen a significant ramping up of Commonwealth attention to, and investment in, water policy and water reform. The National Water Initiative sets out a comprehensive policy framework for water reform and the $12 billion Water for the Future package will accelerate its implementation. For the first time, Australia will have a comprehensive, nationally consistent water accounting framework, overseen by the Bureau of Meteorology. We will finally have a good handle on how much water is being used, by whom, where and when. Apparent inefficiencies will be obvious, as will best practice. Continuing a process that commenced with the COAG Water Reform agreement of 1994, the price of water will increase to reflect the true cost of its provision and delivery. Inefficient users of water will find it increasingly difficult to afford. For businesses looking to implement measures that will substantially lift water productivity, there are now realistic funding options. Conversely, for those looking to get out of irrigated agriculture, there is now a large willing buyer for water entitlements. Urban water reform, urban water infrastructure improvements and an increasing number of reuse and recycling schemes, will see greater availability of wastewater within and close to major population centres, potentially available for food production.

Carbon and water are being counted and valued as never before, which is a good thing. It has fundamental implications for our food system.

We are finally starting to understand the real cost of our food.

Soils, vegetation and biodiversity

Soils, vegetation and biodiversity are crucial environmental assets in their own right, and their stewardship should be a high national priority irrespective of climate change. However they are also pivotal in the carbon and water agendas. Soils and vegetation contain all of the terrestrial carbon

store, they can generate both significant carbon pollution and sequestration opportunities, and they comprise the catchments that largely determine water yields, water holding capacity and water quality. Soil management is a crucial issue for sustainable food production. A more coherent policy framework, with commensurate investment in soil information and an associated research and extension effort, would provide much needed assistance for farmers on issues like soil biology and soil carbon, managing nutrient cycling and soil moisture, and improving soil health and fertility during difficult climatic conditions. Such work is also necessary to underpin more comprehensive food certification and labelling systems.

Soils, vegetation and biodiversity should be receiving more policy attention and investment. They remain important determinants of the sustainability of food production on-farm. Again, with a stronger appreciation of the links between the farming system, the food system and the health system, we can join the dots between our food consumption, the supply chains that support it, and environmental impacts in rural landscapes. There are opportunities for retailers, restaurateurs and agribusiness firms to work with food producers to develop and promote food production systems that genuinely do deliver better environmental outcomes from paddock to plate.

At a Victorian level, the key policy developments relevant to this project are the Future Farming strategy and its $205 million constituent programs, and the Green Paper on Land & Biodiversity in a time of Climate Change. Both of these provide useful background information and analysis, and set out a policy framework for the next decade. On the whole, the two documents are more comprehensive and forward looking than anything comparable in other jurisdictions, although that may change with the imminent release of a state food strategy in Western Australia. However the considerable overlap between them in terms of sustainable farming systems is not articulated in sufficient depth, nor are links to the wider food system, the energy and transport sectors, and in particular the health system, explored as well as they might. Both appear to assume an extrapolation of current trends, and read more like an adjustment package, rather than pushing the envelope for a new approach to agriculture and land use in Victoria. This is disappointing given Victoria's history of innovation and national leadership in natural resource management, and the fact that it has the most mature and professional catchment management framework in Australia, among the best in the world.

Drought relief

The current system of drought assistance based on the notion of 'exceptional circumstances' is unsustainable, is costing billions in relief payments and interest rate subsidies, and needs radical surgery. It is no longer valid (if it ever was) to define extended periods of extremely dry weather in Australia as exceptional. We need to abolish the very word 'drought' from our lexicon, and from our mental models of what it means to live in Australia.

This is not for a moment to suggest that farmers, farm businesses and the rural communities that depend on them should simply be abandoned to their fate. There are compelling arguments for improving the full range of social services available to people who are doing it tough and suffering the debilitating effects of stress and associated social problems. There are also a wide range of potential assistance measures to improve risk management and climate adaptation among farmers, including the successful Farm Management Deposit scheme.

But it is not just about improving the resilience of the Victorian food and farming system in the face of external stresses and surprises. It is equally, perhaps even more importantly, about improving its performance here and now. The status quo is patently unsustainable. It does not make enough money for enough people, and it is running down the resource base and declining human health in the process. Even in the absence of climate change, water scarcity and rising energy and nutrient prices, we would need quantum improvements in the performance of the Victorian food and farming system. Those external pressures simply up the ante, and make the business as usual trajectory even less credible.

International developments

Internationally, especially in the western world, other countries are already re-examining their food systems from both public health and environmental perspectives. Countries like Finland have made major strides in changing dietary behaviour, doubling vegetable consumption within a decade and more

than halving deaths from coronary heart disease within two decades. Europe is seeing environmental modernisation as a new frontier for innovation, making its big manufacturing industries meet cleaner and leaner targets that are setting new world benchmarks, giving its firms an edge in export markets.

The most comprehensive re-thinking of food systems encountered in this project is taking place in the United Kingdom, across the whole of government, leading think tanks, industries, NGOs and the community sector. This focus, spurred in part by the BSE scares of the 1980s and 1990s, and the 2001 foot-and-mouth disease outbreak as well as the overarching concerns listed above, has led to the development of a comprehensive evidence base about the British food system — much deeper and broader than the information available here. In the most developed fresh food retailing market in the world, supermarkets are frustrated by a perceived lack of long-term government strategy on how the food sector can best contribute to government policy goals. British supermarkets are already meeting targets for reducing energy and water consumption, waste and greenhouse gas emissions along the food chain, that are extremely ambitious by Australian standards. They want to work with government to develop a coherent vision for a green, healthy and fair food system, with a roadmap that identifies priorities for retailers, continues to build the evidence base and implements policies that will enable progress across six key priority areas: climate change; waste; water; ecosystems; nutrition and obesity; and fair supply chains. In the words of Sir Terry Leahy, the Chief Executive of Tesco, *"if we want long term growth, we must go green".*

The take home message from the big re-thinking of food systems happening in Europe, and the UK in particular, is the importance of leadership. The Prime Minister and the Cabinet Office is leading the strategy development process and the very considerable analytical work underpinning it. All key portfolios have defined roles and are actively engaged. Agencies like the Sustainable Development Commission and Renewable Energy Authority, think tanks like Chatham House, industry leaders from across the sector and significant expertise from a number of British Universities and think tanks are also contributing analysis, ideas and energy to the debate. It will be interesting to see what sort of systemic changes emerge.

The Nordic countries provide lessons on how farmland and private farm forests can be major providers of biomass energy. Finland, with a similar land area and population to Victoria, but a much shorter growing season and harsher climate, produces 23% of its primary energy, over 75% of domestic and industrial thermal energy needs, and 20% of its electricity, from woody biomass (by-products of forestry and timber processing and bioenergy plantings such as willow) in Combined Heat and Power plants of up to 500MW.

Cuba provides an outlier example of the complete rewiring of a national food system. From the early 1960s, Cuba effectively became a Soviet satellite, exporting its sugar to Russia at preferential rates and receiving heavily subsidised tractors, fertilisers and pesticides in return, for use on its monolithic, state-owned and controlled farms. Cuban agriculture used more fertiliser and nearly as many tractors per hectare as the United States. When the Berlin Wall fell in 1989, US$6 billion in Soviet subsidies to Cuba disappeared almost overnight, the US trade embargo tightened and Cuba was plunged into an economic crisis. Cuban GDP shrank by 25% between 1989 and 1991, oil imports fell by 50%; the availability of fertilisers and pesticides fell by 70%; food and other imports fell by 50%; and food intake fell from 3000 calories per person per day to 1900. An already poor country effectively fell off a cliff and became desperately short of food.

The Cuban response has possible lessons as the world faces potential new climate, energy and food shocks. The Cubans built a new food and farming system on five core principles: a huge re-orientation of their science and extension effort to make **agroecology** (recycling organic matter, use of legumes, vermiculture, raised beds, crop rotation, companion cropping and biopesticides etc) the dominant paradigm (which has also had spin-offs in the health sector with the development of natural medicines); **Land reform** in which state farms were transformed to cooperatives or broken into smaller private units — in effect, a right-to-farm policy; **fair prices to farmers** enabling excess production to be sold at farmers' markets and resulting in a trebling of average incomes of farmers; emphasis on **local production** and **urban agriculture** in order to reduce transportation (and hence energy) costs; and **farmer-to-farmer training** as the backbone of the extension system. Production of tubers and plantains tripled and vegetable production quadrupled between 1994 and 1999, while bean production increased by 60% and citrus by 110%. Potato production went up by 75%, and cereals by 83% between 1994 and 1998. Food intake rose back up to 2,580 calories per capita per day.

The Cuban model may not necessarily be competitive with current conventional agriculture as practised in OECD countries, but it does serve as a case study of a country that has already confronted a massive food, energy and nutrient shock, and managed to survive on a shoestring with minimal outside help.

Key uncertainties and propositions

After reviewing recent literature, a number of recent scenario planning exercises in Australia, and the very good food supply scenarios developed by Chatham House in the UK in 2008, a range of key uncertainties emerge, as do some key propositions about probable trends in the Victorian food and farming system. First the uncertainties:

- Will agriculture be part of a national carbon emissions trading scheme, if so then when, and how will it be treated? Moreover, will there be any incentives over and above the CPRS (Carbon Pollution Reduction Scheme) for farmers to deliver environmental services such as wildlife habitat protection or water quality improvement?
- Can Victoria get its act together on infrastructure — such as transport, renewable energy and water — sufficiently to enable the food and farming system to anticipate and respond to rising demand for food, competing internationally while coping with a much more difficult climate, rising energy, nutrient and carbon prices, and the need to reduce carbon pollution?
- Are alternative (closed loop, low input, regenerative, energy efficient etc) agro-ecological food production systems able to produce enough food to meet demand?
- Can a food system simultaneously deliver both conventional and low-input agricultural paradigms, and both premium and generic food product trajectories, or are the types of infrastructure, value systems, human behaviour and policy settings so different that co-existence is unlikely?
- Will huge demand pressures simply lead to even more industrialised agriculture, making environmental and health concerns a policy-driven luxury that governments find too difficult?
- Will a consensus evolve around the metrics to measure and certify the performance of farming systems and the food chain in terms of environmental impact, human health, animal welfare and socio-economic factors such as fair trade and support for local producers; and will such consensus translate into well-accepted accreditation and food labelling systems in Australia and internationally?

Notwithstanding these uncertainties, here are some propositions:

- The Victorian food and farming system will have to get used to a drying, warming climate, with more frequent and intense droughts, much lower run off into storages, a less Mediterranean seasonality with shorter growing seasons, more extreme and unpredictable weather events, and greater risk of losses due to storms, floods, bushfires, pests and weeds;
- A doubling of world food demand over the next forty years, coupled with severe supply constraints and rising input prices, will lead to sustained increases in the real price of food, exacerbating inequitable food distribution problems, and intensifying public and political concern about food;
- The end to the era of cheap fossil fuels, the increased cost of alternatives and a price on carbon will see sustained rises in the real cost of fuel, fertiliser and chemicals;
- Consumers will continue to seek, and will be prepared to pay for, highly differentiated food of known quality and origins that meets defined and accredited standards in terms of environmental footprint (carbon, water, land, biodiversity, waste) and 'free from' concerns (pesticides, antibiotics, hormones, preservatives, allergens, GMOs);
- The rising cost of obesity and related problems will see renewed focus on the linkages between the food system, the health system and the farming system; greater interest in transport and lifestyle factors affecting health, functional foods and nutriceuticals; and more public investment in promotion of foods that are *'good for you and good for the environment'*;
- Intensifying public concern about climate change and food (including food insecurity for increasing numbers of people) will see more individuals and communities taking an active role in their food choices and suppliers, ranging from environmental, animal welfare and health

credentials; through changed dietary choices; to active participation in local food systems to improve access to fresh healthy foods.

- Victoria will offer more incentives for firms and households to generate their own energy, giving farmers the opportunity to become net energy producers rather than consumers; and
- Rising food demand, food shortages and price rises for carbon, energy and nutrients will see increasing technological development and investment in more industrialised production of food off-farm, in factories and fermentation vats, for bulk generic ingredients produced to minimum defined standards at lowest cost.

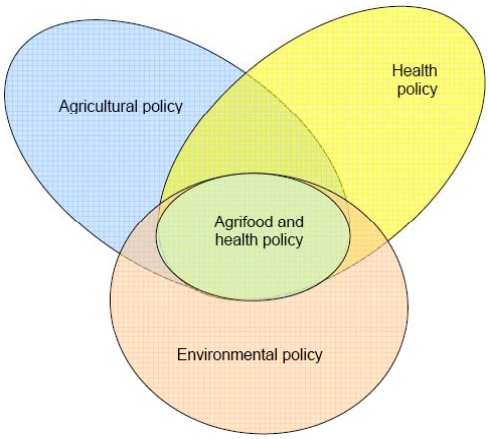
Opportunities to improve the Victorian food system

So where are the key opportunities to improve the performance, sustainability and resilience of the Victorian food and farming system?

A policy agenda

The first key challenge in a policy sense is to comprehend the food and farming system and to develop a coherent evidence base that can underpin policy development.

The diagram at right below (from a Canadian proposal for an integrated Agrifood and Health Policy) highlights the interaction between three major policy areas: agriculture, health and environment. Each of these policy domains has established leaders, forums, stakeholders, knowledge systems, jargon, traditions and ways of operating.



Different bits of the food system have always been connected at various levels with a wide cross section of policy areas, but the food and farming system as a whole does not have a mature, coherent policy framework, institutional apparatus or information-gathering capacity. This major barrier constrains it from comprehending something as big and multifaceted as climate change, resource constraints or responding to increasing demand for food in a carbon-constrained economy.

The challenge for Victorian policy makers is to develop a coherent view about the future development of the food and farming system and the challenges it faces, across traditional departmental boundaries. Getting synergies across departments is important, but not sufficient. It is equally important to develop productive collaborative approaches that extend beyond government to include industry (along the entire food value chain), NGOs (in the environment, agriculture, health and community sectors) and consumers.

Leadership

> *"One doesn't discover new lands without consenting to lose sight of the shore for a very long time."*[2]

In thinking about where to start, always start with leadership.

Leaders are crucial in changing perceptions about what is possible, in being prepared to 'lose sight of the shore' and in setting directions. Crucially, leaders inspire followers. It will be very difficult to attract the sorts of people and skills needed in the Victorian food and farming system in a tightening labour market if the sector is not, and is not seen to be, well led.

This means building the skills, networks, confidence and profile of existing and emerging leaders within the sector. A strategic partnership with an existing leadership program (for example the Australian

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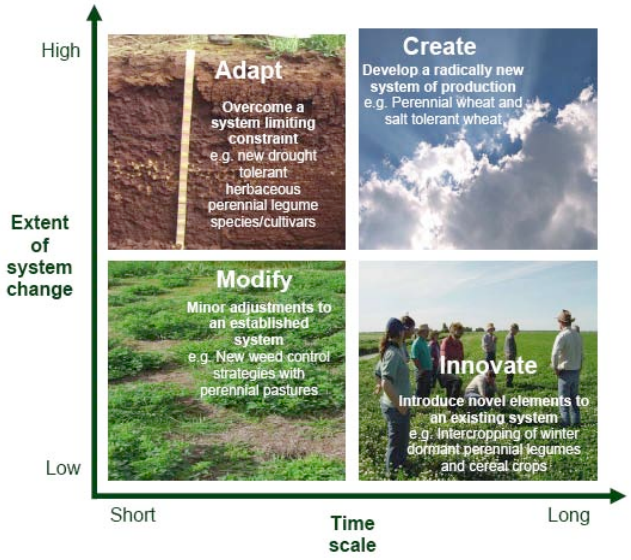
2 André Gide, 1925 *Les Faux-Monnayeurs* (The Counterfeiters), cited in Pretty (1995).

Rural Leadership Program, the Williamson Community Leadership Program, or the Vincent Fairfax Fellowship Ethics in Leadership Program) could deliver several cohorts of industry leaders sprinkled across the sector, with a powerful network grounded in shared experience and mutual understanding. This would be one of the fastest and most effective ways to build cohesion across the sector, in addition to the obvious benefit of developing people who are indeed able to discover new lands.

Such distributed industry and community-based leadership will be easier to attract and motivate however, if there is a clear direction and commitment right from the top of the state, from the Premier, the Cabinet and the heads of government agencies, about the fundamental importance to Victoria of improving the performance, sustainability and resilience of the food and farming system.

This graph[3] provides a good conceptual framework for responding to the challenges facing the Victorian food and farming system. Some aspects of the system need relatively minor tweaking — modifications or adaptations to better cope with changing circumstances. Incremental R&D and extension can deliver these relatively easily, given sufficient resources.



But it is crucial not to default to this comfort zone. There are many areas where the status quo is patently not good enough, where mere tweaking or incremental improvement is insufficient. In such instances genuine innovation is required to deliver quantum improvements. Finally, in the blue sky quadrant, it is important to allocate sufficient space, resources and talent to be creative, to think well outside the box of existing systems — to 'lose sight of the shore'. A well balanced strategy would be consciously working in all four of these quadrants, using different approaches in each one.

Piloting new approaches

This draft background document is a precursor to a much shorter propositions document that will set out new ideas to better prepare and position the Victorian food system for a more challenging world. Thus the focus here is more on analysis than creativity, nevertheless some suggestions are developed later in the document about strategic and project-level pilot approaches that could identify new pathways forward. Suggested pilot projects include:

- A food and farming systems research alliance to improve the evidence base and to target key areas where the status quo is not up to scratch and where innovation is needed.
- Landscape & infrastructure reconfiguration in an irrigation district to create better-serviced, more viable and more sustainable farms in the most favourable parts of the landscape for agriculture, to restore floodplain connectivity and to return land to environmental services.
- Using the institutional food sector (schools, hospitals, nursing homes, prisons etc) as a pilot for demonstrating new approaches to improving environmental and health performance.
- An urban development project to develop and demonstrate 'food sensitive urban design'.
- A trial project aligning public transport (especially rail) with food distribution and marketing.
- A research project to develop a 'beyond oil' tractor drivetrain.

[3] From the Future Farm Industries Cooperative Research Centre's (FFICRC) EverCrop project

A knowledge agenda

"I have always felt that knowledge was better than ignorance,
and we should try knowledge in this country because ignorance hasn't got us very far."[4]

We need better knowledge for three key purposes:

- to help us make better decisions;
- to underpin innovation; and
- so that we learn as we go along, so that, in the words of Peter Cullen, *"at least we should be making new mistakes."*

A more coherent policy framework for the Victorian food system, linking agriculture, food and health, will only be as good as the knowledge base underpinning it. Sorting out basic data about the sector is a key priority, as is developing a research capability that comprehends the system as a whole, and having people who are capable of leading the system in new directions.

Because the Victorian food and farming system is not seen as a distinct and coherent entity, there are no mature frameworks to either develop policies or support research and innovation across the sector as a whole from paddock to plate. There are well-established research funding models for agriculture, although the fact that most funds are allocated along commodity lines is proving to be a constraint to amassing sufficient investment in the big cross-cutting issues like water, energy and carbon; or along the food value chain.

In reviewing the Cooperative Research Centres (CRC) Program as part of the **National Innovation Review**, Professor Mary O'Kane made an intriguing recommendation encouraging the development of a new 'pre-CRC' program for sectors *"with little history of collaborative activity or a low research and development base, particularly service industries and those sectors populated by SMEs"*. Such a program seems perfectly suited to the current situation of the Victorian food and farming system. It could be used to build cross-sector networks and fund scoping activities that would take the higher level analyses in this report and the VEIL Report, and develop much more detailed and grounded proposals to fill critical evidence gaps and to support much needed innovation across the system.

Building skills and attracting talent

As brands, "agriculture" and "farming" are tired and shop-worn, with some negative connotations in terms of profitability, lifestyle, 'old economy' and environmental virtue.

We have to re-think, re-tool, re-wire, re-skill and re-brand agriculture if it is to be competitive in attracting and retaining the sorts of people we need. We need to be thinking about and presenting agriculture as a key part of the food system and consequently the health system, and we also need to start seeing it as part of the energy system. Agriculture needs a new discourse around human health, nutrition, carbon, water, energy, biodiversity and survival, linked to the big demographic challenges that already have policy attention in Australia.

Such a change of tone might start to see agriculture (producing food, fibre, bioenergy and environmental services in clever ways, working with the landscape rather than against it) become sexy again. The entry scores for university courses would start going up again as the best and brightest students want to engage in one of the world's biggest challenges, and to work in an exciting 21st Century industry with enormous growth potential domestically and internationally.

Developing an evidence base

One of the main difficulties encountered during this project has been finding comprehensive, current information about the 'middle' of the food value chain. The information base about farming systems is voluminous, and the information base at the retail and consumption end of the food chain is

[4] The late Peter Cullen, quoted in an obituary by Asa Wahlquist, rural writer for *The Australian* http://asawahlquist.com/content/view/26/2/

reasonable. But the information base along the value chain — around wholesaling, distribution, processing and manufacturing — is much harder to find, fragmented, partial and not always current. This is a significant constraint to the development of a more strategic, forward-looking approach to improving the sustainability and resilience of the Victorian food system in a carbon-, water-, energy-, and nutrient-constrained world.

Filling knowledge gaps

The Victorian Eco-Innovation Lab (VEIL), through its Sustainable and Secure Food Systems for Victoria project, has done a very comprehensive job analysing the areas where we suffer from a lack of evidence or knowledge, and the areas where we need to innovate. Those information and innovation needs are summarised in Appendix D. The analysis undertaken during this project underlines the importance of these identified needs.

Some key priorities for urgent work to fill information gaps include detailed life cycle analyses (LCAs) to explore and map the stocks and flows of carbon, water and energy across the food system, in particular the through chain. It is also important to explore how big a contribution low-input, 'regenerative' farming systems could make under various carbon, water, energy and food price scenarios. In areas close to main population centres, we need to be looking much more creatively at waste — how to minimise it, and how to turn waste streams into nutrient, energy and income streams.

A farming systems agenda

Considerable work is already underway in Victoria to improve the sustainability and resilience of both broadacre and intensive farming systems, in particular to improve the management of climate risk. The EverGraze, EverCrop and Enrich programs of the Future Farm Industries CRC, in which the DPI and Melbourne University are participants, are notable examples in the broadacre sector, and Dairy Australia's Confidence to Grow project is a good example in the more intensive domain. The DPI's Greenhouse in Agriculture (GIA) program is also investigating options to help mitigate greenhouse gas emissions in Victorian farming systems.

An apparent gap in the research and extension effort around new farming systems is to explore the sorts of farming systems that would be viable under severe shortages and/or very high prices of energy, nutrients, water and carbon. There would seem to be big potential advantages in developing a new dialogue between so called 'conventional' agriculture and 'alternative' farming systems like organic, biological and biodynamic farming. Climate change, the policy responses to climate change, rising energy and nutrient costs and increasing water scarcity and hence prices, will all put pressure on the Victorian farming system to use inputs more frugally and efficiently, to make greater use of organic as opposed to synthetic nitrogen, to apply the principles of integrated pest and weed management, and to manage water very carefully. Health and broader environmental concerns will also put pressure on the food system to deliver fresher, healthier foods that meet consumer needs, are not so replete with sugars, salts, saturated fats and food additives, and that minimise net greenhouse gas emissions along the value chain.

From both of these perspectives, organic agriculture as it has been practised for centuries around the world has lessons to offer. It needs to be brought in from the cold in terms of mainstream research and extension systems, treated as a legitimate farming approach and resourced accordingly.

A food value chain agenda

While the bulk of the environmental footprint of the food system is on-farm, there is still much that can be done to improve the sustainability and resilience along the food value chain. Systemic improvements to the food value chain will also involve changes to infrastructure such as renewable energy supplies and improved transport logistics, more sustainable packaging options, and better access to water and waste recycling schemes.

As with farming systems, it will be important to operate in all four quadrants — adapt, modify, innovate and create — with changes ranging from incremental to radical. There is considerable scope to expand alternative food production and distribution strategies such as farmers' markets and urban

food production, especially if that can be integrated with public transport and re-engineering of waste streams to provide recycled water, energy and nutrients for food production.

Food chain redesign should aim to achieve various combinations of several objectives: to shorten food chains; to reduce the transport and energy costs associated with food distribution; to support local producers; to keep people in touch with where their food comes from and how it is grown; and to increase consumption of fresh, whole foods — all consistent with what Kirsten Larsen calls 'food sensitive urban design'.

One of the key factors that may influence whether or not the farming sector can meet its share of the challenges facing the whole food system is the extent to which prices paid by consumers reflect the full cost of food production, and the share of the retail price that is received by the farmer. One strategy is for farmers to try to move further down the value chain, and to capture more of the value accordingly, by differentiating their product and getting involved in its further processing, distribution and marketing. An excellent review just completed by Michael O'Keefe for the Australian Farm Institute suggests that this can indeed be a successful strategy, but it demands a sophisticated understanding of brand differentiation on the basis of developing capabilities that are difficult for others to copy, and close alignment with retailer-driven supply chains.

Industry- or commodity-based EMS (Environmental Management Systems) schemes play a valuable role in establishing acceptable standards of practice and performance within an industry, and in developing more professional and rigorous quality assurance systems at an enterprise level. They lift the bar for the average producer, underpinning food safety and quality, and setting baselines for minimising environmental damage — although their environmental value is limited to the extent that they are only process measures, not actual indicators of environmental performance. Moreover according to O'Keefe, farm accreditation schemes like EMS are a necessary but not sufficient element in securing a greater slice of the consumer dollar for producers. From a brand marketing perspective, having an industry EMS is a useful underpinning quality assurance measure, but it does not help much in brand development or differentiation.

An infrastructure agenda

There are some key areas where new or upgraded infrastructure would make a big difference in facilitating reforms within the Victorian food and farming system that would lead to substantial improvements in its performance and sustainability (in addition to the program already underway on water), including:

- a more comprehensive network of rail freight depots within the existing network;
- an integrated food transport strategy that looks at how road, rail, sea and air can best fit together to maximise efficiency while minimising greenhouse gas emissions;
- increasing the natural gas supply and extending the distribution network to enable widespread use of Compressed Natural Gas (CNG) so that large components of the truck, bus, tractor and vehicle fleet can be converted either fully to CNG, or as dual fuel with diesel; and
- accelerated pilot projects looking at biomass energy from woody perennials integrated into broadacre farming systems, and from methane digesters integrated into intensive farming systems.

Conclusion

Healthy environments, healthy farming systems, healthy foods and healthy people are intricately intertwined.

From a human health, environmental health and economic health perspective, there are very strong imperatives to improve the performance of the Victorian food and farming system right now. Business as usual is not a viable option, especially when the challenges of the decade ahead are considered.

Strategically, the Victorian food and farming sector needs to make a conscious decision about its positioning across two key trajectories in the global food market:

- The 'premium road' servicing discerning markets demanding high quality foods with known and trusted characteristics about environmental impacts, animal welfare and food safety; or
- The 'generic road' producing large volumes of undifferentiated base commodities at least cost on lower margins, meeting the minimum regulatory food safety and environmental standards.

If it is to target the former high-margin end of the market, then serious attention needs to be given to the measurement systems, standards and systems of accreditation and labelling that are necessary to provide consumers with the information and confidence they need to be comfortable with the premium prices paid for these products. In order to develop such systems, considerable work needs to be done at a base line level with Life Cycle Analyses of different products, production systems and value chains to generate robust data and to identify areas for improvement.

Looking beyond the farm gate, there are opportunities to improve carbon, water, nutrient and energy efficiencies. However these are generally more modest than the on-farm opportunities and involve more systemic changes to infrastructure and policies. More could be done to improve the linkages between the food system and the health system, to make healthier, fresh local produce more accessible for more people and to reduce the carbon pollution associated with its consumption.

Positioning the Victorian food system at the premium end of the market will also entail significant attention to infrastructure such as renewable energy, water and transport to improve the systemic efficiency and reduce the environmental footprint of the system as a whole.

In order to deliver all of the above, a very significant investment in human capacity will be required, to develop the necessary leadership and skills among food system participants, and also to improve the environmental literacy of the wider community. Knowledge is already one of the major export products of the Australian mining industry. Hard won Victorian know how in the production of premium foods in a variable climate will be a significant export opportunity as other countries start to grapple with similar challenges, but from a much lower base of climate risk management.

The performance and quality of the food system is a core indicator of the health of any society. The food system has a huge environmental footprint, and is fundamentally dependent on natural resources and environmental services. Food is Victoria's largest manufacturing sector and a very large component of export revenue. The food and farming system is a very significant employer of Victorians throughout the state, especially in the regions. Victoria has a strong science base underpinning its food and farming system and a great platform for innovation and adding value.

Improving the performance, sustainability and resilience of the food and farming system, to thrive and to meet community expectations in a more demanding world, is a very good fit with the government's priorities in innovation, regional development and sustainability.

The major challenge of our time is how to develop a vibrant, self-reliant, carbon-constrained economy and sustain a reasonable quality of life, equitably shared, without depleting or degrading the resources upon which we and future generations depend. This challenge is universal. Grappling with it is a certain growth industry of this century.

Victoria is uniquely placed to make an important contribution.

Chapter 1. Introduction

Food is the most basic of human needs, and securing it has always been a key human endeavour. Since we all have to eat, that will continue to be so. Having a food system is not optional.

However the nature of our food system — the way we produce or procure, process, distribute, sell, buy and consume food — is open to question.

The food system is one of the main components of the human environmental footprint on the planet. If current trends in human population and consumption patterns continue, then the world will need to produce at least twice as much food by 2050 as it is producing now. It will need to do so against a background of a rapidly changing climate and declining production of oil, leading to increasing prices for energy, water, fertilisers, and soon, carbon. The era of cheap fossil fuels is over. The traditional avenues of expanding production though clearing and irrigating more land are narrowing, and food is now competing with energy for land and water resources.

The pressing external drivers for change in the way food is produced don't end there. Consumers in developed countries are increasingly concerned about the quality, safety, environmental impact, human health and animal welfare aspects of their food. For a substantial minority, these concerns are influencing purchasing choices. These concerns extend well beyond the on-farm dimensions of food production, into the overall environmental impact of modern industrial food processing and distribution systems — in particular their greenhouse gas emissions — and to a lesser degree their water consumption and social impacts, with increasing concerns in developed countries about fair trade and support for local producers.

After a very dry decade in southern Australia, it is clear that current conventional farming systems are not good enough. They simply don't make sufficient money in poor seasons to be sustainable in the long term without extensive and prolonged subsidies, and they run down the resource base in the process. Persistent unprofitability and increasing debt levels have obvious economic consequences, particularly for rural communities. They generate insidious and corrosive social impacts, including elevated levels of stress, depression and suicide, contributing to an apparent lack of incentive for talented young people to make, or remain in, a career in agriculture.

Worldwide, agriculture appears to be at a crossroad. Jules Pretty (2002) puts it well:

> *"As we advance into the early years of the twenty-first century, it seems to me that we have some critical choices. Humans have been farming for some six hundred generations, and for most of that time the production and consumption of food has been intimately connected to cultural and social systems. Foods have a special significance and meaning, as do the fields, grasslands, forests, rivers and seas. Yet over just the last two or three generations, we have developed hugely successful agricultural systems based on industrial principles. They certainly produce more food per hectare and per worker than ever before, but only look so efficient if we ignore the harmful side-effects – the loss of soils, the damage to biodiversity, the pollution of water, the harm to human health. Over these twelve thousand years of agriculture, there have been long periods of stability, punctuated by short bursts of rapid change. These resulted in fundamental shifts in the way people thought and acted. I believe we are at another such junction."*

While it is easy to be pessimistic about many aspects of the status quo in food and farming systems, there are also considerable grounds for optimism as we enter Jules' 'bursts of rapid change'.

The world will always need food — in fact it is demanding more and better food than ever. After declining in real terms for decades, food prices are now rising for many commodities. The emergence of carbon markets around the world will generate opportunities for smart and nimble players. The growing size and purchasing power of the discerning consumer base opens up the potential for more sustainable production systems that more than cover the full cost of production including environmental impacts, both positive and negative — generating handsome returns.

However more sustainable and resilient food systems won't just evolve incrementally. Step changes are likely and necessary — in policy, in infrastructure, in technology, in markets, in the skills base and in the way food production, processing, distribution and consumption is organised.

This study attempts to think through some of the developments and changes that might assist the transition to more sustainable food and farming systems in a carbon, water and energy-constrained world. It does so with a focus on Victoria, but with an eye to the wider world, in the knowledge that much of the discussion about the Victorian food and farming system is relevant elsewhere in Australia and beyond, that innovation in Victoria has often led national developments, and also that food system analyses and improvements elsewhere contain lessons for Victoria.

The terms sustainability and resilience are sprinkled throughout this document. Sustainability as used here refers to the ability for an activity or a system to be sustained into the long future, without further damaging the natural environment, or degrading or depleting natural resources faster than they can be replenished. In terms of food systems specifically, I like Ken Dahlberg's definition:[5]

> *"Sustainability as it applies to food means that societies pass on to future generations all the elements required to provide healthy food on a regular basis: healthy and diverse environments (soil, water, air, and habitats); healthy, diverse, and freely reproducing seeds, crops, and livestock; and the values, creativity, knowledge, skills, and local institutions that enable societies to adapt effectively to environmental and social changes."*

Resilience is a key facet of sustainability, particularly in an era of intensifying climate change, as it refers to the extent to which a given system (an ecosystem, farming system, human community or whatever) can withstand, survive and recover from severe shocks or disturbance, without moving to a permanently altered state. Sustainability and resilience have strong ecological, economic and social dimensions.

The Terms of Reference for the project at Appendix B suggest a timeframe encompassing the next 5, 10 and 25 years. However to sharpen the focus somewhat, the discussion here concentrates mainly on the period from now to 2020, well within current planning and policy horizons. The brief here is to think well outside the status quo, to foment new ideas and suggestions, and to stimulate discussion and innovation. The intent is to be constructively provocative, to be imaginative and to fly some kites.

The latter stages of the project will attempt to weave the ideas generated into coherent recommendations, to improve and position the Victorian food system to perform well and meet community expectations in a rapidly changing and much more demanding world.

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[5] This definition was developed by Ken Dahlberg, Kami Pothukuchi and Jim Bingen as part of the 2025 Vision Statement for Michigan Food and Farming. http://www.mifooddemocracy.org

[6] Prentice's orchard, Goulburn Valley, March 2006.

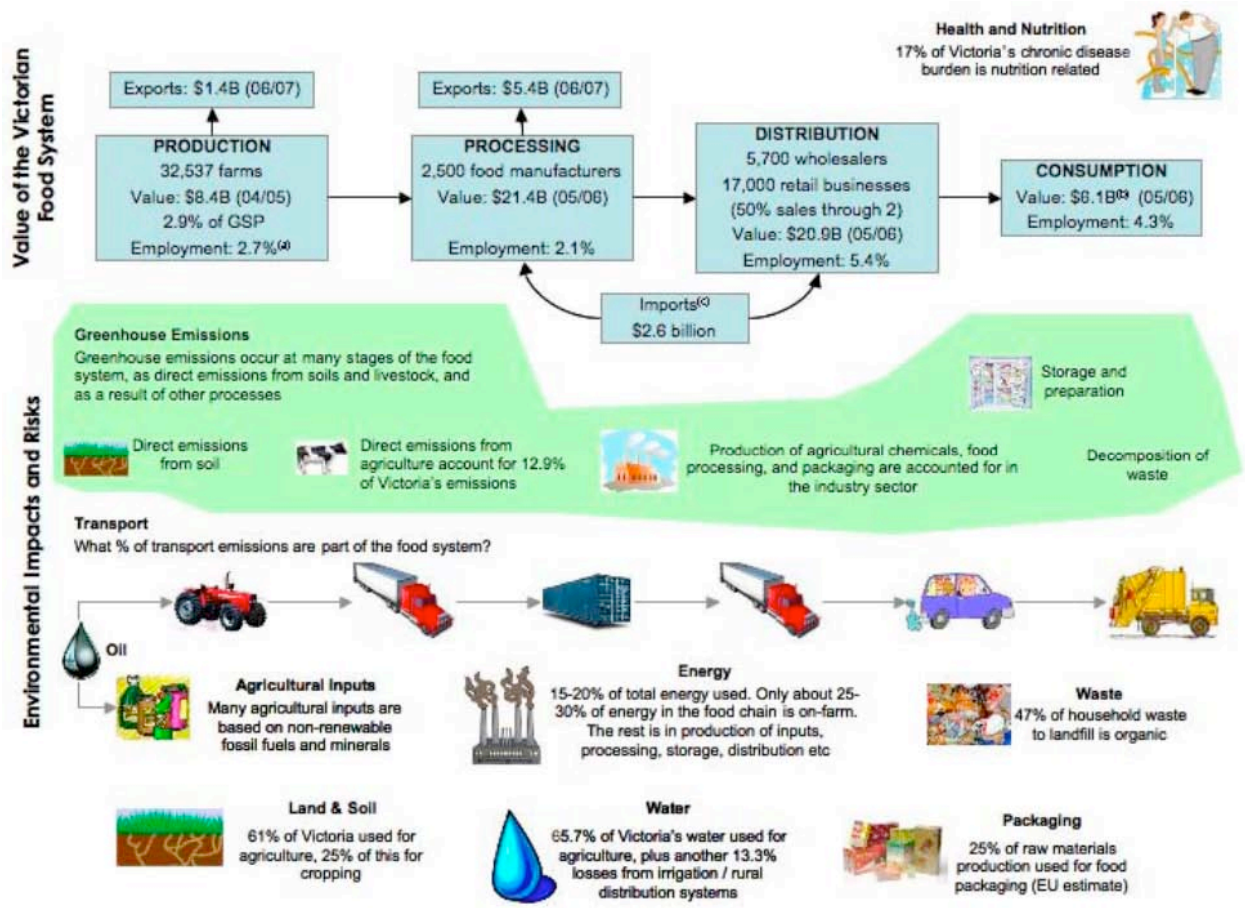
Chapter 2. The Victorian Food & Farming System

The food system comprises the interdependent components and processes through which food is grown and/or processed, stored and distributed, delivered to consumers and consumed, including further processing and storage. It also includes the processes that deal with waste along the food chain (Cornell University 2008, cited in Larsen et al 2008).

2.1 Mapping the Victorian Food System

Figure 2.1 below (from Larsen et al 2008) attempts to capture the Victorian food system and its environmental footprint in a single diagram. The on-farm food production dimension of the Victorian food system is mapped in Figure 2.2.

Figure 2.1 The Victorian Food System (from Larsen et al 2008)[7]



As discussed further below, there is no established and accepted assessment framework for looking at a whole food system.

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7 Much of this first section draws on the excellent work of Kirsten Larsen, Chris Ryan and Asha Bee Abraham of the Victorian Eco-Innovation Lab (VEIL) at the University of Melbourne, in their VEIL Research Report #1 (April 2008) on the sustainability of the Victorian Food System. The VEIL report is a great platform for this study. Figure 2.1 draws figures from a range of sources over different years (and different countries where Australian data is not available). Figures in the blue boxes are drawn mainly from Taylor 2008 and VCEC 2007 (cited in Larsen et al 2008). Values fluctuate from year to year and are indicative, not exact proportions.
(a) Percentage of Victorian total employment, these averages are much higher in regional areas, where employment in food production accounts for up to 22% of total employment.
(b) Includes cafes, bars and restaurants, as well as turnover by hotels and clubs.
(c) Reports in early 2008 suggest that imports of food into Victoria have surged due to drought shortages, the strong dollar and subsidised international production, and now exceed 50% of food exports by value.

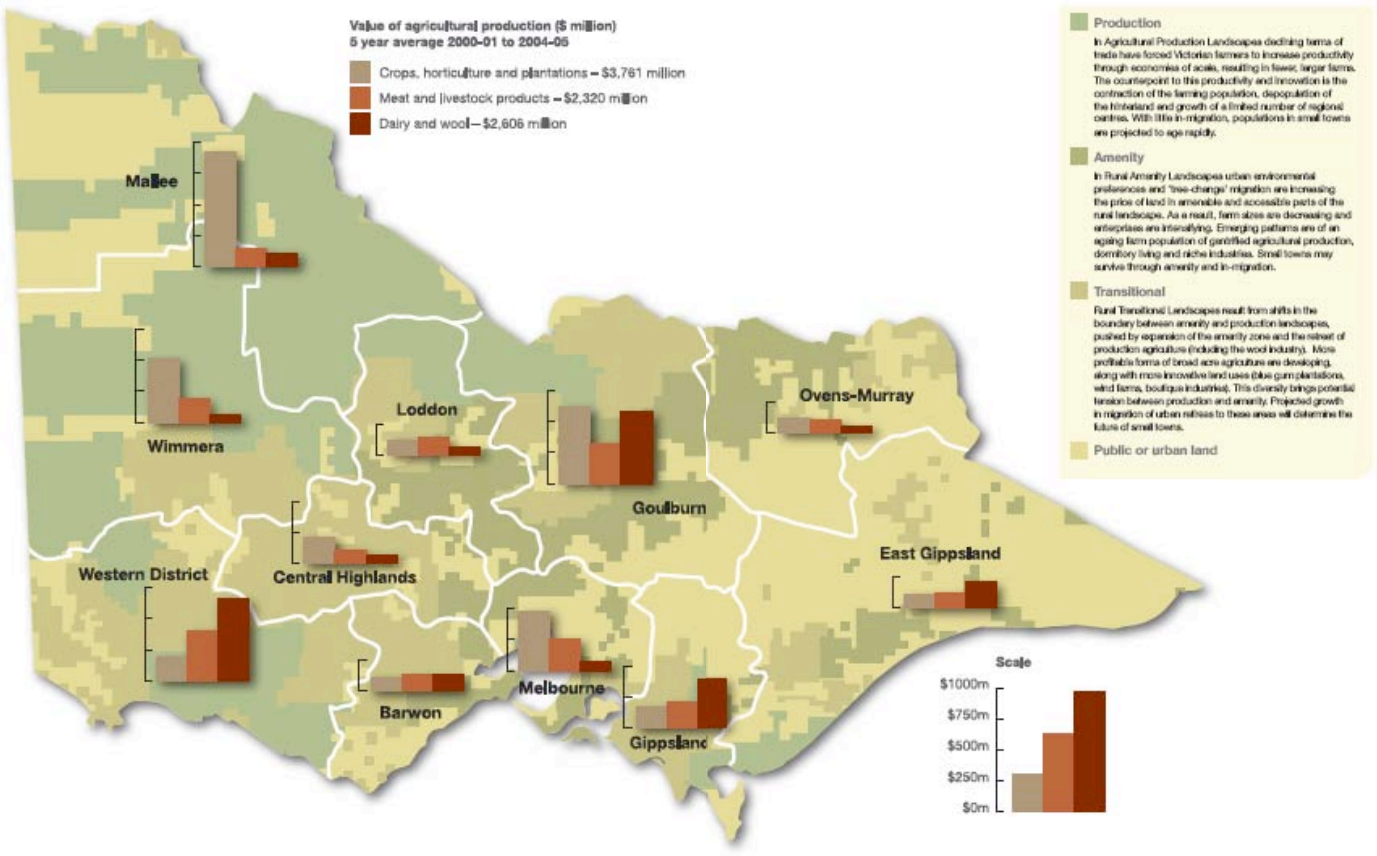
The concept of triple bottom line accountability to measure progress towards sustainability has been around for a decade or so. It has made a useful contribution in getting people to think more broadly than straight economic indicators to include social and environmental dimensions in developing a fuller picture of human progress. Building on this concept, I have found it useful to think about rural sustainability in terms of a 'triple helix' of landscapes, lifestyles and livelihoods — interwoven and interdependent like three strands of DNA (Campbell 2004).

Landscapes are socially constructed, and the ecological capacities and constraints of landscapes in turn shape the sorts of lifestyles and livelihoods people can derive from them. Increasingly, lifestyle choices influence population pressures and resource consumption, and of course people's lifestyles are in turn shaped to a large degree by the need to make a living. The three strands in the 'triple helix' of landscapes, lifestyles and livelihoods are intertwined. In thinking about how we produce and consume food, and manage natural resources, we need to remain conscious of the sense of place, of how people make a living, and how they live their lives — and how these interactions may change in a range of possible futures. The interconnectedness of landscapes, lifestyles and livelihoods is woven throughout this document as a metaphor for considering alternative futures for the Victorian food system.

When we think of the Victorian food system, most of us probably start with bucolic postcard images of Friesian dairy cows on lush Gippsland pastures, extensive golden plains of Wimmera wheat, immaculate geometric orchards in the Goulburn Valley, prime lambs grazing under majestic red gums in the western district, or enticing vineyards in one of Victoria's attractive and distinctive wine regions.

Those classic images are all still to be found (albeit more parched these days than in the past), but they are just pixels in a bigger picture characterised by great diversity and rapid change. Figure 2.2 below summarises agricultural production across Victoria over the period 2000-1 to 2004-5.

Figure 2.2 Agricultural Landscapes of Victoria and Value of Agricultural Production by Region (DPI 2008)



The number of farms in Victoria has halved from almost 70,000 in 1963-64 to around 32,000 in 2004-05, and over the same period the average farm size has grown from 210 hectares to over 430 hectares (DPI

2008). This has been one facet of sustained demographic change in rural Victoria, that has been explored and explained very well in recent years by Neil Barr (2005).

Based on careful analysis of census and other demographic data, Neil Barr divides Victoria into four kinds of landscapes that form the backdrop to the map above:

- **Agricultural Production Landscapes** remain dominated by commercial farming activity, but they are characterised by declining terms of trade offset by increasing productivity, increasing farm size and fewer farms, dying small towns but growing regional centres, and an ageing population.
- **Rural Amenity Landscapes** are emerging as a result of 'tree change' in-migration and urban environmental preferences, leading to escalating land prices, decreasing farm sizes and intensifying enterprises in amenable districts accessible from Melbourne or regional centres. These landscapes retain an ageing farm population of gentrified agricultural production, dormitory living and niche industries, and small towns are more likely to remain viable.
- **Rural Transitional Landcapes** emerge at the intersection of amenity and production landscapes, as the amenity zone expands and the production zone retreats (notably through the decline of the wool industry). New and more profitable forms of broadacre agriculture are developing, along with new land uses such as blue gum plantations, wind farms and boutique industries. The clash of values between production and amenity can bring tension, and places pressure on the planning system and development approvals processes. Projected growth in migration of urban retirees to these areas will determine the future of small towns.
- **Public and urban** land.

One of the interesting features of Figure 2.2 is that regions with few areas of agricultural production landscapes (e.g. Melbourne, Gippsland, Goulburn) remain important in terms of the value of agricultural production they generate. In-migration to an area through 'tree changers' or 'sea changers' seeking rural amenity and lifestyles does not necessarily displace agricultural production, though it tends to change the nature and intensity of that production, and asks more questions of it.

2.2 Livelihoods — economic contribution

Victoria is an engine room of the Australian food and farming system, producing around 26% of Australia's food and fibre exports from just 3% of Australia's agricultural land. The agricultural and food sector makes a major contribution to economic growth and employment in Victoria, generating around 20% of Gross State Product and employing more than 14% of the Victorian workforce (DPI 2008, Larsen et al 2008).

Victoria's farm sector underpins significant food manufacturing industries and the economic activity and employment they generate.

Figure 2.1 illustrates that while food production occupies a large proportion of Victoria's landscapes and consumes a large proportion of its diverted freshwater resources, food processing and distribution are significantly larger sectors of the economy by value, and in terms of the number of people employed. Food production on-farm was worth around $8 billion in 2004-5, employing around 2.7% of the Victorian workforce, whereas food processing and distribution were each worth around $21b in 2005-6 and employed 2.1% and 5.4% of the workforce respectively. The food consumption sector (fast food outlets, hotels, restaurants, public sector food provision such as hospitals etc) was worth a further $6b in 2005-6 and employed over 4% of the Victorian workforce.

The post-farm components of the Victorian food system include 2,500 food manufacturers, 5,700 wholesalers and 17,000 retail businesses (not including thousands of cafes, restaurants, hotels and clubs), collectively turning over almost $50 billion per year and employing almost 12% of the workforce (Larsen et al 2008). Most of the 2,500 manufacturers are small, employing less than 20 people, although 52 companies employ more than 200 people (VCEC 2007). Just as in the farm sector, there has been considerable consolidation over recent decades, and a small proportion of players generate a disproportionate share of the total market.

In the retail sector, just two of those 17,000 firms (Coles and Woolworths) account for over half of all Victorian sales for food, groceries and liquor, compared with their 78% share (in 2005-6) of the Australian market as a whole (DAFF 2007, cited in Larsen et al 2008).[8] This probably reflects the greater concentration of fresh food markets and higher proportion of Independent Grocers Association (IGA) stores in Victoria.

The statewide figures for the economic contribution of the sector are significant, but of course they mask important differences across regions. In rural areas of the state, the proportion of the workforce engaged in food production and processing, and the proportion of businesses dependent on activity in that sector for their turnover, is much higher than in the cities. Outside Melbourne, food and farming account for nearly one in four jobs, and play a vital role in the lives and livelihoods of communities across the state.

BOX 2.1

The Australian Food Industry

(from http://www.daff.gov.au/agriculture-food/food/industry accessed 14.8.08)

The Australian food industry is a vital component of the Australian economy. Food products, incorporating processed food and fresh horticultural produce, account for 46% of total retailing in Australia and 19% of Australia's merchandise exports.

According to **ABS** figures, in 2006-07 food product manufacturing was Australia's largest manufacturing industry as measured by its sales and service income (17%), wages and salaries (17%), employment (20%) and labour costs (17%). The industry remains dominated by businesses employing 100 or more persons, which contributed 73% of sales and service income, 72% of wages and salaries and 57% of employment. The processed food industry had a turnover of $55.3 billion in 2000-01, and employed more than 187,000 people. The industry contributes $14.2 billion or 2.2% to Australia's GDP. The processed food industry is one of only two Australian manufacturing sectors that are net exporters. In 2002-03, Australia had a trade surplus in processed food products of over $9.9 billion: exports had an estimated value of $15.4 billion and imports had an estimated value of $5.5 billion.

Increased consumer expectations over food safety, nutrition, variety, and reliable and consistent quality, as well as rising community expectations for responsible environmental and animal management, are impacting along the entire food chain, from retailer through to producer.

The key issue currently facing the Australian food industry is globalisation. Features of the global marketplace include the ongoing liberalisation of world trade, the rapid development of information and communications technology, and advances in biotechnology. A significant challenge for the Australian food industry is to secure their place in the global sourcing plans of the major international retail chains. The globalisation of the food industry is exerting pressure on food producers and processors in a number of ways. The emergence of global retail chains will result in major changes to the structure and operation of the food processing industry over the next five to ten years. Emerging trends include the development of global sourcing networks, industry restructuring along global lines and the changing focus on brands. Emerging global trends present opportunities for the Australian food industry to increase their market share. These opportunities include: responding to different consumer demands; participating in global supply chains; taking up new technologies, including e-commerce; biotechnologies; and adapting to a changing regulatory environment. If these opportunities are actively pursued, they will enhance the industry's ability to be globally competitive.

The long-term viability of the Australian food industry will depend on its ability to capture a part of these emerging global opportunities.

The Box above describes some aspects of the national food industry. A much richer picture is presented in the FOODmap project (Freshlogic 2007) commissioned by the Department of Agriculture, Fisheries and Forestry (DAFF). This interesting comparative analysis of Australian food distribution channels examines the different ways food reaches consumers; ranging from the expected, such as supermarkets and coffee shops, to the less obvious, such as hospitals and prisons. The report includes 'distribution maps' for several recognised food groups, including beverages, grains, dairy, meat, horticulture and snack-foods, to illustrate the journey they make from production to end user. It assesses the capacity of different food industries to understand their market, develop innovative products and diversify their product range. It concludes that a lack of comprehensive information

[8] The Australian Competition and Consumer Commission (ACCC 2008) has recently concluded an inquiry into the extent to which their influence over the market is enabling the two major retailers to limit competition and control food prices. It concluded that competition in the retail sector is 'workable' while noting 'tough dealing' on the part of supermarkets towards their suppliers.

across and along the food chain is a significant constraint for suppliers, as most information about consumer preferences and trends is held by supermarkets, who see a competitive advantage in not sharing it, and the rest is held by a large number of small businesses, each with only a pixel in the bigger picture.

It is noteworthy that neither the introduction to the sector from DAFF in Box 2.1 above, nor the Freshlogic (2007) comprehensive mapping of food distribution channels makes any mention of climate, energy, water or soil as factors affecting the Australian food industry.

Victorian food exports and imports

According to the DPI Agribusiness Group, Victorian food and fibre exports were valued at $6.35 billion in 2007. Victoria maintained its position as Australia's largest State food and fibre exporter, with a 25% share of Australia's total food exports, and a 28% share of Australia's total wool and fibre exports. The key food and fibre commodity groups for Victoria's exports continued to be dairy and meat, accounting for over 50% of food and fibre exports. Japan remained the most valuable market for food exports, and the second most valuable market for food and fibre exports overall behind China. Other key markets included the United States, New Zealand, Indonesia, Malaysia and Singapore.

In Australia, and in Victoria in particular, we tend to think of ourselves as major food exporters. This is true. The Victorian dairy industry for example, between 1999-2000 and 2004-5, produced 64% of Australia's milk and accounted for 85% of Australia's dairy exports. However, we also import a significant proportion of our food. After years of low rainfall and even lower inflows into storages and hence irrigation water allocations, and with a strong Australian dollar, free trade agreements and continued subsidies for food production in other countries, the value of Victorian food imports now is greater than half the value of food exports. We don't just grow food for the rest of the world, we import lots of it from other countries. Check for yourself by seeing how many products in your refrigerator or pantry have *'made from local and imported ingredients'* somewhere on the container.

We are enmeshed in the global food system and are affected by developments in the food systems of other countries, just as the UK Cabinet Office (2008) cites drought in Australia as a contributor to falling world grain stocks and rising British food prices.

2.3 Landscapes — environmental impacts

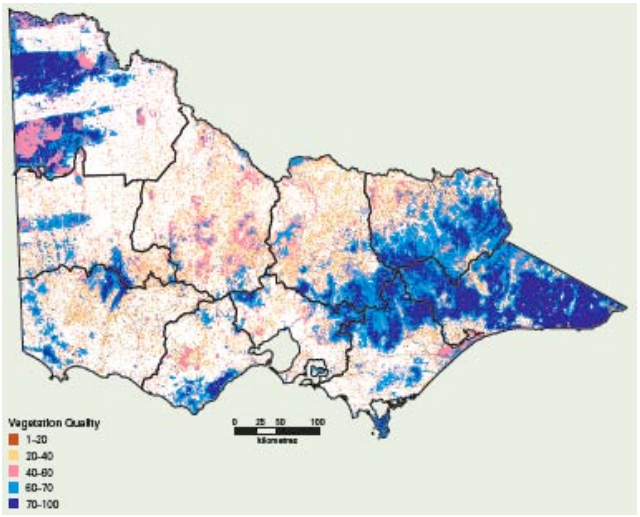
Farming practices — clearing, cultivating, irrigating, grazing, spraying, cropping and so on — are the single biggest ecological disturbance across Victoria. Their aggregate and cumulative impact, including related impacts such as the introduction of pests and weeds and the downstream impacts of agricultural water use, soil loss and dryland salinity, have profoundly changed Victorian landscapes over the last century and a half. These impacts have been extensively chronicled in a number of major reports, including the massive 1991 State of the Environment Report (Commissioner for the Environment 1991), the National Land & Water Resources Audit (NLWRA 2002a,b,c, 2001a,b), the Victorian Catchment Management Council (VCMC 2002, 2007), and the recently released Victorian Government Green Paper *Land and Biodiversity at a time of Climate Change* (DSE 2008). The introduction and early sections of the Green Paper on Land and Biodiversity (DSE 2008) provide a useful timeline of significant events and actions in Victoria since 1800 that have both reduced land health and biodiversity and served to protect and maintain it.

It is not the purpose of this document to do more than summarise some of the key findings of these studies. Suffice to say that Victoria has the highest proportion (48%) of sub-regions in Australia assessed as being in poor landscape condition and suffering landscape stress. The extent and condition of Victoria's native vegetation is well captured in Figure 2.3 below, from VCMC (2007).

According to the Green Paper on Land and Biodiversity (DSE 2008):

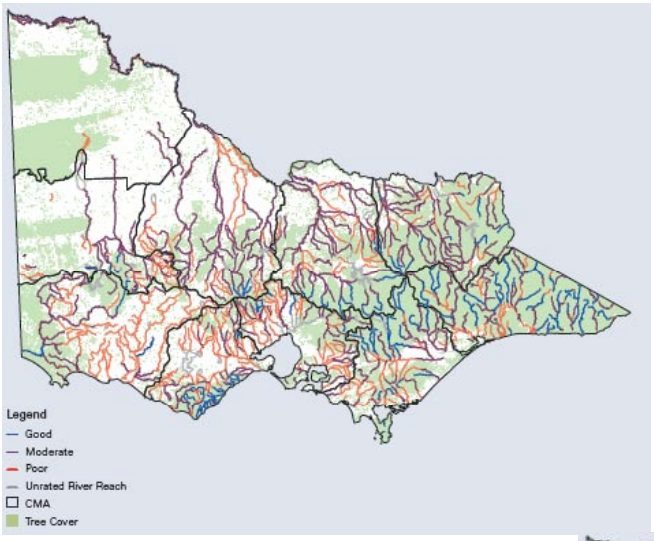
> *"Since European settlement, Victoria has lost approximately 54 per cent of its native vegetation (over 12 million ha) and 80 per cent of private land has been cleared. This means that we have removed a significant proportion of our native vegetation in some areas. This remaining habitat is not consistent across the state and in some regions only small and isolated patches of once extensive ecosystems remain."*

Figure 2.3 Modelled vegetation quality (combines site condition and landscape context)[9]



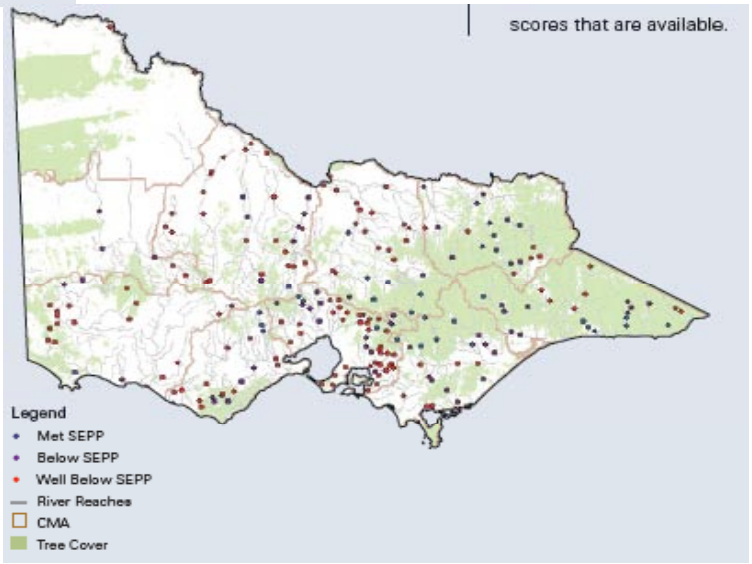
The Green Paper goes on to note that the on-going decline in remnant vegetation extent and condition is more than offsetting revegetation efforts — in other words Victoria is continuing to lose native vegetation. Declining native vegetation cover and on-going fragmentation of habitat has profound implications for biodiversity, soil health, water quality and net greenhouse gas emissions. There is also emerging evidence to suggest that over-clearing in Australian agricultural landscapes has been a contributing factor to declining rainfall in recent decades (McAlpine et al 2007).

Figure 2.4 Index of stream condition 2004 condition ratings for river reaches in Victoria.[10]



Water is the great integrator of catchment management and health. Poor practices in the catchment ultimately reveal themselves in the rivers and streams. With highly cleared and fragmented landscapes and the few remnants in parlous health, one would not expect to find rivers and streams in good condition, except in those areas of the state with relatively intact landscapes. That is pretty much the story in this map showing stream condition ratings for Victorian river reaches in 2004. Rivers and streams in forested public lands in Gippsland, the North East and the Otways are generally fine, whereas in heavily cleared landscapes they are generally in moderate to very poor shape.

The map on the right, also from VCMC (2007), shows how the condition of river reaches shows up in water quality data. The 120 red dots are where water quality is well below State Environment Protection Policy (SEPP) standards, the 33 purple dots are still below SEPP standards and the 30 blue dots indicate satisfactory water quality. Again, these are 2004 data from 183 water quality stations. Given the reductions in rainfall and even steeper reductions in run-off, and the unprecedented extent and duration of the 2006 bushfires, it is likely that stream condition and water quality in most river reaches has deteriorated since 2004.



In cleared agricultural country, a very low

[9] Quality is rated from 0% (lowest quality, in red) to 100% (highest quality, in blue). Source: DSE Corporate Geospatial Data Library 2007.

[10] Source: DSE 2007 Victorian Water Resources Data Warehouse, cited in VCMC (2007).

proportion of rivers meet SEPP water quality objectives, which should trigger community concern and policy responses.

Trying to pull it all together in one map is not easy, but the VCMC has attempted to summarise catchment condition in the different Catchment Management Authority (CMA) regions in Victoria, shown in Figure 2.5 below. This is a qualitative 'traffic light' rating, with green squares indicating 'good' condition, orange 'moderate' and red indicating 'poor' condition against each of the main indicators of native vegetation (NV), forests and parks (FP), biodiversity (B), soils (S), rivers and streams (RS), groundwater (GW), lakes and wetlands (LW) and estuaries and coasts (EC).

Note that the situation for soils mirrors that for native vegetation and water, with agricultural landscapes in poor condition and forested public land in relatively good condition. Groundwater is assessed as being in moderate or poor condition in all regions.

In summary, the enormous wealth, economic activity, export income and employment generated by the on-farm dimension of Victoria's food system has had an extensive and profound environmental impact in rural landscapes. This impact is on-going.

Figure 2.5 Qualitative summary of catchment condition 2007 (VCMC 2007)

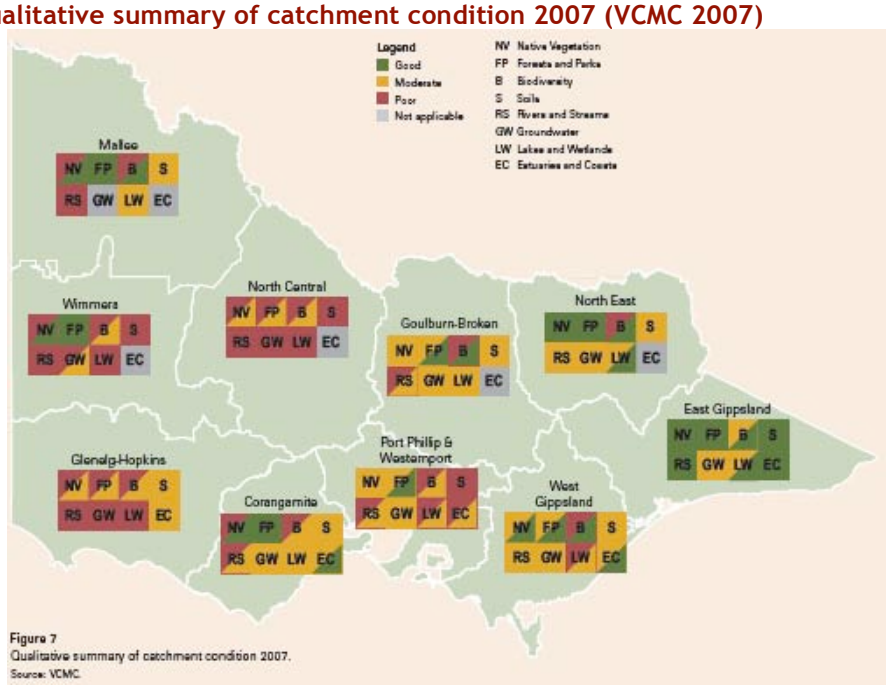


Figure 7
Qualitative summary of catchment condition 2007.
Source: VCMC.

However just as farming systems and practices are the largest disturbance on Victorian rural landscapes, so they are the single biggest ecological lever in landscape restoration. Developing more sustainable farming systems is fundamental to turning around the story of decline in these maps. Let's now turn to the food system as a whole, including the through chain environmental impacts and performance of the Victorian food system.

Assessing the sustainability of the food system

Assessing the sustainability of any food system from paddock to plate (and beyond to follow the waste stream) is extremely complex and difficult. There are no commonly agreed, standardised metrics, nor are there good data to underpin measurement, certification and accreditation systems. The diagram above portrays some of this complexity.

The lack of any accepted assessment framework is in itself one of the major long-term challenges for the Victorian food system. Consumers here and elsewhere are increasingly interested in the production and provenance of their food. Their concerns range from environmental factors such as greenhouse gas emissions, water consumption and biodiversity loss; to ethical concerns around animal welfare and genetically modified organisms; to human health concerns about nutrition,

contamination, pesticides and additives; and social concerns about issues such as fair trade, child labour and support for local producers.

In the absence of any widely agreed standards, faced with consumers' demands for reassurance about food quality in the broadest sense, and seeking product differentiation, a plethora of different approaches have emerged. Some of these are of long standing and refer to specific production systems, such as "organic", "biodynamic" and "free range". Others are more recent and refer to specific ways of assessing products, such as "food miles" and "embodied water". None of these labels or approaches purport to cover all the concerns listed above, which is fair enough, but it leaves consumers in a quandary trying to sort out a plethora of competing claims.

Newly emerging concepts such as food miles and embodied water are intuitively attractive, but problematic in terms of representing environmental impact in a useful way, even within their relatively narrow respective scopes.

Food miles

The concept of food miles arose out of a recognition that the modern globalised food system has dramatically lengthened food supply chain distances. Food produced locally may be processed overseas, and then re-imported for local consumption, and in other cases food may be exported that is virtually identical to food being imported (Larsen et at 2008). These supply chains involve significant greenhouse gas emissions through both transport and refrigeration over long periods. Common sense would suggest that the further the food has to travel to get from the paddock to the plate, the more environmental impact it has — hence the attractiveness of food miles as an indicator.

In practice, the situation is far more complex.

The distance travelled is only a part of the picture, and often a small part (Rama and Lawrence 2008). The type of transportation is critical, as is the transport load factor (how much the unit of conveyance can carry and how full it is), the type of fuel used and the type of packaging, in determining energy consumption and CO2 emissions. Food is often only part of the cargo on a container ship for example, and the transport emissions are only one component of greenhouse gas emissions alongside food packaging and disposal, and obviously the on-farm production (usually by far the biggest component).

A 2005 DEFRA study in the UK, found that the most significant environmental impact of food transport was congestion, rather than greenhouse gas emissions (DEFRA 2005). The UK Cabinet Office (2008) study concludes that *"the environmental case for 'local' is less clear. '**Food miles' are a poor indicator of the environmental impact of food products** and small-scale production is not necessarily resource-efficient or low-impact. Evidence suggests that at some times during the year, transporting produce from other countries may have a lower environmental impact than heating or refrigerating produce grown in Britain. For consumers, driving six and a half miles to a shop to buy food emits more carbon than flying a pack of green beans from Kenya to the UK."*

Another UK study commissioned by DEFRA found that 'car miles' — the shopping trip to and from the supermarket — is a bigger source of transport emissions in the UK than the production and distribution phases (Foster et al 2006 cited in Larsen et al 2008). In Seattle, it was found that for some foods these car miles could be the single most important emissions contribution (Morgan et al 2006).

Given the spread out nature and low population density of our cities — a recent study found that Melbourne's transport emissions per person are 2.5 times those of London (BusVic 2008 cited in Larsen et al 2008) — the 'car miles' involved in our shopping trips are likely to be an even bigger factor. This means that how far someone lives from the supermarket, the mode of transport they use to get there, and the amount of food they purchase per trip, are likely to be more important in determining the transport emissions of their food than the 'food miles' of their chosen purchases — the distance their food products travelled to get to the supermarket.

Rather than food miles, it is more instructive to look at the total energy consumption and global warming potential of different food systems. It is important to be cautious about generalisations about production systems, because differences between individual farms in key practices such as manure management can have a much more significant greenhouse impact than the average difference between production systems.

BOX 2.2

The complexities of environmentally sound food shopping

I live in Queanbeyan, a country town in New South Wales that got a national capital plonked beside it 95 years ago, and now finds itself just to the south east of Canberra, about 12km as the crow flies from Parliament House. On a weekend, we often make a family trip interstate to the excellent Rotary Club Farmers' Markets at the Canberra Showgrounds, well to the north of the city (a small slice of which is shown in the photo below). One of the purchases we often make at those markets is to buy a frozen chicken from an organic, free range poultry producer. He travels to the market from his farm at Gilgandra, 400km away, with his small refrigerated van. We make the 60km round trip in our car, and usually barely manage to fill up our small wheeled shopping cart — about 10kg of food at most (usually including a few kgs of delicious but hail-damaged apples for $1/kg that the supermarkets reject on appearance grounds and would otherwise go to waste).

We love the whole shopping experience at the farmers' market. With an affluent, well-educated population of well over 300,000 people in Canberra and its hinterland, this covered market attracts a wide diversity of high quality producers, with a reasonable level of competition. Excellent fair trade coffee stalls and ethnic delicacies nourish the palates and the consciences of the many leftie/greenie customers. We love chatting to the vendors, appreciating their obvious pride in the quality of their produce. As chook keepers ourselves we are very interested in the way our Gilgandra farmer looks after his birds and are reassured by his description of their living conditions and his processing system.

But from a greenhouse perspective, this shopping is extravagant. While some of the producers are local, many drive more than 100km each way, and the quantities involved are relatively small. Some of the fitter consumers come by bicycle, but the nature of Canberra is such that the vast majority travel by car, and public transport is limited to a sparse and infrequent bus network. In our case, it would almost certainly involve less energy consumption and CO2e emissions produced per unit of food energy purchased, for us to drive down to Woolworths in Queanbeyan and buy a frozen chicken produced and processed industrially by Steggles or Inghams.

With carbon not yet priced, and with fuel prices in Australia still very low in comparison with most OECD countries, it is still a fairly easy choice for relatively well-off families like mine to travel 60km to buy one or two bags of high quality food once a week. We value animal welfare and direct contact with the producers, and we treat it more as an outing than a shopping trip.

There is very little information available, whether on product labelling or in more generic ready reckoners, to assist consumers like us to be more aware of the trade-offs we are making, and to evaluate the full environmental impact of our food shopping choices.

The UK Cabinet Office (2008) analysis concluded that, in Britain *"evidence on health and the balance of environmental analysis suggests that a healthy, low-impact diet would contain less meat and fewer dairy products*

than we typically eat today." However it also notes that if meat or dairy products were not produced, energy would be expended and greenhouse gases emitted to produce substitutes for the foods, leather, wool, fertiliser and other products currently derived from animals.

There are further complexities to the energy/greenhouse story. The UK Cabinet Office (2008) study found that *"growing tomatoes in hothouses in the UK can use 10 times as much energy, and emit nearly four times as much CO2, as producing the same quantity of tomatoes in unheated polytunnels in Spain and transporting them by road to the UK. But UK tomatoes are often grown using fewer pesticides and closed irrigation systems to minimise the release of excess nutrients to the environment. The types of tomatoes grown in the UK also tend to be higher value cherry or vine tomatoes rather than the classic round type imported from Spain."*

For the consumer, data about the relative impacts per kilogram, per dollar or per megajoule of product from different food production systems is important in informing their choice, but of course won't necessarily change those choices. There are other dimensions to environmental impact than energy consumption and global warming potential, just as there are other factors influencing consumption choices than just environmental footprint.

Embodied Water

In the southern Australian context in particular, an obvious further dimension of environmental impact is water. As later sections will show, a sharp reduction in rainfall and even steeper decline in run off over the last decade or so has placed a severe drying squeeze on Victorian agriculture. As agriculture is by far the biggest water user in Victoria[11] there has been an increasing focus on analysing the amount of water involved in the production and processing of different foods.

The concept of 'embodied' or 'virtual' water has emerged as a way of comparing the amount of water used in the production and processing of different products.

Like 'food miles', 'embodied water' has its critics, there is as yet no gold standard for measuring it and calculation methods vary.[12] The fundamental problem with the concept is that it assumes that 'water is water' and that the litres of water consumed per kilogram of product is a meaningful statistic. In fact the timing, location and type of water are critical factors, both economically and environmentally. For example, the opportunity costs of rain falling on a dryland farm producing beef or sheepmeat from cattle or sheep grazing on rainfed pastures, are much lower than those for food products grown with diverted water delivered through a pipe or a channel. Water is very heavy and very cheap, yet expensive in energy terms to move over large distances (especially if it is piped and/or pumped). It is simply not the case that a litre of rain contributing to rangeland beef production in central Australia could have been used to produce Grange Hermitage in the Barossa Valley. Timing is equally important — water used during wet seasons or years is not the same as water used during dry periods. Moreover, most measurements of embodied water do not consider the through chain, just the on-farm component. Given these flaws and the lack of any consensus about measurement methodologies, cross-commodity comparisons of embodied water are generally problematic (Frontier Economics 2008). A much more significant issue for Australia is the gap between the most efficient water users and the average, and the often even larger gap between the average and the least efficient, within commodities and within particular districts.

Given the weight of agriculture as a water user, it should not surprise that the single largest impact that Australian households have on water use is through the food they consume — about half of total household water use compared with around 11% used directly in washing, cleaning and gardens (Lenzen 2002 cited in Larsen et al 2008).

A more useful indicator than embodied water is water intensity, which considers the economic value delivered per litre of water rather than the weight of product. The most comprehensive analysis of the value generated by water use has been conducted by Barney Foran of CSIRO, and Manfred Lenzen and

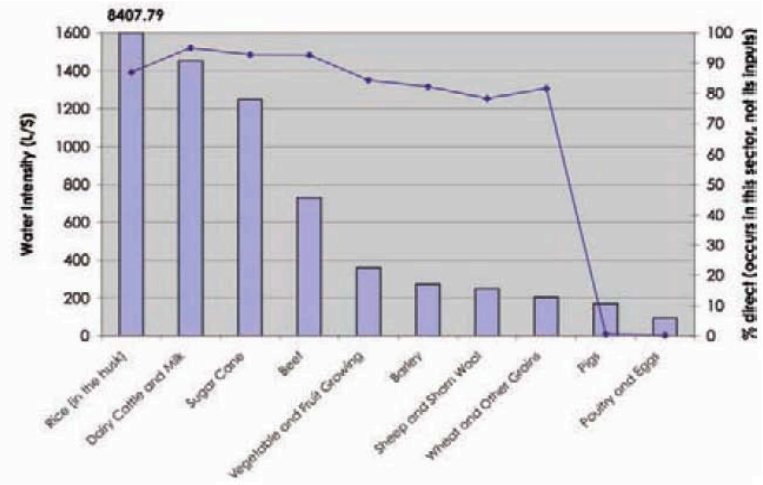
---

11 In 2004-05, Victorian agricultural industries made up 65.7% of total Victorian Water consumption. Losses from irrigation and rural distribution make up another 13.3% (Taylor 2008 cited in Larsen et al 2008) although a portion of these losses is environmentally beneficial for groundwater and baseflow in rivers.

12 See VWIA (2006) and Frontier Economics (2008) for discussion and descriptions of virtual water and water footprinting methods.

Christopher Dey of Sydney University, in their landmark *Balancing Act* report on the stocks and flows in the physical economy (Foran et al 2005). Figures 2.6 and 2.7 below (from Larsen et al 2008) illustrate the relative water intensities in litres per dollar of output of various agricultural sectors, in the production phase and the processing phase respectively.

Figure 2.6 Water intensity in primary food production sectors[13]



Pigs and Poultry/Eggs have a low percentage of the water intensity directly attributed because most of the water impact is through their inputs.

For pigs, the water use occurs through inputs of: dairy products, rice → flour and cereal foods, fruit & vegetable production, and sugar → other food products.

For poultry and eggs, the most signficant water inputs are beef cattle → meat products (28%) and sugar → other food products (25%).

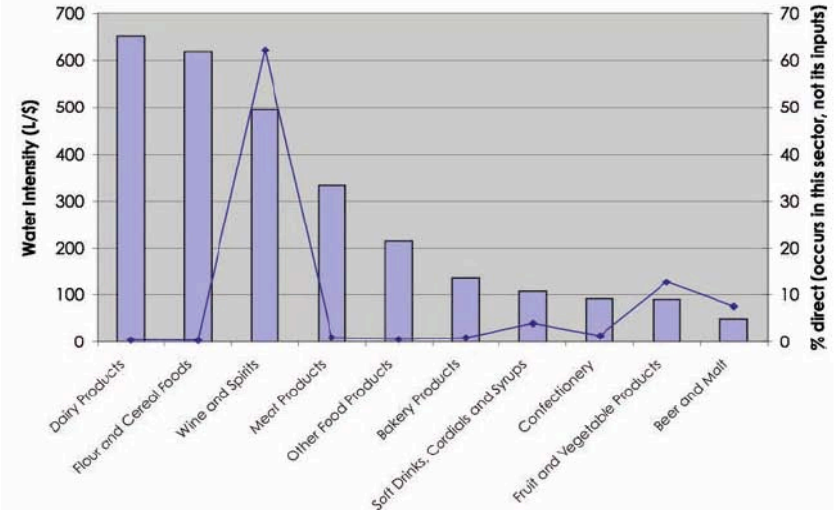
[The picture at right is of a newly sown, flood irrigated dairy pasture in northern Victoria, in March 2006.]

Comparing the scales of water intensity on the y axes of these two graphs shows that the biggest proportion of water use for water intensive products is on-farm, in the primary production phase. Only in fruit and vegetable processing and alcoholic beverages are there opportunities to save significant amounts of water in the secondary processing stage of the food system. The sectors that use most water per dollar of output are rice, dairy, sugar cane and beef.[14]

13 From Foran et al (2005) cited in Larsen et al 2008.

14 At over 8,000 litres of water per dollar of output, rice has more than five times the water intensity of dairy (1450 litres/$) which in turn uses about twice as much water per dollar as beef. These figures should be treated with some caution however, as they assume a single average figure for the water intensity of each commodity, whereas there is likely to be considerable diversity within commodities as well as between them. For example, some dairy farms are irrigated, some rely entirely on rain-fed pastures. As with the concept of embodied water, it should not be assumed that water used to grow one commodity could easily have been used to grow something else.

Figure 2.7 Water intensity in secondary food production sectors[5]

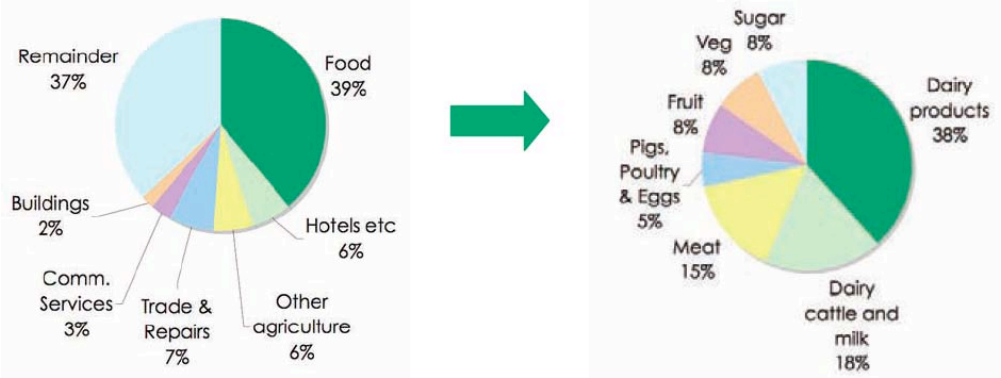


For value-adding food sectors, the water intensity is generally lower and most of the water intensity is at the production stage (rather than in processing).

Wine & spirits, beer & malt and fruit & vegetable processing are exceptions, indicating that a significant portion of the water is used in the processing stage for these products.

Kirsten Larsen and colleagues report that the Victorian Water Trust has commissioned a Victorian analysis of all the water embodied in Victorian goods and services that is being undertaken by GHD and will be released during 2008. That will be an important development in identifying the main opportunities for system improvements and quantifying those opportunities. At present, the best available information suggests that the carve up of the Victorian water 'cake' approximates Figure 2.8 below (from Muntisov 2007, cited in Larsen et al 2008).

Figure 2.8 Virtual Water in Victorian Final Demand



These pie charts show that food is by far the single biggest user of water in Victorian final demand. Of that, red meat and dairy products consume more than 70% of the water. In other words, the embodied water in red meat and dairy products represents more than a quarter of total Victorian water consumption (Larsen et al 2008).

It is crucial that we know how, where and when water is being used, and in particular how well it is being used. The fine-grained detail of water use efficiency and productivity across the landscape; the level of extractions compared with sustainable yields of groundwater and surface water; the management of environmental flows and the health of streams and wetlands; the design and management of irrigation infrastructure to enable best practice approaches; the pricing of water to reflect the full cost of its delivery; the facilitation of the water market so that (within environmental and hydrological constraints) water can trade to its highest value use — these are all far more useful indicators of the appropriateness of water use and management than simplistic notions of embodied water at an aggregate level across a whole commodity.

The bottom line of any analysis of the impact of the Victorian food system on water resources is that the status quo is not good enough. The current extended dry period is exposing problems of allocation, and successive catchment condition reports have revealed extensive water quality problems in cleared agricultural landscapes. Rivers, floodplains and wetlands — and terrestrial biodiversity for that matter — are collateral damage, caught in the crossfire between a drying climate and the water demands of

industries and communities.

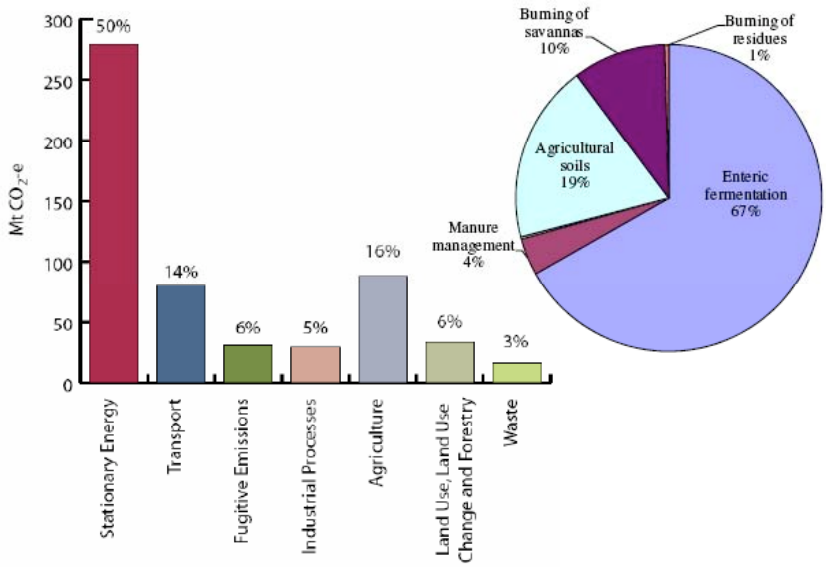
Greenhouse pollution

The food system, and agriculture in particular, is one of the major causes of greenhouse pollution. It will come under increasing pressure to meet its share of responsibility for reducing carbon pollution. As soil and vegetation are the largest terrestrial carbon stocks, there are potentially significant opportunities for agriculture to assist other sectors to offset their own carbon pollution.

This field is changing very rapidly — in scientific understanding, in technological development, and in political, policy and market responses. This section provides but a brief introduction to a very complex and dynamic scene, through the lens of the Victorian food system.

Figure 2.9 below sets out the contribution of agriculture to Australia's greenhouse pollution in 2005, according to the National Greenhouse Gas Inventory (NGGI 2007). Agriculture is the second biggest emitter, albeit well behind power stations. Enteric fermentation (ruminants belching and farting methane) is the biggest component of agricultural emissions, followed by nitrous oxide lost from nitrogen fertilisers, animal manure and soils. Agriculture accounts for 60% and 85% respectively of Australia's total methane and nitrous oxide emissions (NGGI 2007), both potent greenhouse gases. The indirect emissions related to agriculture's use of transport and stationary energy account for around 11% of national emissions, but are attributed to the stationary energy and transport sectors in Figure 2.9 below. Within Victoria, agriculture's share of total emissions is slightly smaller at 12.9% (Victorian Greenhouse Gas Inventory 2007), presumably due to the predominance of brown coal-fired power stations in Victoria. Garnaut (2007) estimates that the food system generates at least 23% of Australia's emissions, when emissions from energy, transport and waste are included, making it our second largest emission-generating activity after power stations.

Figure 2.9 Greenhouse Gas Emissions from the Agriculture and Forestry Sectors 2005 (NGGI 2007)



There are no comprehensive data on energy use or greenhouse pollution specific to the Victorian food system. Larsen et al (2008) provide an excellent discussion of the information that is available and the types of information that would enable rigorous analysis and identification of opportunities to improve the greenhouse performance of the system.

Waste

One of the least well-recognised environmental problems with modern food systems is the sheer amount of food wasted. Waste is important, because the water and energy consumed and greenhouse pollution generated along the food chain are for nought — they are all disbenefit for no benefit.

So how much food do we waste?

In an Australia Institute report exploring wasteful consumption, Clive Hamilton, Richard Denniss and David Baker (2005) found that food accounted for the largest proportion of wasteful consumption in Australia. Based on a national survey of 1644 respondents carried out by Roy Morgan Research in November 2004, Hamilton et al (2005) found that Australians discarded an estimated $5.3 billion worth of food: $2.9b of fresh food, $876m of leftovers, $630m of uneaten take-aways, $596m of unfinished drinks and $241m of frozen food, totalling nearly 3.3 million tonnes per year. According to EcoRecycle Victoria (2005, cited in Larsen et al 2008), food and green waste makes up around 47% of municipal waste sent to landfill.

These Australian figures are in line with international studies.

Food waste is a major concern in Britain, where the British government launched a national Waste Strategy in 2007, and where a dedicated NGO called **WRAP** (Waste and Resources Action Program) has a national campaign called **Love Food, Hate Waste** (WRAP 2008). According to WRAP, people in the UK throw away 6.7 million tonnes, worth more than 10 billion pounds (around £420 per family) of food every year. They estimate that eliminating this waste would equate to taking one in five cars off British roads in terms of reductions in greenhouse pollution. In a report for DEFRA in the UK, the Manchester Business School calculates that each kilogram of food waste that makes it to landfill generates about 420g of CO2 equivalents in methane emissions (Foster et al 2006), in addition to the emissions generated during its production, processing and distribution.

In the USA, *Food Production Daily* (2007, cited in Larsen et al 2008) reports studies showing that households throw away about 14% of their purchased food (15% of which is unopened and within its use-by date), which is consistent with the Foster et al (2006) estimate that about 10% by weight of food purchased by UK households is thrown away.

These figures emphasise food waste post-sale, but in fact food is wasted at every point in the food chain.[15] Larsen et al (2008) cite a 2004 US study which estimated that almost half all food produced in the USA to the point where it is ready for harvest goes to waste (*Food Production Daily* 2007). Some of this waste is weather-related, some is due to speculation on commodity markets and some is driven by the preferences of major retailers for products meeting specific size and attractiveness criteria. The latter is particularly a problem in markets like ours, dominated by a couple of large players.

At face value, reducing waste appears to be a no brainer — one of the simplest ways of improving the environmental performance of the food system. However Clive Hamilton and colleagues (2005) caution:

> *this study… deems waste not as an 'end-of-pipe' environmental problem – the leftovers after we have consumed – but as something inseparable from modern consumer society. The analysis suggests that waste should be considered not so much as an unfortunate by-product of the economy but as an essential aspect of the psychology of consumption. It suggests that when there is a conflict between our desire to help the environment by 'doing the right thing' and the desire to gratify our consumption, appeals to reason may fail. In that case, we must overcome the deep-seated need to create a sense of personal identity through consumption expenditure. Asking people not to consume so much may, in fact, be an invitation for people to destabilise their sense of self. Under such circumstances, the assumption that the path to sustainability lies in the provision of enough information and public education for people to understand that it is 'in their interests' to try to reduce waste may be ill-founded.*

2.4 Lifestyles — social significance

The discussion on waste segues nicely into modern lifestyles and the social dimensions of the food system. Food of course has enormous social and cultural significance. Cuisine is bound up with our sense of identity, and shared meals remain fundamental to many of our closest relationships.

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15 The global dimensions of food waste, and what that means in terms of water stress, are dealt with comprehensively by Lundqvist et al 2008 and discussed in the next section

Before looking at the consumption end of the food system however, it is important to get back to some of the social dimensions of food production in Victoria's rural landscapes.

Figure 2.10 Social Landscapes in Victoria (from VCMC 2007)

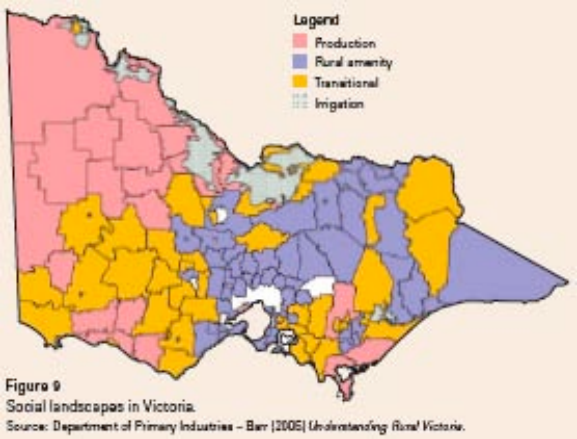


Figure 9
Social landscapes in Victoria.
Source: Department of Primary Industries – Barr (2005) Understanding Rural Victoria.

The map at left is a simplified version of the background in Figure 2.2, showing Neil Barr's (2005) classification of Victoria into Agricultural Production Landscapes (pink), Rural Amenity Landscapes (blue) and Transitional Landscapes (orange).

The rural amenity landscapes are important in the Victorian food system for several reasons. Firstly, they produce a significant amount of food in their own right, particularly higher value products such as fruit and vegetables and wine. Secondly, the influx of people into these regions for lifestyle reasons has brought with it both new money and urban preferences, so these areas are now sprinkled with good restaurants and in even the smallest town the chances are you can find an excellent coffee and some quality local value-added produce. Culinary and heritage tourism is an important component in such areas and these landscapes are as much arenas of consumption as they are of production. Thirdly, because of the high proportion of non-farm income in these areas, they are less vulnerable to the vicissitudes of agricultural markets and the weather.

In 1900, almost 60 percent of people lived outside Melbourne. By 2006, just 27 % (1.39 million people) lived in regional Victoria (ABS 2006). Population is still declining in the pink areas of the map — where agriculture still dominates — while it tends to be increasing in the transitional and amenity landscapes. In the agricultural production landscapes, farms are not just getting bigger, they are increasing their size and output per unit of labour — i.e. they are employing fewer people per unit of land and output. Neil Barr's data shows that farmers are not just thinning out, they are ageing — in fact the number of woolgrowers over the age of 80 has increased in each of the last two censuses. These landscapes are losing critical cohorts, like young women aged 15-24, at disproportionately high rates, with profound social consequences. This has led to innovative (some might say desperate) responses, like the *Find the Farmer a Wife* television program, but the problem is real and far-reaching.

As a kid growing up on a farm in western Victoria, many of my classmates at Cavendish Primary School (No 116) in the 1960s were the children of farm workers, there were about 125 students at the school and four smaller schools nearby (Hensley Park, Melville Forest, Bulart and Mooralla). Most properties larger than the one square mile (640 acres or 260 hectares) Soldier Settler Scheme blocks employed permanent labour. Anyone with more than 5,000 DSE (dry sheep equivalents) of stock certainly did. Now many properties now carry 10,000 DSE per labour unit, and the farm cottages that used to contain farm workers are more likely to have been sold and removed, or be rented by someone working in Hamilton. Cavendish now has 70 students in the primary school (after dropping to a low of 25 in the late 1980s) and the four smaller adjoining schools have long since closed and been removed.

Increases in average farm size and labour unit productivity in recent decades have been a response to falling farm terms of trade — i.e. the prices paid for farm inputs have risen faster than the prices received for farm outputs. However only the top one third of farms (by gross value of production GVAP) have had productivity gains that have exceeded the decline in their terms of trade, and only the top one fifth of Australian farms generate a positive long term return on capital (Barr 2005). The larger farms are better able to afford capital investment and to adopt new technologies and systems, and they generate a disproportionate share of total production. According to Neil Barr (2005) the top 10% of Australian farms generate more than 50% of GVAP, and the bottom 50% generate less than 10% of Australia's gross value of agricultural production.

This means that most farmers are losing money in most years, increasing their level of debt. To some extent this has been masked by rising land prices through the 1990s and 2000s, which has seen overall farm equity increase. Farmers wishing to exit agriculture, whether by selling to neighbours, other farmers, tree changers or blue gum companies, have generally been able to do so and retain sufficient

equity to buy a house in town and make a new start. But those remaining in agriculture who are not in the top 10% are subject to chronic unprofitability, rising indebtedness, and consequently increased stress levels and health risks, including depression and suicide. These social impacts have consequences well beyond the individual concerned, obviously for their families, but also their communities and the wider society, health system and economy.

Food Consumption

"Eating is an agricultural act"[16]

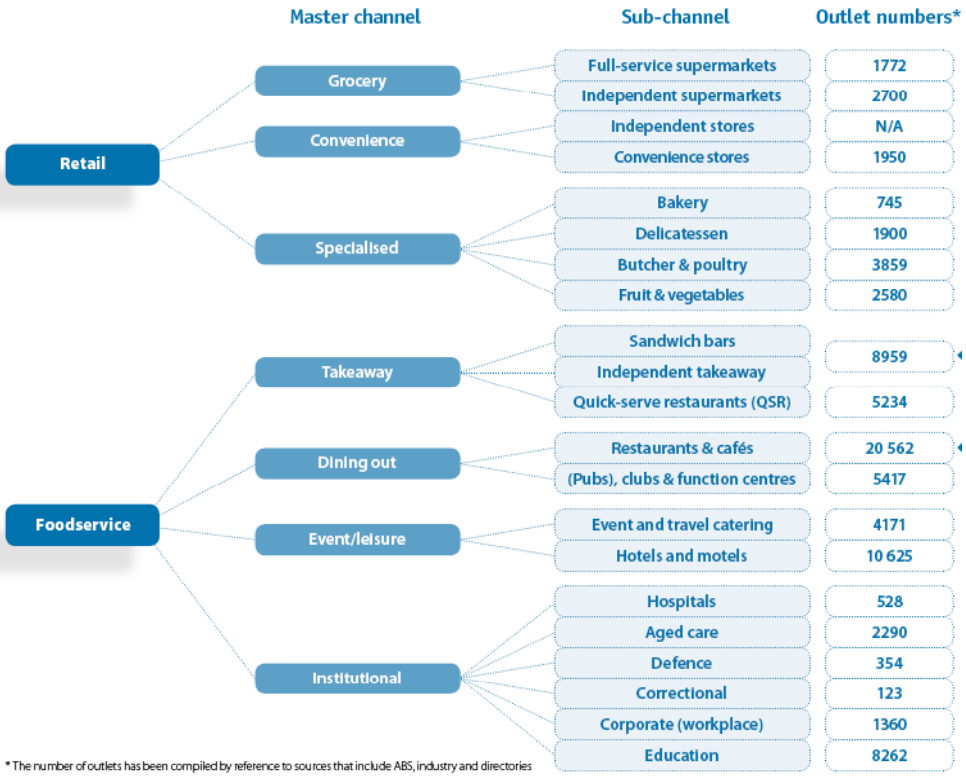
The way in which we produce food is changing, as is the way we prepare and eat it.

In Australia, as in much of the developed world, there is an increasing trend towards eating out, take-away food, home deliveries, pre-processed and packaged food (DAFF 2007). These changes are being driven by a number of factors including a desire for convenience in the way people shop, cook and eat, the role and status of women (especially the proportion of women in paid work), food and kitchen technologies, marketing (including the popularity of cooking shows on TV), new food technologies, sophisticated advertising and marketing, successive waves of immigration such as Mediterranean and Asian ethnic groups, growing familiarity with foreign foods and willingness to experiment with new foods, increasing interest in the provenance and production of food, a desire for healthier food options and the increasing affordability of food (Larsen et al 2008, UK Cabinet Office 2008).

Figure 2.11 below outlines the key distribution channels in the Australian food system, illustrating some of the complexities embedded in the notion of a 'food system'. The food chain analysis by Freshlogic (2007) agrees with that of the ACCC (2008) in concluding that the domestic food market is very competitive, notwithstanding the supermarket duopoly. AC Nielsen estimate in their 2006 Grocery Report (Foodweek 2006) that the major retail chains hold about 78% of the market share of the grocery channel, excluding liquor sales. However according to Freshlogic (2007), *"independent fresh food specialists and takeaway and dining out establishments are winning a greater 'share of stomach' as consumers eat outside the home more."*

[16] Wendell Berry (1990) "The Pleasures of Eating" in *What are People For?* North Point Press, New York. Cited in Pollan (2008)

Figure 2.11 Food distribution channels and numbers of outlets in Australia (from Freshlogic 2007)



According to Freshlogic (2007):

- growth through the traditional Full Service Supermarket (Coles & Woolworths) channel is slowing;
- consumers are seeking more convenience and time-saving options for shopping, meal preparation and eating;
- more food is being consumed out of the home; and
- a greater diversity of options for eating out of the home is fuelling the expansion in casual dining.

Freshlogic (2007) conclude that the pressures of performance and increasing competition on the major retail chains will continue to compel them to streamline costs and drive category performance in existing supermarket networks, alongside the expansion of their retail format. This will create pressures further back up the supply chain however, as supermarkets seek to pass on cost reductions.

Suppliers can potentially tap into the increasing growth and diversity of non-supermarket retail channels, especially those providing convenience meals and eating occasions that meet increasingly complex consumer needs. Many of these channels are growing faster than the average being achieved by the total food market, but the Freshlogic analysis suggests that the poor information systems across the sector are a major constraint to suppliers in tailoring new products and processes to meet consumer needs.

One of the fascinating aspects of the diagram above is the importance of what Freshlogic (2007) calls the Institutional Market, such as hospitals, schools, aged care facilities, corporate workplaces, prisons and defence establishments, which serve literally millions of meals each day. Many of these institutions are publicly funded, underlining the importance of public sector food policies and practices, over and above the framework-setting and regulatory roles of government. The demographic discussion in Section 3 highlights the demographic momentum of the ageing of the Australian population, with a likely tripling to quadrupling of the number of people over 65 in coming decades. Increased concerns about the nutritional content of the diets of people living in care will place significant demands on the institutional food sector.

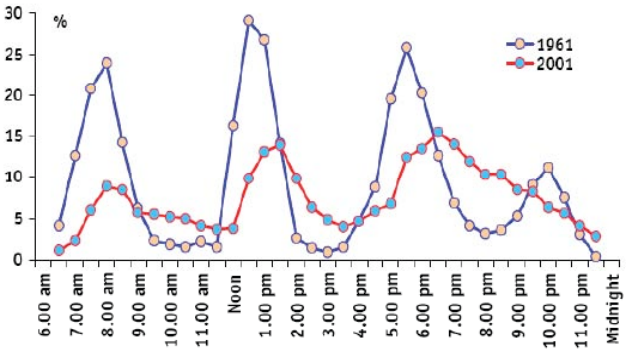
The potential for high quality Victorian products, grown in sustainable production systems, with a high level of product certification and through chain integrity to attract premium prices as consumers become more discerning, is discussed later in this report. The conclusions of the Freshlogic (2007) FOODmap project offer some comfort about this scenario:

> *"The environment continues to provide opportunity for new entrants in food retail, not only in specialty areas and specific food categories but also where there is scope to improve the integration of an offering across added-value processing and wholesale supply. As a result, specialists (meat, fresh food, bakery, deli, etc) and those focusing on convenience—including independent grocery outlets able to offer greater product flexibility—will have more influence."*

The United Kingdom is devoting a great deal of policy attention to the sustainability of its food system at present, driven by the same factors that stimulated this study, but also with heightened sensitivity about the food system within the British community after successive food system-related public health scandals including foot and mouth disease and BSE ('mad cow disease'). The British scene is discussed in more detail later. A comprehensive analysis by the UK Cabinet Office (2008) has tracked changes in consumption patterns including a marked decline in consumption over the last twenty years of milk and cream, potatoes and to a lesser extent bread and fresh meat, with an increase in consumption of fruit and vegetables and processed meat. The latter is an indication of what the UK Cabinet Office says is a gap between what people say and what they do. They have found that peoples' positive attitudes to healthy eating and the environment is not matched by spending patterns (UK Cabinet Office 2008).

Figure 2.12 Changing eating habits, UK 1961—2001 [17]

The graph below left shows the proportion of people in the United Kingdom eating or drinking, in or out of home, by time of day. The blue line represents eating habits in 1961, with very distinct meal times during which more than a quarter of the population are eating or drinking. The red line represents 2001, showing never more than 15% of people eating at any one time, and a marked flattening of the curve, with at least 5% of the population likely to be eating at any time from 6AM until midnight.



The same is probably true in Australia. As Larsen et al (2008) report *"there has been an ongoing shift from consumption of unprocessed wholefood meals to processed wholefoods, and again to "processed reconstituted" foods (products*[18] *constructed from reconstituted components of wholefoods, chemical additives, artificial fats and sugars)."* In Australia we appear to be moving away from red meat, eggs, grains and sugar, towards seafood, poultry and fresh fruit and vegetables, while dairy consumption appears to be stable. We may have replaced some red meat with poultry, but we still have the second highest average meat consumption in the world at 304 grams per person per day, behind only the USA at 342, well in excess of the developed country average of 224 and dwarfing the developing country average of 47g/person/day (ABS 2000 cited in Larsen et al 2008).

17 From UK Cabinet Office (2008b)

18 Michael Pollan (2008) refers to these products as 'edible food-like substances'.

 [19]

Victoria's population has increased dramatically over the last century from around 1.21 million in 1900 to 5.13 million people in 2006. In 2004, it was estimated that Victoria's population would exceed 6.2 million people by 2030. At current growth rates that population may be reached ten years earlier. This will increase local demand for food, for release of significant areas of new land for urban development, and the building of more than 600,000 new houses (DSE 2008).

[19] Jigsaw Farms, Hamilton, October 2004.

Chapter 3. Drivers for change in the Victorian food & farming system

The previous Chapter attempted to summarise the status quo in the Victorian food system, while mentioning some trends and on-going changes. The premise behind this whole project is that external drivers for change are such that the Victorian food and farming system will need to anticipate and respond even more rapidly and possibly radically over the coming decade to remain profitable and to avoid major environmental and social problems. This Chapter describes some of the main external drivers that will affect the Victorian food and farming system over the next decade and beyond. Chapter 4 looks at how other countries are responding to these drivers, then Chapter 5 sketches some scenarios for the future evolution of Victorian food and farming systems.

In order to structure the discussion, drivers for change are dealt with in turn through this section. However it is important to keep in mind that many of these drivers intersect and interact with each other, sometimes synergistically, sometimes in tension, often in complex, unpredictable ways.

For example, many of the prescriptions to improve water supplies or efficiency, such as desalination plants, pipelines or even drip irrigation systems, require large amounts of energy. Biofuels to improve energy security use large amounts of water, nutrients and land (and energy in their full production cycle), while displacing food production. Reforestation for carbon sinks also requires energy and land, with the net impact on water resources or food production dependent on where plantations are located within watersheds.

Policy responses that target one of the drivers discussed below, without considering the others, risk unintended consequences.

3.1 The external operating environment

Adapting to Climate Change[20]

The evidence of warming of the Earth's climate system is unequivocal. It is evident from increases in global average air and ocean temperatures, melting of snow and ice, and rising sea levels. Numerous changes in climate have been observed at the scales of continents or ocean basins, including wind patterns, precipitation, ocean salinity, ocean acidification, sea ice, ice sheets, and aspects of extreme weather.

These are the sober conclusions of the most comprehensive and authoritative analysis of the Earth's climate ever undertaken — the 2007 Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC 2007). The IPCC concludes that there is a greater than 95% probability that the observed increases in temperatures are mainly driven by the increased concentration of greenhouse gases in the atmosphere due to human activities. The earth is getting warmer and we are causing that to happen. Furthermore, there is a risk that climate change trends may continue to track at the upper end of IPCC projections (Rahmstorf et al 2007).

We are already having to adapt. Adaptation to climate change is no longer a question of "if" but rather of "how", "where" and "how fast". From a water perspective alone, the implications of climate change are profound. They will reach deeply into every aspect of our lives and those of our children and their descendants.

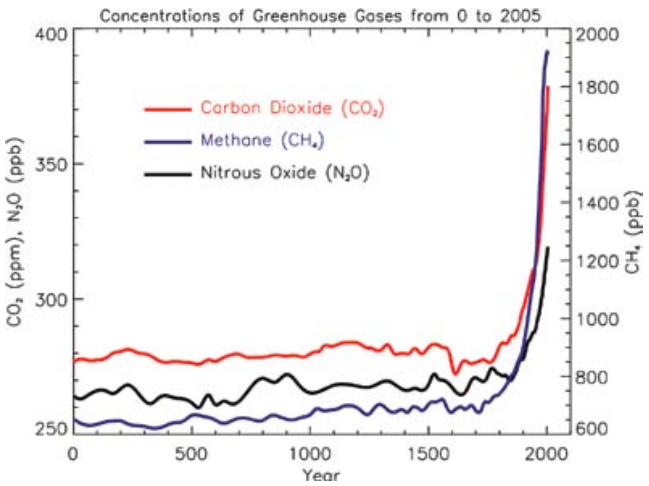
In its Fourth Assessment Report 2007, the IPCC found that levels of greenhouse gas emissions such as carbon dioxide, methane and nitrous oxide in the atmosphere have increased markedly as a result of human activities since 1750. These changes have altered the energy balance in the atmosphere, resulting in a warming effect. For the next two decades, a global warming of about 0.2 degrees per decade is projected for a range of emissions scenarios. The IPCC report also found that more intense

[20] This section draws heavily on a Climate Change Primer for Regional Natural Resource Management recently published by the Department of Climate Change (Campbell 2008). There is a wealth of information becoming available on potential climate change impacts in Victoria and beyond, with new publications almost weekly. This section refers to key findings but does not purport to be comprehensive in representing the climate change literature.

and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics. Increased drying linked with higher temperatures and decreased precipitation has contributed to changes in drought. Changes in sea surface temperatures, wind patterns and decreased snowpack and snow cover have also been linked to droughts.

Figure 3.1 below summarises human influence on the atmosphere since industrialisation. The red line is carbon dioxide (CO_2), the most ubiquitous greenhouse gas. In the pre-industrial era, CO_2 concentrations were stable for many centuries at about 280 parts per million (ppm) in the earth's atmosphere. The carbon dioxide concentration has increased markedly since industrialisation and is now at over 380ppm and rising strongly. We know from ice core sampling that temperature and the concentration of CO_2 in the atmosphere have been closely correlated for millions of years.

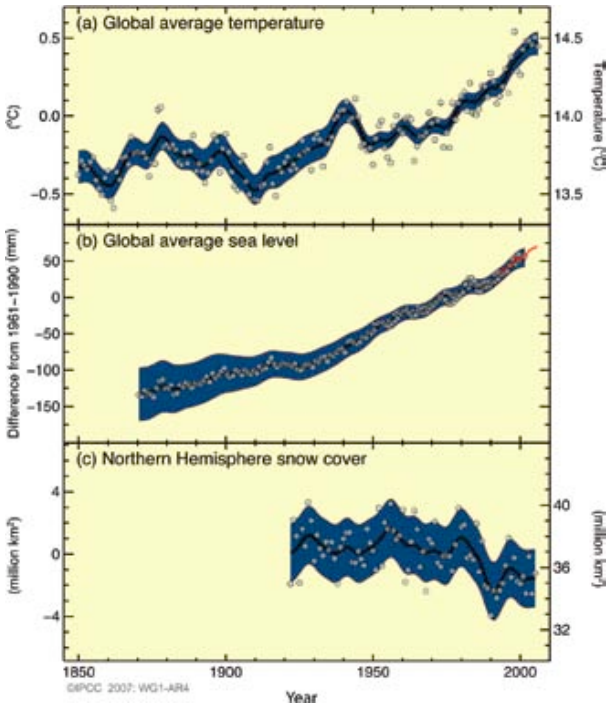
Figure 3.1 Trends in key global atmospheric parameters (IPCC 2007)[21]



The other two lines in Figure 3.1 represent the concentrations of the other key greenhouse gases in the earth's atmosphere: methane (blue line), nitrous oxide (black line), both measured in parts per billion. Note that all the curves are the same shape, and the IPCC concludes that *"Increases since about 1750 are attributed to human activities in the industrial era"*.

Global temperatures have tracked the same 'hockey stick' curve, trending sharply upwards in the late 20th Century, as outlined in the graph in Figure 3.2 below, which looks at average global surface temperatures, global average sea levels and snow cover in the northern hemisphere.

Figure 3.2 Average global surface temperature, sea levels and northern hemisphere snow cover[22]



The graphs at left illustrate observed changes in:
(a) global average surface temperature;
(b) global average sea level from tide gauge (blue) and satellite (red) data; and
(c) Northern Hemisphere snow cover for March-April.

All changes are relative to corresponding averages for the period 1961–1990. Smoothed curves represent decadal average values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c).

The global warming trend is also very evident in Australia. We are already seeing what the climate models have been predicting for some time in terms of temperature.

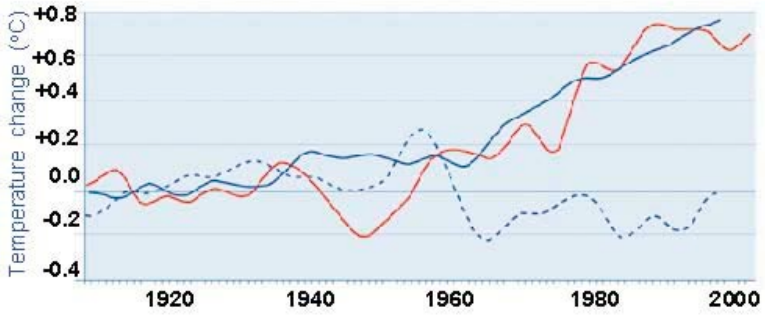
There are also suggestions that model projections of changed rainfall distribution, severe weather and so

21 From the Fourth Assessment Report (AR4) of the IPCC (FAQ2.1)

22 Also from the Fourth Assessment Report (AR4) of the IPCC.

on are being realised. The graph in Figure 3.3 below (from Karoly and Braganza 2004) shows the change in mean annual temperature in Australia since 1910. The red line indicates the measured temperatures, the blue line represents the average predictions of eight climate models with greenhouse gases factored into the models, and the dotted blue line represents the modelled temperature with the effects of greenhouse gases removed from the models.

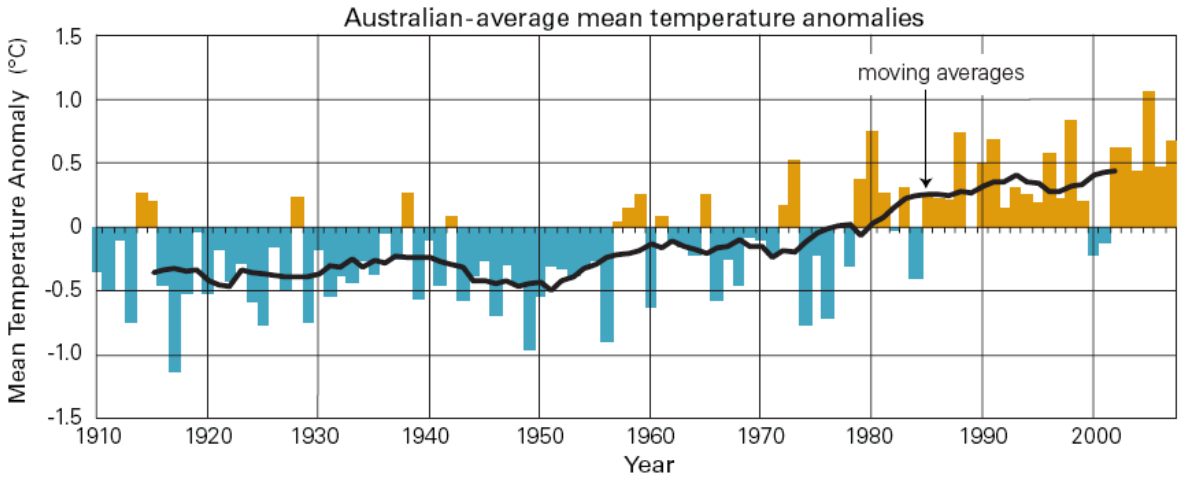
Figure 3.3 Modelled and actual changes in mean annual temperature in Australia since 1910



This graph suggests that the climate models, taking into account the additional greenhouse gases in the atmosphere, are now able to explain and predict temperature fairly well.

The CSIRO and Bureau of Meteorology have recently released an important report looking at the likely effects of climate change on the nature and frequency of severe climatic events (Hennessy et al 2008). The warming trend in Australia is very clear, as shown in Figure 3.4 below from the CSIRO-BoM report.

Figure 3.4 Time series of Australian-average annual mean temperature anomalies (1910-2007)[23]



Not known for its enthusiasm for climate change, ABARE (the Australian Bureau of Agricultural & Resource Economics), recently published an analysis (Gunasekera et al 2007) concluding that Australia is one of the countries most affected by climate change, and that agriculture is among the most affected sectors of the Australian economy, a judgment shared by Ross Garnaut (2007).

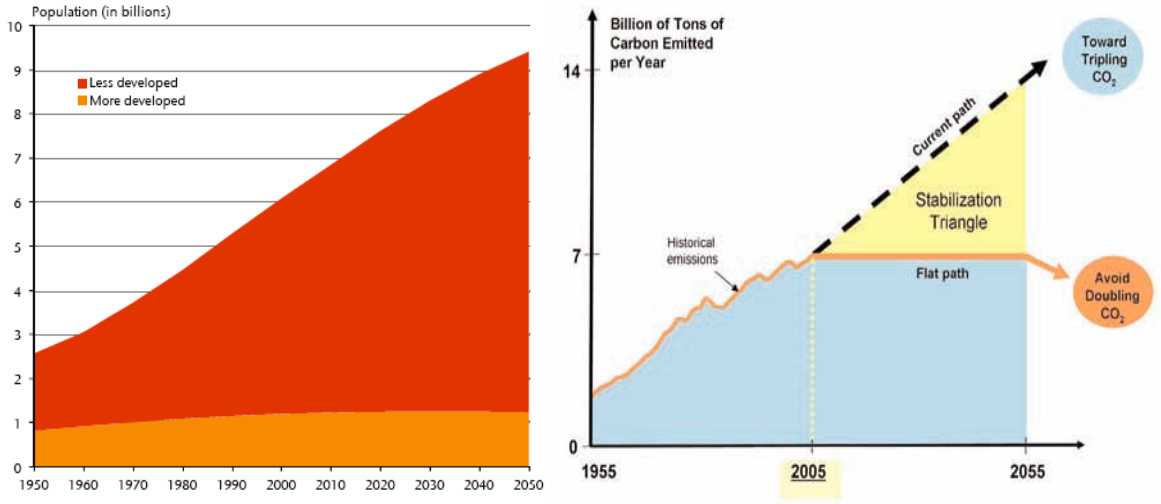
Future climate scenarios indicate the Victorian climate will be warmer and drier, particularly in northern Victoria. The latest projections from the CSIRO and the Bureau of Meteorology indicate that climate change in Victoria will lead to more days over 350C, less annual rainfall but more intense rainfall events, fewer frosts, more days with very high and extreme fire danger, less snow cover and more extreme weather events (Hennessy et al 2008). Soberingly, the CSIRO-BoM report notes that global greenhouse emissions have been tracking at the very top end of IPCC projections, whereas most of the global climate models, including the models used by CSIRO and BoM, still assume mid-range

[23] From Hennessy et al (2008). The reference period is 1961-1990 and the black line represents an eleven year moving average

emissions projections. The obvious risk here is that, unless there are fast and deep cuts to global greenhouse pollution, even the more alarming of the predictions coming from global climate models may turn out to be optimistic.

Figure 3.5 below underlines this point. Global carbon pollution has been increasing broadly in line with population for decades. While the carbon intensity of OECD economies has been decreasing slightly, the rapidly industrialising 'BRIC' countries (Brazil, Russia, India, China) have been increasing the carbon intensity of their economic output, meaning that their emissions have grown even faster than their population. The graph on the right shows that, if the world is to avoid doubling the concentration of CO2 in the atmosphere (compared with pre-industrial levels), then we need to stabilise global emissions at, or preferably well below, current levels. This implies a radical decoupling of greenhouse gas emissions from economic growth. It implies a fundamental rewiring of the global economy, which for the last couple of centuries has been turbocharged by abundant, cheap fossil fuel energy.

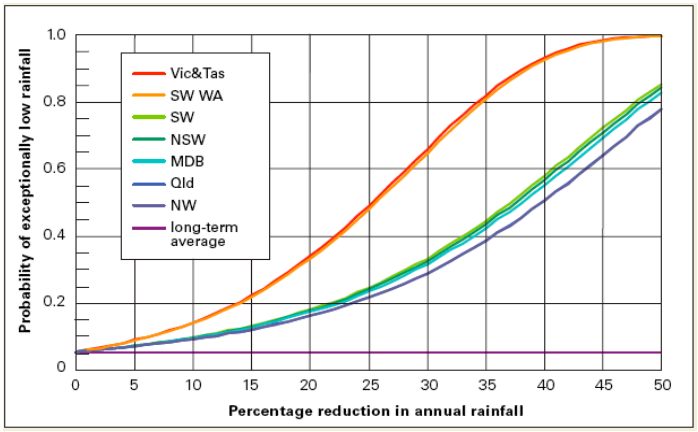
Figure 3.5 Global population and global carbon emissions, 1950-2050[24]



We need to work out, very fast, how to reorganise production, distribution and consumption for a low carbon future. The biggest market failure the world has ever seen demands the biggest industrial, economic and social re-engineering response the world has ever attempted.

The CSIRO-BoM analysis of the likelihood of severe climatic events appears to suggest that Victoria is one of the regions of Australia most affected by climate change, as Figure 3.6 below illustrates.

Figure 3.5 Probability of exceptionally low rainfall for mean rainfall decreases of up to 50%



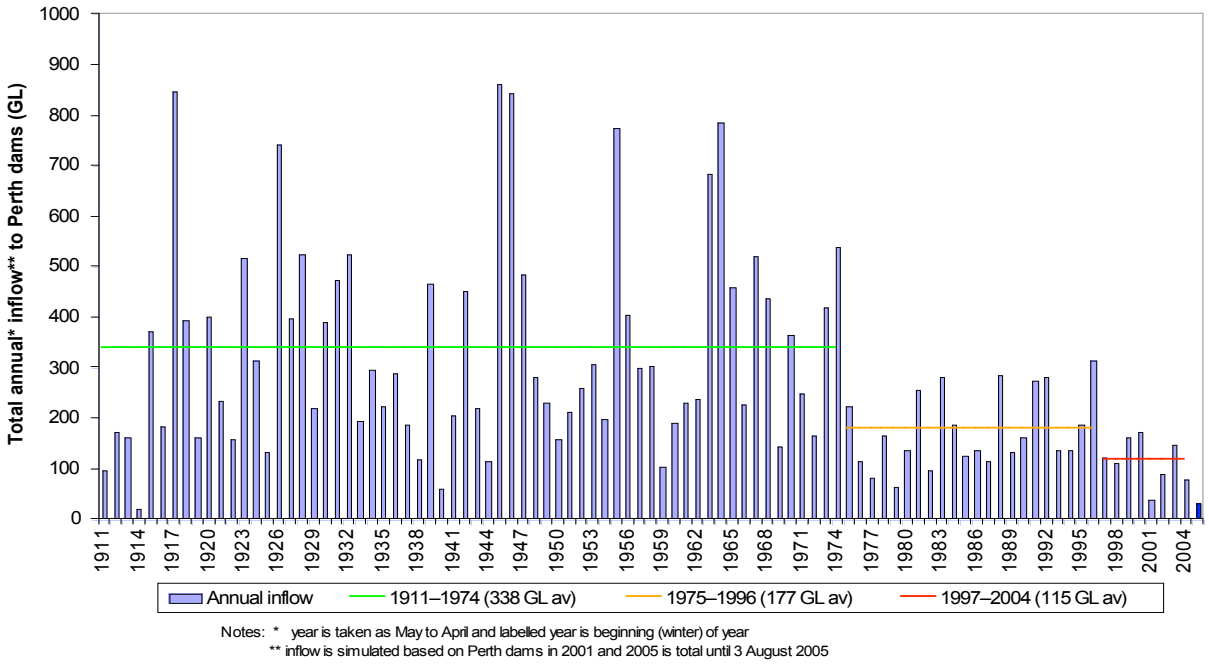
24 The graph on the left is from WBCSD & IUCN 2008; that on the right is from the Harvard Medical School (Epstein et al 2008). Measures that would deliver energy savings sufficient to stabilise emissions consistent with the 'stablisation wedge' in this graph are outlined at Appendix G.

This graph illustrates that, for a given percentage overall reduction in annual rainfall across Australia, there is a much greater increase in the probability of exceptionally dry conditions in Victoria and south-west Western Australia than in other states. Predicting future rainfall is more difficult than temperature, and potential evaporation is more difficult again. Nevertheless, the CSIRO-BoM report (Hennessy et al 2008) concludes that in Victoria and Tasmania, the frequency and areal extent of exceptionally hot years and exceptionally dry years are likely to increase in the future.

[25]

The overlap in Figure 3.6 between the curves for Victoria and for south-west WA is cause for concern. Percentage changes in rainfall are amplified in runoff, as has been seen already in south-west Western Australia, where a 10-15% decline in average annual rainfall since 1970 has seen inflows to Perth's water storages drop by around half (Pearcey and Terry 2005), shown in Figure 3.7 below.

Figure 3.7 Perth's Annual Storage Inflows, 1911-2005



Notes: * year is taken as May to April and labelled year is beginning (winter) of year
** inflow is simulated based on Perth dams in 2001 and 2005 is total until 3 August 2005

[25] Lake Wendouree, Ballarat, Anzac Day 2008. This lake hosted the rowing at the 1956 Melbourne Olympics — rowing sheds on the far bank.

Figure 3.7 tracks the inflow to Perth's storages since 1911. The green line represents the average annual inflow of 338GL[26] from 1911 to 1974. Incredibly, not a single year since 1974 has reached that previous long-term average. The 20 years from 1975 to 1996 saw an average inflow of 177GL — just over half the previous average. Just as in the Murray Darling Basin, the current drought is even worse again, with the average now dropping to around 100GL per year — less than one third of what it was for most of last century. The graph for inflows into Melbourne's storages appears to be tracking down a similar staircase, albeit a decade or so behind south-west WA. Average inflow to Melbourne storages since 1997 is 35% below the average prior to 1997.

If Victoria continues to echo south-west WA, as the CSIRO-BoM projections suggest, then the Victorian food system will need to operate with radically less water than it enjoyed in the 20th century.

The notion of 'average rainfall' has always been dubious for most regions of Australia, both agriculturally and ecologically. The real story is in the variance, not the mean, and how the system (whether farming system, food system or ecosystem) responds to extreme events. Farmers should be as familiar with the standard deviation of their growing season rainfall, and key thresholds such as sowing dates, soil moisture levels at a given depth, or fruit setting temperatures, as they are with their mean annual rainfall. Conventional wisdom about the average annual rainfall for many regions appears to have solidified during a series of relatively wet decades from the 1950s to 1990s. Historical rainfall records are becoming increasingly irrelevant in attempting to predict future rainfall.

The timing of rainfall events and changes in temperature extremes may be more important impacts of climate change in Victoria than the net decrease in annual rainfall. For example, a farmer in the Western District might measure a drop in aggregate annual rainfall of just 10% — from say 600mm to 540mm — but 150mm of the 540 might occur in one or two January/February storms, whereas well distributed rainfall during the critical growing season might halve. So an aggregate drop in rainfall of just 10% (manageable) might mask a halving of agriculturally useful rainfall (very difficult).

Campbell (2008) and Larsen et al (2008) note other potential impacts of climate change on agriculture and natural resource management in southern Australia, including:

- likely increases in stream salinity;
- potential surprises as 'sleeper' weeds and pests take off in more favourable conditions[27] and as pests and diseases from northern Australia (e.g. cattle tick, fruit fly and cane toads) extend their range southwards;
- shorter growing seasons and less reliable access to water for irrigation;
- fewer cold days and significant increases in minimum temperatures affecting fruit setting;
- earlier ripening grapes, and quality problems for red wines in particular; and
- increasing heat stress for livestock, including dairy cows in northern Victoria.

Adaptation vs Mitigation

There are two broad categories of climate change responses: mitigation (avoiding or reducing greenhouse gas pollution and increasing sequestration of greenhouse gases); and adaptation (learning to live with climate change).

It is not a question of choosing between two alternative pathways — we have to do both.

Multifaceted mitigation efforts, with deep and broad impacts in reducing greenhouse gas pollution, are essential and urgent if humans are to avoid runaway climate change. Like every industry, every business and every household, players at all levels in the Victorian food system need to understand

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26 A GL is one gigalitre, or 1 billion litres of water, weighing 1 million tonnes. Sydney Harbour is about 500GL, and a full Hume Dam is 3,000GL or 3 cubic kilometres.

27 For example, *Mimosa pigra*, now a major problem on floodplains in the Top End, was deliberately introduced and existed quietly in one small patch for about 90 years before it exploded out of control, presumably in response to one or more favourable seasons.

their own carbon footprint, and their options for reducing it. Those options are explored further below and later in this report. Irrespective of mitigation actions taken now, we — in Victoria more than most places — will have to adapt to climate change for the foreseeable future.

The most successful farm managers will integrate climate risk into their decision-making effectively. That is the essence of a climate change adaptation strategy. It means anticipating climatic extremes and managing for them, not for the illusory average. It means tailoring the farming system so that it makes big money in good seasons, and neither loses money nor crashes the resource base in poor seasons. It means maximising anticipation and opportunism in the system, to enable quick responses ahead of time if possible. It means knowing the critical thresholds and triggers for decisions like whether to sow and what crop to plant, if and when to de-stock or to re-stock, and if and when to buy or sell water. It means aggressively pursuing new technologies that improve anticipation, responsiveness and resilience.

Robert Poole,[28] looking at dairying in northern Victoria, where production appears to have stabilised after three very bad years, suggests that we need *"farming systems that are aggressively conservative"*, meaning that farmers need to be able to get crops in fast, purchase water fast, use that water better and be geared to using feedlots as well as pastures.

Above all, managing climate risk means being proactive rather than just crossing fingers and hoping for the best. That may mean taking big, uncomfortable decisions about the whole farm enterprise, its location, opportunities to invest off-farm, and whether or not to remain in agriculture. Farming profitably in Australia has always demanded sophisticated risk management. Climate change will force us to get much, much better at farming in the tough and variable Australian environment.

Energy

There are two key dimensions to the energy outlook for the Victorian food system. Firstly, energy use is a key component of our greenhouse pollution, so there is an imperative to become much more efficient in our use of energy and to maximise the use of renewable energy, as opposed to energy derived from fossil fuels. Secondly, while there are arguments about the timeframe, the era of cheap fossil fuel energy appears to be drawing to a close. The net result of these two drivers is that energy costs are likely to rise, probably steeply, and the imperative to find alternative sources of energy (preferably renewable) for products and services that currently depend on oil is intensifying. This has big implications for the Victorian food and farming system.

Oil

The map below shows the world's known reserves of crude oil as at 2005, according to the independent German Energy Watch Group (EWG 2007). In 2005, the world was producing about 30 Gb (billion barrels) of crude oil per year and consuming about the same amount.

Figure 3.8 Remaining reserves (billions of barrels) of crude oil (EWG 2007)

[28] General Manager, Sustainable Growth, Murray Goulburn Co-operative Co. Ltd.

There are fierce debates about the concept of 'peak oil' — the notion that global oil production will peak (if it has not already) and then decline as extraction exceeds the rate of new discoveries, leading to a widening gap between supply and demand, and moving beyond rising prices into absolute scarcity. The standard economic response to this argument is that increasing demand and increasing prices will drive further exploration and innovation to find alternatives.[29] This is already happening, for example with oil shales in Canada and proposals for off-shore drilling in the USA, expansion of exploration inside the Arctic Circle (where the ice cap used to be), and obviously with the rapid expansion of biofuel production, discussed further below. This is not the place to rehash the peak oil debate, however more data is presented in Appendix D.

This is a classic case of intersecting drivers for change. As easily-extracted (cheap) oil runs out, the search for new oil reserves is intensifying. But those oil reserves will almost certainly be harder to get at, and require more expenditure of energy per barrel of oil. That is certainly the case with the vast Canadian oil shale reserves, which will become less viable as a higher price is put on carbon. Further, the increasing frequency of extreme weather events such as hurricanes poses risks for oil exploration alternatives, and for the continuity of supply from such regions.[30]

BOX 3.1

Greening the milk fleet

The Murray Goulburn Cooperative Co. Limited, wholly owned by its 2,800 dairy farmers, is Australia's largest exporter of processed foods. It is one of Australia's top 100 companies, its largest dairy company, directly accounting for 50% of Victoria's dairy food production, 40% of Australia's dairy exports, and about 8% of world dairy trade. It processes more than 3.5 billion litres (38% of Australia's milk) annually, at eight locations in Victoria and one in Tasmania, into 150 different products exported to more than 100 countries.[31]

Murray Goulburn is a big business, and it is one of Australia's top 700 emitters of greenhouse gases, which means that it is obliged to measure and report on its emissions under the **National Greenhouse and Energy Reporting** (NGER) Act 2007. Murray Goulburn's own analysis shows that 'low hanging fruit' in terms of energy efficiencies that can be achieved relatively easily across the company are modest, at less than 5% of total emissions. The single biggest opportunity to reduce emissions is in the company truck fleet, which requires substantial changes within and outside the company for potential energy and carbon pollution savings to be realised. Murray Goulburn operates the largest private tanker fleet in Australia, comprising 150 prime movers that travel a total of around 32 million kilometres annually and use around 17 million litres of diesel.

Working with the Australian Government's Alternative Fuels Conversion Program, Murray Goulburn has already converted 54 of its prime movers to dual fuel — liquefied natural gas (LNG) and diesel — at a cost of $2.7 million. According to the company: *"Operational results have exceeded expectations. Diesel consumption has reduced by an average of 80% on converted vehicles. The LNG modified engine technology has undergone extensive independent testing and shows an 8% reduction in CO2 emissions together with significant reductions in Nitrous Oxide, Sulphur Dioxide and both heavy and light particulate emissions. Noise emissions have also been reduced."*

Murray Goulburn has pioneered the use of LNG as a transport fuel in Victoria. While Australia has enormous reserves of natural gas, there are major infrastructure constraints to expanding the use of this technology. The availability of LNG year round is limited by Victoria's gas infrastructure, and in the peak gas usage (winter) months LNG access is curtailed as its use in the Melbourne domestic gas network has first priority. Paradoxically, while this is a promising development that should have lessons for other companies with large truck and bus fleets, it is not in Murray Goulburn's interests for other companies to follow its lead, as with current infrastructure constraints any increase in LNG use by others would reduce the security of supply for Murray Goulburn.

This project highlights the interconnectedness of climate change issues and the imperative for the Victorian food and farming system to think well beyond its own boundaries in developing response strategies.

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29 Dr Brian Fisher, the former and long-time head of ABARE, once responded at a Senate Estimates hearing: *"Senator, when the price of eggs is high enough, even the roosters will lay."* This applies equally to food production as it does to oil exploration. If food prices continue to rise steeply, never underestimate the potential for farmers around the world to respond quickly, expanding and intensifying their operations, notwithstanding the water and land constraints discussed here.

30 25% of Gulf of Mexico oil and gas production is still down three years following Hurricane Katrina (Epstein et al 2008). Heat waves caused power outages over almost half the U.S, and shut down nuclear power plants in France, in the summer of 2003. Thawing tundra is undermining arctic pipelines; and shrinking montane glaciers threaten hydropower in developed and developing nations. Prolonged U.S. Southwest drought is affecting the cooling water for over 24 of the nation's 104 nuclear energy reactors (Hightower 2008).

31 All figures in this Box are from Murray Goulburn (2008).

Figure 3.9 Real daily oil price since 2004 (Future Fuels Forum 2008)

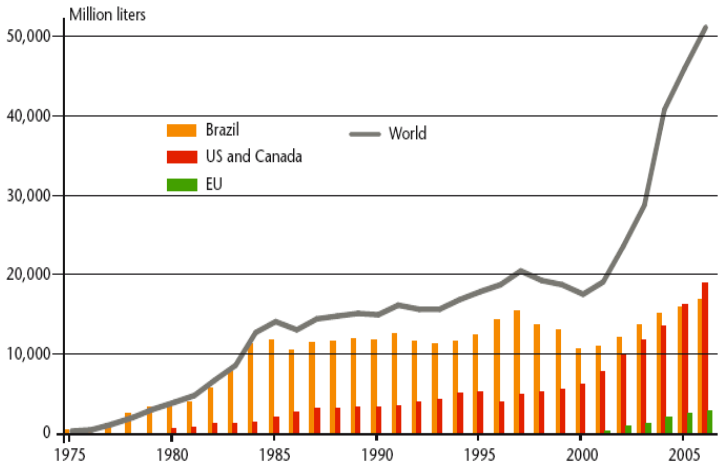
This graph tracks the oil price over the four years to January 2008, since when it continued to increase to almost US$150/barrel, but has since dropped back to around the January level. Given the outlook for both supply and demand (explored further in Appendix F), it is very difficult to see the long term trend of rising oil prices turning around in the forseeable future. For the Victorian food system, energy costs will continue to increase, probably steeply. This has big implications for the products and services that depend on oil. For the food system, these are many, with long supply chains involving significant transport components, and the obvious on-farm dependence on diesel for farm operations. Oil is also a critical input in the manufacture of fertilisers and other chemicals, plastics used in packaging and synthetic fabrics. Increasing the price of synthetic fibres might be a good thing for producers of natural fibres like Australian wool and cotton, but it will impose extra costs on the food system.

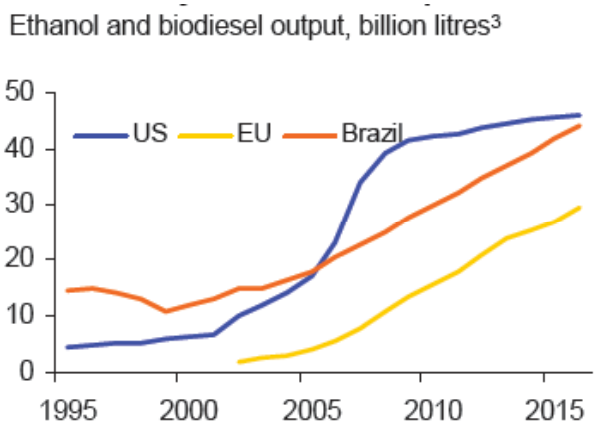
Biofuels

The rapid expansion in biofuel production, and the amount of land, forests and water resources reallocated to it, is one of the most obvious examples of perverse unintended consequences in responding to the climate change dilemma.

Predominantly for energy security reasons, but also ostensibly to reduce carbon pollution, there has been a sharp upsurge in the use of biofuels for ethanol production since 2000, especially in the North America and the European Union, as Figure 3.10 below shows, with the graph at right showing the projections if current biofuel support policies are maintained. However the penny is dropping that the 'first generation' biofuels producing ethanol from wheat or maize and biodiesel from canola oil, do not make sense, either on economic or environmental grounds.

Figure 3.10 World and regional ethanol fuel production (1990-2006)[32] and 1995-2015[33]





Two recent reviews make this point very persuasively. The OECD's Economic Assessment of Biofuel Support Policies (OECD 2008) found that government support for biofuel production in OECD countries is costly, has limited impact on reducing greenhouse gases and improving energy security, and has a significant impact on world crop prices.

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32 From WBSCD and IUCN (2008). Data for 1975-2003 taken from IEA. *Biofuels for Transport: An international perspective*. 2004. Data for 2004-2006 cited at ethanolrfa.org/industry/statistics/#E. Original source: F.O. Licht.

33 From UK Cabinet Office (2008b)

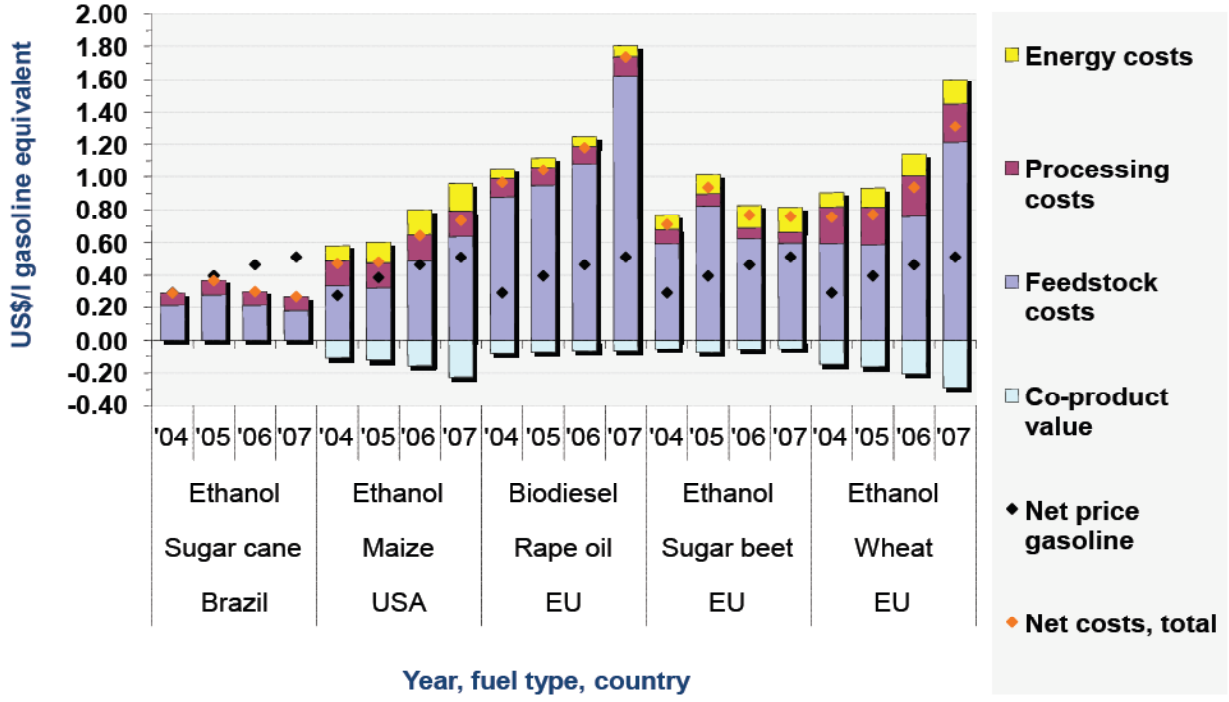
Figure 3.11 below compares production costs for the main biofuels with gasoline prices, highlighting the inefficiencies of the American and European approaches.

The reduction of greenhouse gas emissions is purportedly a primary reason for current biofuel policies but the savings are limited. Ethanol from sugar cane — the main feedstock used in Brazil — reduces greenhouse gas emissions by at least 80 percent compared to fossil fuels. But emission reductions are much smaller from biofuels based on the feedstocks used in Europe and North America. Biofuels produced from wheat, sugar beet or vegetable oil rarely provide emission savings of more than 30 to 60 percent while savings from corn (maize) based ethanol are generally less than 30 percent (without counting emissions from any associated land use change). Overall, the OECD report concluded that continuation of current biofuel support policies would reduce greenhouse gas emissions from transport fuel by no more than 0.8 percent by 2015 (OECD 2008).

The impact of current biofuel policies on world crop prices, largely through increased demand for cereals and vegetable oils, is significant but should not be overestimated. Current biofuel support measures alone are estimated to increase average wheat prices by about 5 percent, maize by around 7 percent and vegetable oil by about 19 percent over the next 10 years (OECD 2008). Taking into account the 2007 US Energy Independence and Security Act and the proposed EU Directive for Renewable Energy, the OECD (2008) report estimates that 13 percent of world coarse grain production and 20 percent of world vegetable oil production could shift to biofuel production in the next 10 years, up from 8 percent and 9 percent in 2007, respectively.

The OECD (2008) report concluded (as the graph below shows) that biofuels are currently highly dependent on public funding to be viable. Huge amounts of money are involved. In the US, Canada and the European Union, government support for the supply and use of biofuels is expected to rise to around US$25 billion per year by 2015 from about US$11 billion in 2006. The report estimates that biofuel support costs between US$960 to US$1700 per tonne of greenhouse gases (CO2 equivalent) saved. With carbon prices between $20 and $50 per tonne of CO2e (or even at $100), it is clear that subsidising ethanol production from corn or wheat is a very inefficient way of reducing carbon pollution. There are probably better uses for these funds, which we'll come to later.

Figure 3.11 Biofuel production costs vs gasoline prices (OECD 2008)



Support policies include budgetary measures, either as tax concessions or direct financial support for biofuel producers, retailers or users. Blending or use mandates require that biofuels represent a minimum share of the transport fuel market, and result in increased fuel costs to consumers due to the higher production costs of biofuels. Trade restrictions, mainly in the form of import tariffs, protect

the domestic industry from foreign competitors but impose a cost burden on domestic biofuel users and limit development prospects for alternative suppliers.

The OECD (2008) report calls on governments to refocus policies to encourage lower energy consumption, particularly in the transport sector. It also calls for more open markets in biofuels and feedstocks in order to improve efficiency and lower costs. The report recommends a clear focus on alternative fuels that maximise the reduction of fossil fuel usage and greenhouse gas emissions. Further, research to accelerate development of 'second generation' biofuels that do not require commodity feedstocks is suggested.

The OECD's findings are consistent with those of Professor Ed Gallagher in a Renewable Fuels Agency review of the indirect effects of biofuels production, commissioned by the British Secretary of State for Transport, released in July this year (RFA 2008). Gallagher notes in his foreword to the report:

> *We cannot afford to abandon biofuels as part of a low carbon transport future.*
> *Equally, we cannot continue producing biofuels which are ultimately more environmentally and socially damaging than the fossil fuels they seek to replace.*

The Gallagher Review found that the displacement of existing agricultural production, due to biofuel demand, is accelerating land-use change and, if left unchecked, will reduce biodiversity and may even cause greenhouse gas emissions rather than savings (RFA 2008). Its key findings included:

- A slowdown in the growth of biofuels is needed, and feedstock production must avoid agricultural land that would otherwise be used for food production;
- There is probably sufficient land for food, feed and biofuels, but biofuels production must target idle and marginal land, and use of wastes and residues;
- Specific incentives must stimulate advanced technology that improves energy efficiency, better utilises wastes, and does not lead to further deforestation or displacement of food production;
- Biofuels contribute to rising food prices (especially of oilseeds) that adversely affect the poorest people;
- Stronger, enforced global policies are needed to prevent deforestation, which is being accelerated by biofuel production, leading to net greenhouse gas emissions from biofuels;
- A genuinely sustainable industry is possible, but lower targets and stronger controls are needed.

The Gallagher Review (RFA 2008) concluded that comprehensive, mandatory sustainability criteria within the EU Renewable Energy Directive should be implemented for biofuels and bio-energy, including requiring feedstock that avoids indirect land-use change.

Clearly the biofuel policies of the USA and EU need a rethink, but what does this mean for Australia?

Currently, only three existing biofuel technologies can reduce carbon pollution compared with gasoline or diesel (even without considering emissions from associated deforestation): ethanol from sugarcane in Brazil, ethanol as a by-product of cellulose production in Sweden and Switzerland, and biodiesel from animal fats and used cooking oil (Larsen et al 2008).

While we already produce bioenergy from sugarcane wastes in some Queensland sugar mills, the main opportunity for expansion in Australia is likely to come through second generation lignocellulosic systems based on woody crops. The Cooperative Research Centre for Future Farm Industries (CRCFFI) has a research program looking at the integration of woody perennials such as oil mallees into Australian farming systems[34], and Barney Foran has done an exploratory study for Land & Water Australia (LWA) on what would be required for Australia to move towards a biofuel economy. Foran suggests that production of methanol from eucalypt plantations is technically feasible, much more energetically efficient than ethanol, and would provide an effective alternative to petrol and diesel for

[34] See http://www.futurefarmcrc.com.au/programs.html

transport fuels. However it would require an extensive infrastructure based on a distributed network of integrated processing plants that would also export bioenergy into the electricity grid.

The displacement and opportunity cost issues raised by Gallagher would also apply here, in that if large areas of woody plantations are required to produce fuels and bioenergy, where should they be placed in the landscape? Location is critical in order to minimise impacts on food production and water consumption, and species selection is critical in order to minimise weed risks. Taking these criteria alone, Australia obviously has vast tracts of already cleared land where the opportunity costs are relatively low, so at face value this should not be a problem for us compared to tropical countries, the EU or to a lesser extent the USA. But Foran's analysis for LWA found that transport distance (from the woody biomass crops to the processing plant) is a critical factor in determining both the economic and carbon efficiency of a biofuel economy. In other words the trees can't just be consigned to the 'back of Burke', they need to be relatively evenly distributed spatially, and they need sufficient rainfall to grow at an economic rate. This sharpens the focus again on potential trade-offs with water consumption and food production.[35]

While biofuels are clearly not a magic bullet, it is clear that within our lifetimes, or certainly those of our kids, in a big sparsely populated country like Australia we are going to need alternative transport fuels on a significant scale. Whether LNG, lignocellulosic biofuels or fuel cells, there are major technological and infrastructure issues on which we need to get cracking.

Water

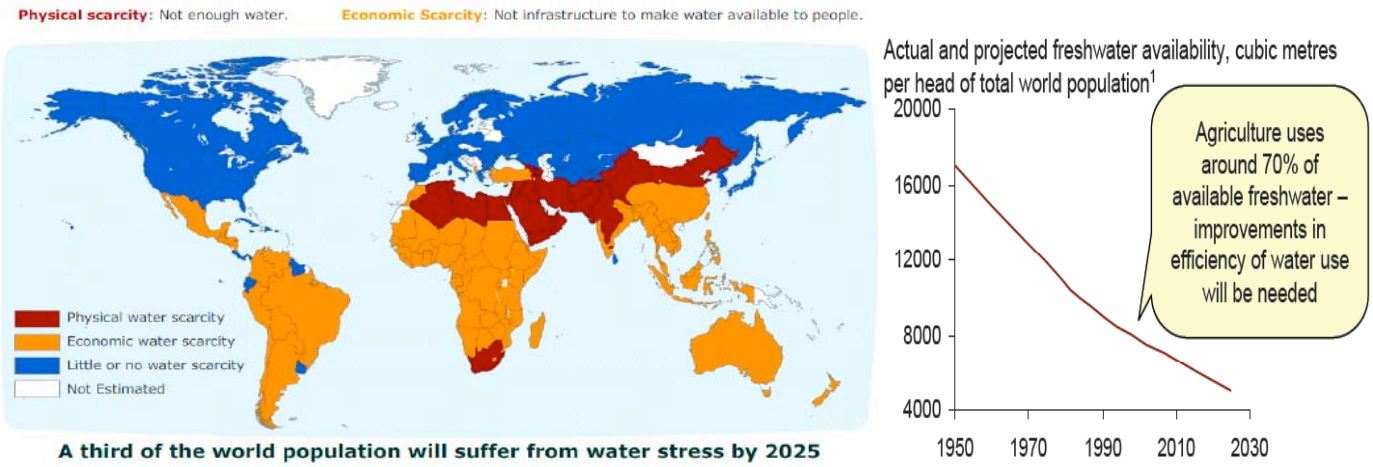
The last seven years have been the driest seven years since records have been kept in southern Australia. Inflows to Melbourne storages since 1997 are 35% lower than the average inflows prior to 1997. In the last ten years, inflows into the Murray River have declined by 33% and into the Campaspe by 67% — with the volume of water available to the environment declining even more, by 44% and 84% respectively. From the climate change discussion above, the Victorian food and farming system would be prudent to regard the current situation of severe water shortages, not as an unprecedented drought that will eventually pass into history as 'normal' seasons return, but as seasonal conditions that we are likely to see more often in future. Systems and businesses that are suffering and struggling for viability through lack of water in current conditions will struggle in the future, in the absence of changes that reduce their dependence on water.

Competition for scarce water resources will continue to increase, both within agriculture, and between agriculture, industry, towns and cities. Policy and infrastructure reforms will enable water to move around more, a point discussed further later. Water recycling schemes will become more competitive, depending on their energy efficiencies and relative prices for water and carbon, but they will remain a small component of the system and they do have issues to manage around salt accumulation over time in systems relying on wastewater. The price of water will inevitably increase. At the moment it is still incredibly cheap. What other commodity can you have delivered to your home, with a high level of security and quality assurance, for less than three dollars per tonne?

At the level of the whole food system, Larsen et al (2008) suggest that we may have to think about new ways of assessing the way we use scarce water resources and the notion of a 'high value' crop, from looking purely at export revenue to looking at the nutritional value per litre of water. Muntisov (2007) sees the options as including reviewing the export product mix, importing water-intensive products from water-rich countries like New Zealand, or moving water-intensive industries to wetter parts of Australia. The latter option of course needs to take into account availability of suitable soils and infrastructure, which is problematic in northern Australia.

[35] The flaws of the land use planning system and development approval processes in dealing with relatively modest land use changes associated with the expansion of blue gum plantations in the Green Triangle region don't inspire confidence in the ability of the system to handle more radical and extensive land use reform.

Figure 3.12 Physical and economic water scarcity (IWMI 2007)



Looking more broadly, it is clear that we are not alone in facing water scarcity, or indeed any of the other drivers for change discussed in this section. Food systems in all countries are facing all of these issues to a greater or lesser degree. The map at left above of projected global water scarcity by 2025 shows that water scarcity and insecurity, already a grim reality for billions of people, is likely to get worse, underlined by the sheer arithmetic of available water per capita as shown in the right hand graph (UK Cabinet Office 2008b).

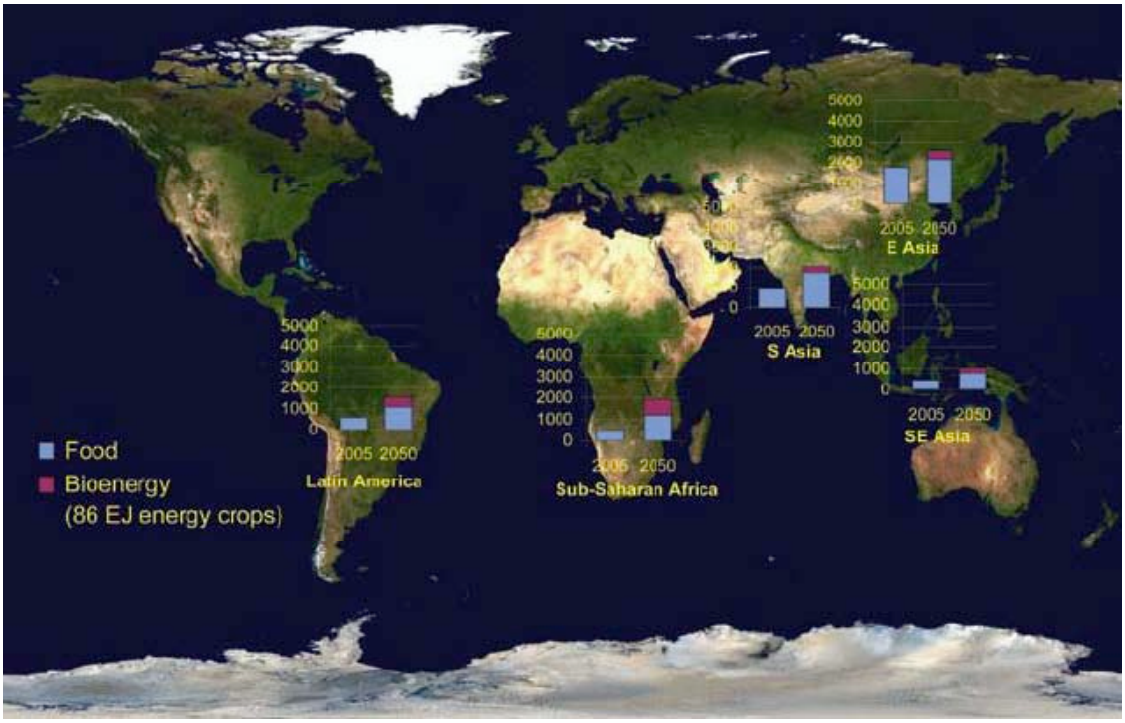
Figure 3.12 makes a useful distinction between physical water scarcity — the red zones — where there is simply not enough water for the number of people who need it; and economic scarcity — the orange zones — where there is enough water overall, but not the infrastructure available to get it to where it is needed.

In the case of water scarcity, we are among the most affected of developed countries, but we are starting from a high base — droughts and extreme climate variability have long been part of farming in Australia. Many other countries are experiencing extremes of heat and dryness for which they are not prepared, as the massive impacts of the 2003 heat wave in western Europe revealed. Australia is marked in orange in Figure 3.12, because while we have more freshwater per capita than most other countries, it is inconveniently located. Its distribution does not overlap with our major centres of population and water using industries, and it is not economic to shift the water from the tropics to the south, nor in the main is it economic to move the people and the industries to the Top End.

Figure 3.12 is taken from the Comprehensive Assessment of Water Management in Agriculture, a major international study involving hundreds of scientists from many countries coordinated by the International Water Management Institute (IWMI 2007). That study found that, just as in the Murray Darling Basin, all the world's major food producing basins — including the Yellow River, Colorado, Amu/Syr Darya, Egypt's Nile, Lerma-Chapala, Jordan, Gediz, Zayanda Rud, Indus, Cauvery, Krishna and Chao Phraya — are effectively 'closed' or already over-allocated.

Of course water use and consumption is not static. We are already seeing water scarcity, but it seems likely to get much worse in future. The map below comes from a very interesting report undertaken by the International Water Management Institute (IWMI), the Stockholm International Water Institute (SIWI), Chalmers University and the Stockholm Environment Institute (Lundqvist et al 2008) called *Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain*. It estimates water requirements for food today (the left hand bar on each graph) and hypothetical water requirements for food and bioenergy around year 2050, assuming a world population of 10.5 billion. It envisages doubling water consumption in Latin America, South Asia and South-east Asia, a tripling in Sub-Saharan Africa and a 50% increase in East Asia.

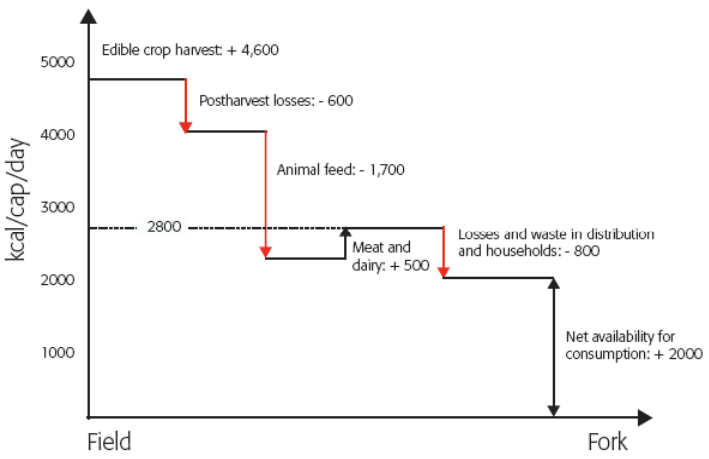
Figure 3.13 Bioenergy, Food and Water Pressure (Lundqvist et al 2008) [36]



Given the foregoing discussion, it is very difficult to see where this water will come from. Radical improvements in water productivity will be required if widespread ecological damage (further undermining long-term water security) and intense and widespread water scarcity is to be avoided.

One of the big opportunities to save water identified by Lundqvist et al (2008) is to look much harder at the issue of waste along the food chain, summarised in the graph below.

Figure 3.14 Production, losses, conversions and wastage in the food chain[37]



The vertical axis on this graph is global average kilocalories per person per day — the benchmark for an adequate intake being 2800 kcal/person/day. This graph suggests that at a global level in the field we produce more than enough food (4600 kcal/person/day), but after wastage and conversion along the food chain, by the time it reaches the human plate the average drops to around 2000 kcal/person/day, which is less than sufficient. Of course this production is far from evenly distributed, so many people are eating far more than 2800 kcal/day, and many people are malnourished and have access to far less food than this. It

36 From **Lundqvist** et al (2008) The vertical axis is crop evapotranspiration in km3/year (1cubic km = 1,000 Gigalitres). It is assumed that lignocellulosic crops will mainly be used for bioenergy with an average water use efficiency (WUE) of 2.5 kg biomass per m3 of evapotranspiration. This is a high average WUE compared to that presently achieved for agricultural crops. However, calculations are based on a possible situation almost 50 years ahead, when WUE will likely be higher than today as a result of plant breeding and improved agronomic practices (Lundqvist et al. (2007).

37 From Lundqvist et al (2008), after Smil (2000).

also underlines the point that it is much more efficient to eat plants directly than to feed plants to animals and then eat the animals or drink their milk.

At present, we use a bit more than one litre of water for every calorie of food energy we consume. The global food supply is thus inextricably entwined with the global water situation. We'll return to that shortly, but it is important to recognise that water is not the only limiting factor.

Other resource constraints

Land & soil health

"In Australia, we have covered our best agricultural lands with suburbs and golf courses — and the market won't fix it. Anywhere that has the combination of good soil and regular rainfall is now of great strategic significance."[38]

Two recent reports complement each other beautifully in highlighting concerns about the pivotal importance of soil stewardship and management in meeting world food needs.

In the current edition of *National Geographic* (September 2008), Charles Mann takes the reader through a graphic 30 page travelogue that highlights — with extraordinary images, poignant human stories and sharp insights — the precarious state of soil resources in many of the world's historically important food production regions. Mann's is an unashamedly anecdotal, qualitative, subjective analysis, and no less compelling for it.

In a contrasting approach with a systematic, dispassionate application of the latest satellite technologies, the FAO[39] in July released an important report (Bai et al 2008) on the extent of and trends in land degradation globally, based on analysing remotely sensed data over the last twenty years. Defined as a long-term decline in ecosystem function and net primary productivity, land degradation is increasing in severity and extent in many parts of the world, with more than 20 percent of all cultivated areas, 30 percent of forests and 10 percent of grasslands undergoing degradation.

An estimated 1.5 billion people, almost one quarter of the world's population, depend directly on land that is being degraded. The consequences of land degradation include reduced productivity, migration, food insecurity, damage to basic resources and ecosystems, loss of biodiversity through changes to habitats at both species and genetic levels, loss of biomass and soil organic matter releasing carbon into the atmosphere, and reducing the quality of soil and its ability to hold water and nutrients.

Crucially, the Bai et al (2008) study found that l**and degradation is cumulative.** Comparing 2004 data with 1991 data, there was limited overlap between 24 per cent of the land surface identified as degraded by the present assessment, and the 15 per cent classified as degraded in 1991. This implies that land degradation over recent decades has mainly affected new areas, while some areas of historical land degradation have been so severely affected that they are now stable at stubbornly low levels of productivity. Degrading areas are mainly in Africa south of the Equator, south-east Asia and southern China, Central Australia, the Pampas, and boreal forests in Siberia and North America. Almost 20 per cent of degrading land is cropland — more than 20 per cent of all cultivated areas; 24 per cent is broadleaved forest, 19 per cent needle-leaved forests, and 20-25 per cent rangeland. As cropland occupies only 12 per cent of the land area, degradation is over-represented in cropland globally (Bai et al 2008).

There were however, areas where net primary productivity has increased over the same period — i.e. there is more photosynthesis taking place, more plant growth — representing 19% of cropland, 10% of forests and 19% of grassland. Many gains in cropland are associated with irrigation, but there are also swaths of improvement in rain-fed cropland and pastures in the prairies and plains of North America

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38 Julian Cribb, personal communication August 2008.

39 Food and Agriculture Organisation of the United Nations. The data on global land degradation are part of a study released by FAO, the United Nations Environment Programme and the World Soil Information Centre (ISRIC) on global land degradation entitled Land Degradation Assessment in Drylands. Funding for the study was provided by the Global Environment Facility. http://www.fao.org/newsroom/en/news/2008/1000874/index.html

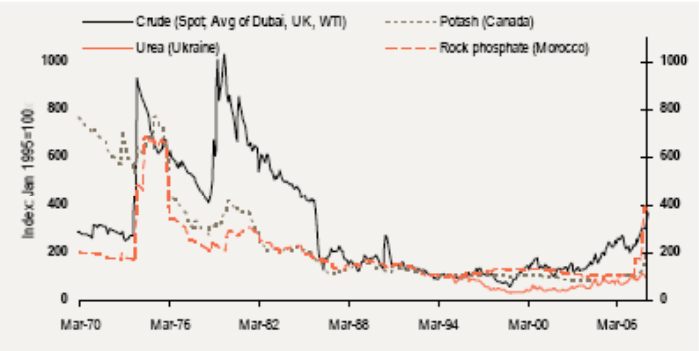
and western India. Some gains are a result of increasing tree cover, either through forest plantations, especially in Europe and North America, and some significant land reclamation projects, for instance in northern China. However, some of the positive trends represent woodland and shrub invasion of rangelands and farmlands, which is not generally regarded as land improvement (Bai et al 2008).

Importantly, the FAO study notes that there is no obvious relationship between degrading land and the nature of soil or terrain (Bai et al 2008). Land degradation is driven mainly by management. This is entirely consistent with the Australian experience (Campbell 1994).

[the photo at left (taken between Avoca and Maryborough, April 2008) shows conventional cultivation practices in preparation for sowing a winter crop,. Other parts of this paddock were 'blowing' at the same time this photo was taken. There has been a significant increase in reduced tillage and no-till approaches over recent decades, but conventional cultivation is still practised fairly widely.]

Figure 3.15 Real price of crude oil compared with key agricultural fertilisers, 1970-2005[40]

This graph shows a 'perfect storm' of rising costs for all major agricultural inputs simultaneously. However it puts current price rises in perspective — just as with food prices, they are still no where near as high in real terms as they were in the 1970s and early 1980s. Again like food prices, this graph suggests that prices for farm inputs could yet rise much further.



[a] Index: Jan 1995=100. The price deflator is a weighted average of the G-7 consumer price indexes.
Data source: IMF IFS database.

Fertilisers

Part of the reason for the rise in input costs is of course the rising oil price, which affects all other inputs except perhaps interest rates. There is a considerable energy cost embedded in synthetic nitrogen fertiliser and in most agrichemicals. Moreover some key nutrients, notably phosphorous, are depletable resources. According to the US Geological Survey, there are no substitutes for rock phosphate in agriculture. With biofuel demand increasing steadily, and world food shortages making headlines, rock phosphate is arguably as important to the world situation as oil supply. Fertiliser supplies are a critical component of many biofuel projects, creating an interrelationship between phosphate and energy supplies.

According to Julian Cribb (*pers. comm.*) *"nutrients are the oil of the 21st Century"* and global yields are starting to decline as farmers reduce fertiliser inputs because they can't afford the higher prices. Cribb estimates that Australia throws away at least $1 billion per year in poor fertiliser practices: *"what can we do to trap nutrients on-farm, and if they get into the creek, how do we use nutrients there?"* Processed agricultural wastes (husks, shells, stalks etc) can be turned into nutrients or bioenergy. Cribb suggests that we need to start looking at nutrients the way the aluminium industry looks at its energy-intensive product, and achieve similarly high rates of recycling.

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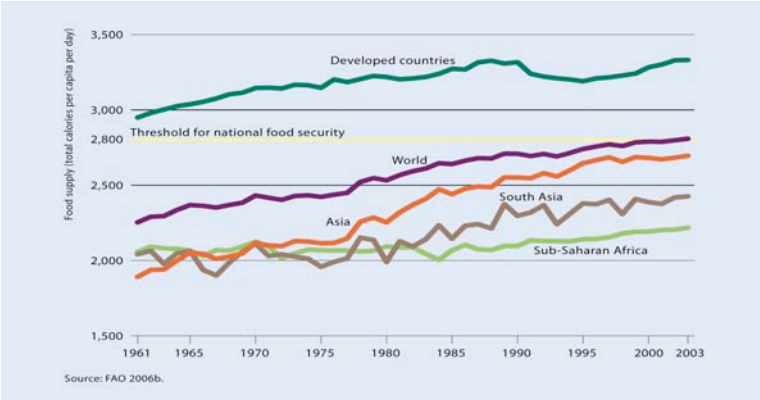
40 Andy Stoeckel (2008) Index: Jan 1995=100. The price deflator is a weighted average of the G-7 consumer price indexes. *Data source:* IMF IFS database.

Feeding the world

Over recent decades, while there have been problems of distribution and consequent lingering malnutrition and poverty in Sub-Saharan Africa and South Asia in particular, in aggregate, global food supplies have met global demand for food.

Figure 3.16 Global food supply (calories per capita per day)

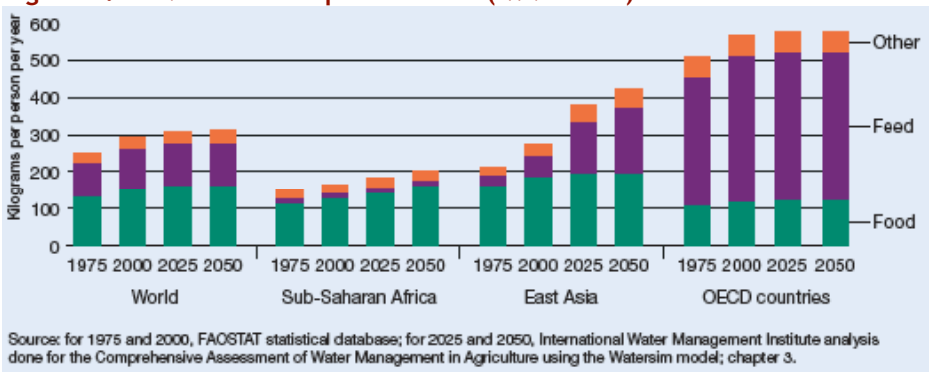


The graph at right, from IWMI (2007) shows trends in global food supply. Note that the yellow line at 2800 calories per person per day is considered the threshold for food security. The world as a whole (the purple line) in recent years has reached that point. But there remains a problem of distribution, and there are now real questions about whether we our food systems can sustain that performance without quantum improvements in water and land productivity.

The Comprehensive Assessment of Water Management in Agriculture concluded that, given the number of basins worldwide that have already reached or breached maximum extraction levels, and the level of over-use of groundwater, the world can't double its irrigated area again over the next forty years, as it has done over the last forty. But there is scope to make better use of "old" traditional irrigation practices — many of them small scale — to make better use of 'green' water in dryland or rainfed agriculture. Traditional water conservation measures in rainfed agriculture still have potential to increase food production and food security with a more modest impact on the water cycle (and more modest energy demands) than huge dams and pipelines (IWMI 2007).

The twin elephants in the room with global food security are world population growth and changing food consumption patterns. By 2000, China had already passed the global average in meat consumption per person, and is projected to be approaching that of the USA by 2050. Coupled with the demographic momentum of population growth, this has both huge water resource implications, and potential opportunities for meat exporting countries like Australia.

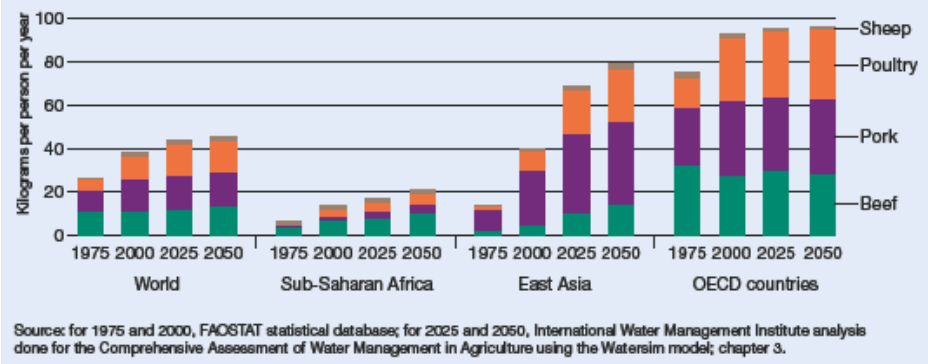
Figure 3.17 Meat consumption trends (IWMI 2007)



Meat consumption per capita in East Asia is projected to more than double by 2050, mainly through big increases in consumption of poultry and to a lesser extent pork and beef. This drives a significant increase in demand for feed grains, as shown in Figure 3.18 below.

Changing consumption patterns, coupled with population growth, means that global demand for food effectively doubles from 2000 to 2050. Biofuels further complicate the picture. India, for example, has set a goal of meeting 10% of its gasoline needs from biofuels by 2030, which will involve the reallocation of significant soil and water resources from food production to energy production, taking the country into a zone of absolute water scarcity (IWMI 2007).

Figure 3.18 Feed demand drives future demand for grains (IWMI 2007)



Julian Cribb (2007) summarises the problem:

> *Barring nuclear wars, pandemics and cosmic accidents, there will be about 9.3 billion people living in the world of 2050 – but they will eat as much food as 13 billion people at today's nutritional levels. The critical issue is whether such a harvest can be sustained.*

Recent sharp rises in food prices, coupled with a realisation that world grain reserves have declined to their lowest levels for decades, have already sparked widespread concern about food security as these headlines indicate.[41]

Even without climate change impacts, there are major constraints on the world's ability to increase the amount of water allocated to food production. Later sections will suggest constraints on land, soils and nutrients also. Biofuels have already been discussed, and there are urgent greenhouse imperatives not just to reduce deforestation, but to re-establish forests over large areas both as a carbon sink and for other environmental reasons.

In the past, the world has easily doubled food production within fifty years, through a combination of clearing, cultivating and irrigating more land, improved varieties, and intensification through the application of new technologies (including mechanisation), fertilisers and pesticides.

Julian Cribb puts this challenge in an historical perspective;

> *Two centuries ago, English clergyman and pioneer economist Thomas Malthus argued that population growth inevitably outpaces food output unless checked by moral restraint, disease or famine. His predictions were echoed in the mid-1960s when the Club of Rome warned humanity of a looming food crisis for a global population of 3 billion, a third of whom were hungry. Criticised by some because their predictions did not 'come true', it is more accurate to say that their warnings aroused the world to its peril in time for solutions to be developed. These were the C18th agricultural and C20th green revolutions.*
>
> *A third global food revolution is now necessary.*

The traditional options of clearing, cultivating and irrigating more land are largely now closed. Over the last 40 years, the area of global agricultural land has grown by only 10%, and in per capita terms agricultural land area has been in decline (WBCSD & IUCN 2008). This trend is expected to continue. The best land has already been developed, water is now limiting, and we need to increase forest cover, not reduce it further. Climate variability, and the frequency and intensity of extreme weather

41 From a presentation by Peter Weeks of Meat & Livestock Australia (MLA) to the Informa Soft Commodities Conference, Sydney August 2008.

events, are increasing in all the world's major food producing regions. The cost of energy and hence many agricultural chemicals will increase inexorably, and we may be approaching 'peak phosphorous' as well as peak oil.

Fisheries and Aquaculture

Of course agriculture is not the only option for feeding the world. According to FAO[42], over 140 million tonnes of fish are eaten world-wide each year, providing two and a half billion people with at least 20 percent of their average per capita animal protein intake. This contribution is even more important in developing countries, especially small island states and in coastal regions, where frequently over 50% of people's animal protein comes from fish. In some of the most food-insecure places — e.g. many parts of Asia and Africa — fish protein is absolutely essential, accounting for a large share of an already-low level of animal protein consumption. Globally, per capita consumption of fish is increasing, especially in Asia and the Americas, while in Europe and Africa consumption growth is moderate.

So if we are running out of arable land, good soils and freshwater for agriculture, could fish, through wild harvest or aquaculture, take up the slack in doubling food production over the next forty years?

Unlikely, and certainly not through wild harvest.

Figure 3.19 Global trends in the state of world marine fish stocks since 1974 (FAO 2007b)

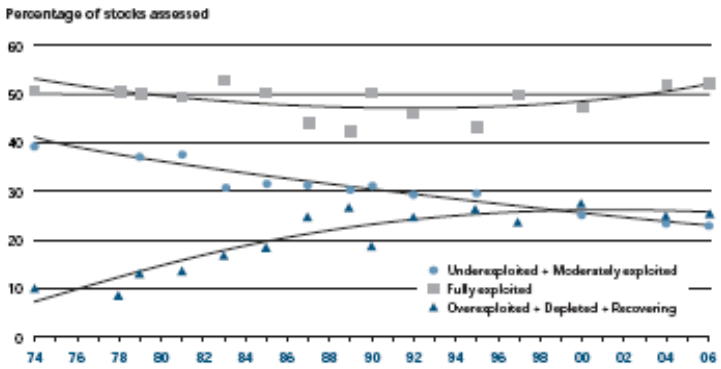


Figure 3.19 at left shows the FAO assessments of marine fish stocks. It shows that the proportion of fisheries assessed as being fully exploited (i.e. no potential for expansion) has stayed around 50% for the last 30 years, although may be trending upwards slightly. About 25% of fisheries are assessed as being overexploited, depleted or recovering (again no potential for expansion) and about 25% (trending downwards) are assessed as being under-exploited or moderately exploited, with some expansion potential.

According to the Millenium Ecosystem Assessment (MEA 2005), the increase in total fish supply over the last 50 years has been at a high cost to the sustainability of fish stocks and to the quality of many coastal and marine environments. Technological changes followed by economic subsidies have fueled the expansion of fisheries into every ocean. Many fishing fleets are continuing to fish further offshore and deeper to sustain catches and to meet the growing demand for fish products, and this has led to a number of targeted stocks in all oceans having collapsed due to overfishing (MEA 2005). Provisioning of fish for food directly and indirectly (via fishmeal, animal feed, and fertilizers) has in many places resulted in degradation of coastal and marine systems and of other ecosystem services. Overfishing of many fish stocks in shallow coastal shelf systems has changed highly diverse, complex, and robust coastal ecosystems into systems of reduced diversity and resilience. Due to fishing pressures, for example, the Gulf of Thailand has changed since 1970 from a system with a high diversity of fish, including top predators, to one dominated by small, short-lived species that support a low-value fishery from which catches are mainly used for feed in the high-value invertebrate aquaculture industry (MEA 2005). Such a reduced diversity system may be more sensitive to external impacts and has a lower capacity to deliver ecosystem services.

Many coral reefs have shifted to algal-dominated systems where recovery is highly unlikely due to a combination of overfishing, disease, and climate change. The impact of destructive fishing practices

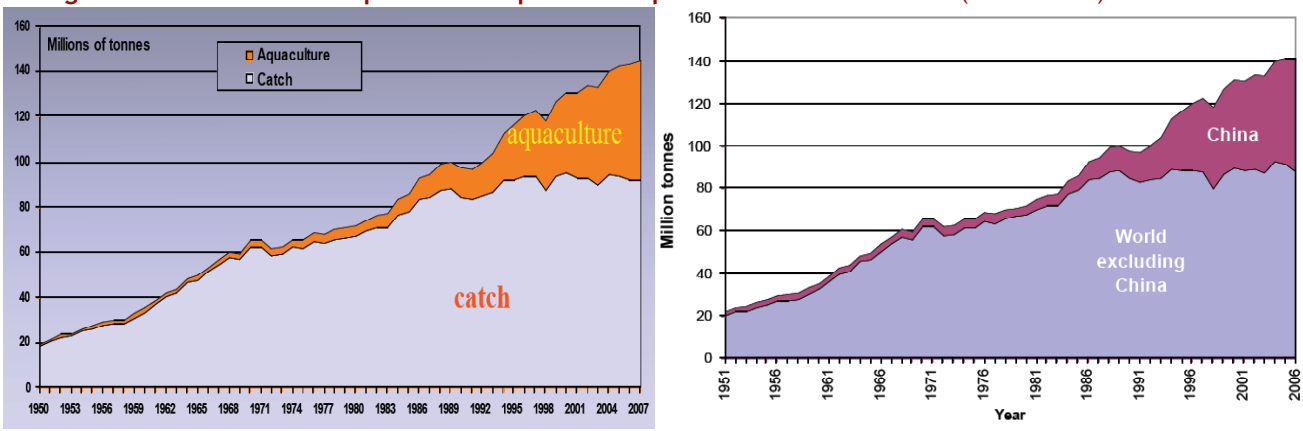
[42] http://www.fao.org/newsroom/en/news/2005/102911/

such as bottom trawling and bombing exacerbates the problem of overfishing and restoration of depleted stocks. Although our understanding of the impact of overfishing in deep water and pelagic systems on regulating and supporting services is limited, the exploited species in some deepwater systems such as seamounts that were fished in the 1970s have not been recorded since then, suggesting that such systems are unable to recover over the short to medium term (MEA 2005).

Overfishing has also affected the cultural services provided by marine and coastal systems. Many communities whose culture is based on a long history of fishing are in decline, with many fishers and their families migrating to urban areas. Those who choose to remain find that their social and economic conditions often decline (MEA 2005).

There are two big stories in fish — the rise of aquaculture and the rise of China. These parallel growth paths are illustrated in the two graphs below. Wild catch fish production has plateaued at about 90 million tonnes per annum, as has total fish production outside China.

Figure 3.20 World fish capture and aquaculture production 1950-2007[43] (FAO 2007b)



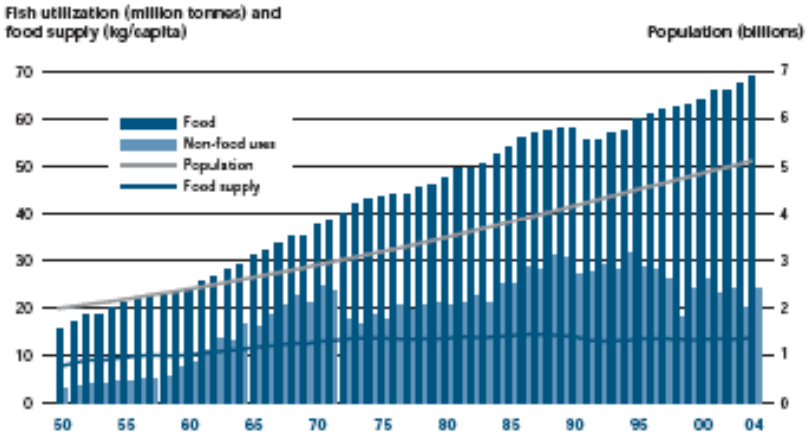
Declining marine fisheries, coupled with increasing consumer demand for selected marine products throughout the year, has driven a sharp increase in fish production through inland, coastal, and offshore aquaculture. From 2.6 million tons in 1970, world aquaculture output (excluding aquatic plants) grew to 38 million by 2001 (Hishamunda & Ridler 2003). This is an annual average growth rate of more than 9 per cent, and a faster rate than other animal food producing systems such as the capture fisheries and terrestrial farmed meat (FAO, 2007b). Aquaculture's share of world food fish supply grew from seven percent of world tonnage in 1973, to twelve percent in 1985 and to more than thirty percent in 2000. With so many fisheries at or near their limit, aquaculture's contribution to food fish supply will continue to increase. However, much of the increase in marine aquaculture is in high-value species such as shrimp and salmon and therefore is not necessarily meeting the needs of poor consumers. Baseline forecasts suggest that aquaculture will account for 40 percent of food fish supply by 2020, but it could exceed 50 per cent (Delgado et al 2003). Much of this aquaculture expansion has occurred in developing countries particularly China. From 28 per cent of world aquaculture output in the 1980s, China's share rose to exceed two-thirds of world output by 2000. However other Asian countries and some Latin American countries have also seen impressive output gains.

As with wildcatch fisheries, rapid aquaculture expansion has caused significant damage to ecosystems. For example, the development of shrimp aquaculture has caused a significant loss of coastal habitat, mangroves in particular, in many tropical countries (MEA 2005).

The graph below shows that consumption of fish has increased slightly over the last fifty years but is fairly steady at around 16kg per person per year, and use of fish for non-food purposes (fish meal, fertilisers etc) has remained reasonably steady in a band between 20 and 30 million tones per year. The big driver of the increase in fish production is world population growth.

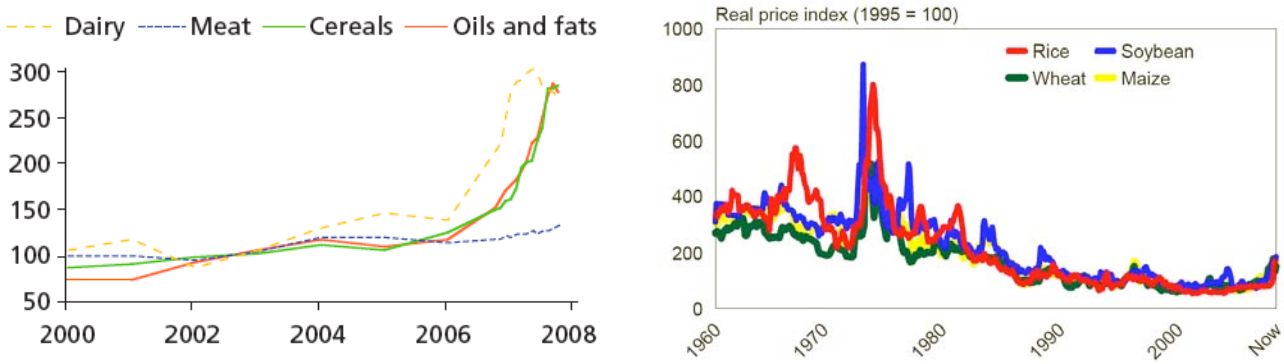
[43] The graph on the left is from the FAO's Fishstat database, the one on the right is from FAO (2007b)

Figure 3.20 World fish utilisation and supply, excluding China 1950-2004 (FAO 2007b)



The current growth in aquaculture shows no sign of slowing, either in Australia or elsewhere. Clearly there is further potential to increase the production of protein through aquaculture. However the experience of the last twenty years suggests that aquaculture needs to be just as mindful of its environmental impacts as both wild catch fishing and agriculture, and that issues such as energy consumption and nutrient availability will also be important in determining the sustainability of many aquaculture systems.

Figure 3.21 International food price trends, recent and longer term[44]



Before outlining what Cribb's 'third global food revolution' might entail, it important to raise our sights above the gloom to consider some of the positive drivers and emerging opportunities in the global food scene. After declining steadily in real terms for several decades, recent steep rises on world oil prices, coupled with some influence from biofuels, the impact of drought and both the resource constraints and increasing demand outlined above, have led to a rapid increase in food prices, as shown in Figure 3.21 above. Many experts believe that this is a permanent step shift in food prices, not a blip. The graph on the right gives a more useful longer term perspective, illustrating that food prices are still very low by historical standards, and that recent rises merely arrest a long term declining trend.

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44 UK Cabinet Office (2008). FAO Indices 1998-2000 average = 100. The figure on the right is from a presentation by Peter Weeks of Meat & Livestock Australia (MLA) to the Informa Soft Commodities Conference, Sydney August 2008.

BOX 3.2

The Warby Ranges cherry grower & farmers' market vs wholesale

At face value, selling your product direct to the public for cash, and cutting out the middle man, would seem to be an attractive option for farmers, especially those producing fresh fruit and vegetables. For hobby farmers with smaller outputs, farmers' markets are ideal, and the cash is very handy indeed. But for commercial operations it is not always that simple.

Mr Rak (*pers.comm.*), a cherry grower from the Warby Ranges, summarised his situation thus:

"I like going to the farmers' market on a weekend, because of the contact with the customers. It is nice to get good feedback about our produce. But on a good day I might sell 500-600 kilograms of cherries — whereas in the season we have 50-60 tonnes to dispose of over a six week period. There is just no way the local farmers' markets, even if I drove around to all of them, could handle it.

What makes me mad is that I can't just go into town and sell my cherries to the local supermarkets directly. My cherries have to go all the way down to Melbourne, and then back up here to the local supermarkets several days later. From an environmental and food quality point of view, that makes no sense."

The question is whether food prices will rise sufficiently and be sustained at a high enough level, to underwrite the necessary changes in food systems around the world to deliver more and healthier food, using less land and water, in more demanding climatic conditions. We'll return to this point later.

[45]

Trade

The current concern with food price fluctuations must not result in a reconstruction of the kind of policies and programmes that have distorted agricultural markets and damaged the environment in the past. Farmers across the world will respond positively to price signals from the global market, given a chance to do so, and freer trade in food will allow people to access food more cheaply.[46]

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[45] Organic heirloom tomatoes at the farmers' market in the main street of Santa Barbara, California, September 2007.

[46] UK Cabinet Office (2008)

The recent collapse of the Doha round of world trade negotiations does not give rise to optimism that there will be widespread reform of market-distorting farm subsidy programs, or a freeing up of food trade. Food riots in many countries including Cameroon, Haiti, Egypt, Somalia and the Philipines led to many countries placing restrictions on food exports over the last year, including Vietnam, Argentina, China and Egypt. In April 2008, Kazakhstan, the world's sixth-largest wheat exporter, banned wheat exports and Indonesia, the world's third-largest rice producer, held back surplus rice. When Thailand, the world's largest rice exporter, came under domestic pressure to restrict exports, a World Bank official likened any such restriction to Saudi Arabia reducing oil exports.

Andy Stoeckel (2008) gives an excellent overview of the underlying causes of current high food prices and a rather gloomy prognosis:

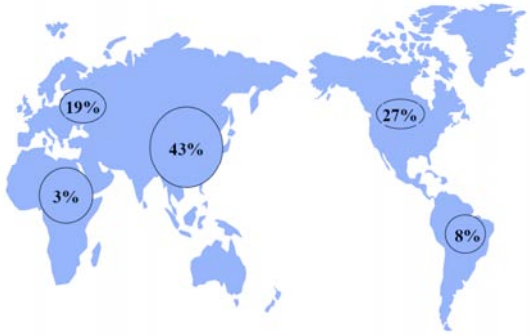
> *On the supply side, the weak growth in production relative to demand, that has led to a significant rundown in stocks of rice and grains, requires longer term investments and policies to increase cropped land areas and support yield expansion. This cannot happen quickly. Movements in agricultural input prices will reflect developments in oil prices, which are not expected to abate. …Government policies that restrict production (including restrictions on genetically modified crops in some countries) and trade in food show no signs of being dismantled. In fact, the food price crisis has created political pressures for policy to move in the opposite direction, which have resulted in many countries raising barriers to trade in food.*
>
> *On the demand side, the news is no better. Population growth will continue apace, although consumers in lower and middle income countries may respond to higher prices by substituting away from the most expensive foodstuffs, such as meat and dairy. The dramatic increases in the production of ethanol in the US and biodiesel in the EU, which have diverted substantial quantities of maize and oilseeds from food production, are unlikely to be quickly unwound. There has, and continues to be substantial investment in manufacturing facilities for biofuels, primarily driven by government incentives, subsidies and targets. In addition, the contemporaneous existence of high oil prices, and associated 'energy security' concerns, are likely to continue impelling politicians to embrace biofuels.*
>
> *Food stocks… will need to be rebuilt, political demands for barriers to food exports are intensifying and biofuels policies are likely to remain unchanged. Therefore, food prices are likely to stay high…"*

Stoeckel points out that the response of countries to limit trade in food is typical of food crises (and was also widespread in the global food crisis of 1974), and is inevitably counter-productive, with disastrous impacts on the poor in particular. He goes on to argue that open markets free from government intervention are most likely to deliver a food system that leads to the following outcomes:

- the **right amount of food** of the right type is produced;
- **food is produced in the right places** where it is needed; and
- production and subsequent distribution should be done in a way that **makes the best use of the planet's scarce resources** with the least amount of waste and pressure on the environment.

As more countries confront food shortages and increasing climate variability however, there is the possibility of new markets opening up for food exporters like Victoria. The relentless increase in world demand for food outlined earlier will certainly deliver expanding markets for those countries able to produce a surplus of food tailored to the needs of those markets.

Figure 3.22 Predicted distribution of world growth in GDP over the next decade[47]



This map illustrates the predicted distribution of world growth in Gross Domestic Product over the next decade.

Food security

Unlike many European countries in successive world wars, or many developing countries, particularly in

47 From a presentation by Peter Weeks of Meat & Livestock Australia (MLA) to the Informa Soft Commodities Conference, Sydney August 2008.

Africa, Australians have not since the earliest days of the settlement at Sydney Cove had to confront the possibility of not being able to feed ourselves. That is important in the national psyche — we think of ourselves as major food producers, not just feeding ourselves but also feeding tens if not hundreds of millions of people in other countries as well. Because of our space, our natural resources and our distance from everywhere else, we also tend to assume that we can grow almost anything we need.

In the United Kingdom, a country where older people still remember food rationing and long, bitter queues for vouchers, there has been a renewed interest in food security in recent years. However the UK Cabinet Office (2008) concludes that the main issue for the British food system is not really food security, but the **resilience** of the food system — how well it can cope with constant and rapid change, and how well it can withstand and recover from shocks, whether they be climatic, market or trade-induced. Importantly, this insight leads to a focus not just on food production within Britain (which is nevertheless seen as critical that productive capacity is maintained) but also in other countries where food consumed in Britain is or could be grown, and on the interactions between Britain and those countries.

Even after several very poor seasons, Victoria still exports almost twice as much food by value as it imports, so for the foreseeable future, absolute food security should not be a problem for Victoria. The insight from the UK Cabinet Office that the issue is not food security, but resilience, seems to be equally valid in Victoria.

Human Health

Thus far the big external drivers that will affect the Victorian food system can be summarised as strongly increasing world demand for food and real increases in food prices, with the ability to meet that demand depending on how well the system deals with more difficult climatic conditions, resource depletion and degradation (land, soil, water, nutrients and energy) and rising input costs (labour, energy, nutrients and water).

However there is also a wild card — human health.

Since the industrial revolution, or even the agricultural revolution, we (in the developed world at least) have been accustomed to ever-improving human health. This has been reflected in measures such as longer average lifespans, lower infant mortality rates and so on. Each generation has been bigger and healthier than their parents, living longer and living better than all previous generations. In part this has been due to improvements in medical science and health systems, in part it has been due to lifestyle changes, but in the main it has been due to better nutrition, as food has become steadily more plentiful, more accessible and cheaper.

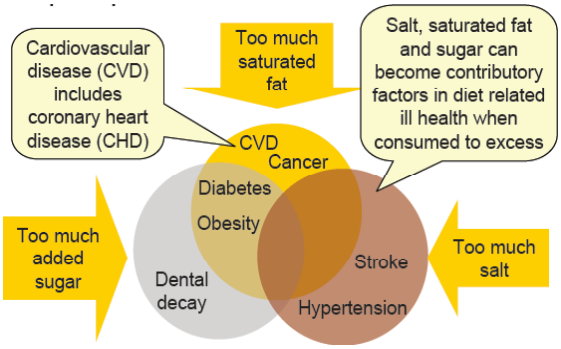
But in recent years in western countries, particularly in the Anglosphere, we have started to confront the uncomfortable fact that the steady improvement in human health over recent centuries appears to have peaked, and that this generation may live shorter and less healthy lives than our parents. More sedentary lifestyles and less exercise are important factors, but it is widely accepted that the biggest contributor to rapidly rising levels of obesity and associated health problems is diet and nutrition. In western diets over recent decades, there has been a steady increase in consumption of processed foods, fast foods, meat, fats and sugars, and a corresponding decrease in the proportion of fresh whole foods, fruit and vegetables. Food portions have also increased in size.

The link between diet and various health problems is illustrated in the diagram below, from UK Cabinet Office (2008b). Obesity increases the risk and prevalence of diabetes, cardio-vascular disease, certain cancers and a range of other health problems. Access Economics (2006) reported that in 2005, 3.24 million Australians were estimated to be obese: 1.52 million males (15.1% of all males) and 1.72 million females (16.8%) and that at current rates of increase, this would more than double to exceed 7 million people (around 30% of the population) by 2025. This issue has enormous economic implications. The direct impacts on the health system are obvious — estimated to be around $3.7 billion in 2005. However there are also significant indirect economic impacts through lost well-being, estimated to exceed $17 billion in 2005, bringing the total cost of obesity to $21 billion (Access Economics 2006). The intersection of rising obesity levels with the demographic momentum of an ageing population will impose enormous costs on the Australian economy by increasing costs and reducing productivity.

Conversely, turning the current trends around would generate significant returns for the economy.

Table 3.23 UK food consumption vs nutritional recommendations (Garnett 2008)

Food category	Daily nutritional recommendations	Actual UK consumption
Fruit and vegetables	Five (UK) or more (US) portions (1 portion is @90 g) >400 g a day (WHO)	3.4 portions[1] – lower for children
Overall fat	15-30% (WHO) 35% (UK)	37.6% (2003-4)[2]
Saturated fat	11% (UK) < 10% (WHO)	14.7% (2003-4)[3]
Protein	0.6-0.75-0.83 g/kg/day. For an average 65 kg British woman this is 39-53.95 g. For an average 80 kg man this is 48-66.4g.[4]	72 g plus 10 g from food eaten out = 82 g (2005-6)[5]
Iron	The Referent Nutrient Intake is 8.7 mg (men) and 14.8 mg (women)[6]	Average 12.7 mg[7]
Calcium	700 mg – more for some population groups	1,002 mg[8]
Vitamin B12	1.5 μg[9]	6.6 μg[10]



As these economic implications sink in, there is likely to be increasing policy attention from treasuries and central agencies on the food system. This should lead (hopefully) to rebuilding and strengthening the linkages between the health system, the food system and the farming system — in science, in public policy and in the daily lives of citizens. The food system should be seen as being central in the front line of preventative health care. Investment in measures that lead to more people eating better food in healthier ways is likely to be more effective and to have a much bigger return than remedial expenditure on health care after people have become obese, or morbid fascination with *The Biggest Loser*.

Robertson et al (2007) discuss the potential for agriculture to be tuned specifically to meet dietary needs, through 'functional foods' and 'nutriceuticals'. Functional foods are foods that may provide a health benefit beyond basic nutrition, while nutriceuticals are foods that specifically aid in the prevention or treatment of diseases or disorders (Kalra 2003). Some of these products have enhanced levels of nutrients or functional components, through manufacturing or product selection, while other products use the natural levels of nutrients or functional components as a marketing tool. Considerable research is occurring into methods to enhance levels of nutrients and the development of markets for functional food and nutriceutical products. As markets for such foods develop, so will specialised production systems. Genetic engineering of plants and animals may also deliver improved levels of functional components and nutrients in food products.

While alternative high protein foods may emerge as commodity foods, a market for authentic food is likely to grow and to command higher prices. Tesco, which has the largest share of the UK grocery market (now exceeding 30%), has found that about a quarter of its customers prefer to purchase highly differentiated premium foods of known origin with demonstrable sustainability and animal welfare characteristics, and that these customers are relatively price-insensitive (Humby et al 2007). Demand for such products can be seen in today's market places where traditional foods command very high price, for example Waygu beef selling for more than $120 per kilogram wholesale.

The nature of food has the potential to change radically in the future. Increasing production costs of traditional agriculture, particularly in the production of protein-based food, will make highly controlled factory production increasingly viable. These factory production systems will need some form of input or feedstock. Agriculture may have a place in providing all or some of these inputs, but alternatives to agricultural production may also exist (Robertson et al 2007).

Elements of a Global Food Strategy

While the focus of this project is Victoria, many of the same dilemmas are faced at national, regional and global levels, as this quote from the British Cabinet Office (2008) encapsulates:

> *"Too much of the agricultural productivity gain of the past 50 years has been bought at the expense of genetic diversity and the environment, with unsustainable exploitation and pollution of water resources, soils and valuable natural habitats. Natural resources have been underpriced and agricultural markets distorted and overprotected. The increasing scarcity of water, land and other resources means that in 2050 a world population of 7.8 to 10.8 billion people will need to use a different mix of production methods and, quite possibly, see diets change."*

Julian Cribb (2007) sets out what he sees as the key elements of 'the third agricultural revolution' that he argues is needed if the world is to be able to feed itself satisfactorily over coming decades:

1. *Increase massively global public investment in agricultural research and development, with a particular focus on:*
   a. *exploitation of soil biota to double crop yields*
   b. *doubling crop water use efficiency*
   c. *novel crops or traditional foods 'rediscovered'*
   d. *polycultures of crops/pastures, perennials in mixed crop/grazing systems, agroforestry*
   e. *haline and acid-tolerant farming systems*
2. *Increase massively the rate at which new food production technologies are disseminated to farmers, especially in the poorer countries*
3. *Plan to peacefully limit the human population to 2-3 billion by the end of the century*
4. *Eliminate nutrient waste. Recycle all nutrients on farm, in industry, in restaurants, supermarkets, the home and in urban waste disposal systems back into the agrifood chain*
5. *Develop "green food" – alternative, low input production systems, including urban horticulture, polycultures, algae culture and plant cell bioreactors, to feed urban populations on novel foods derived directly or indirectly from waste streams but with low environmental costs compared to agriculture.*
6. *Develop "Green Cities" in which crops are produced on roofs, walls and in waste areas, reducing urban energy use (heating & cooling) and using waste water or storm water. Recycle all urban water to limit demand on farm water.*
7. *Develop systems which convert waste CO2 and hydrocarbons into carbohydrates.*
8. *Promote low protein diets, vegetable consumption and low-input culinary traditions for affluent societies.*
9. *Use advanced genetics, agronomics and other methods to enhance food production under recurrent drought and climatic instability*
10. *Integrate regional natural resource management so the needs of food production dovetail with those of the environment and other human activities, avoiding conflict and enhancing sustainability.*
11. *Phase out commercial wild harvests, including fishing and forestry.*
12. *Expand recording, conservation and banking of food plant and animal genetics worldwide.*

Cribb does not explain how he thinks number 3 could be achieved. However his analysis suggests that, in the absence of far-sighted and aggressive strategies to improve agricultural productivity and lift food production, billions of people will be badly affected by escalating malnutrition, conflict and disease.

3.2 National policy settings

This section and the following one do not purport to be a comprehensive overview of all the policies at national and state levels that could potentially affect the Victorian food and farming system. That would be an endless task covering virtually all areas of policy, and the policy environment is changing constantly. However there are a couple of notable areas with a direct bearing on the context within which the Victorian food and farming system will be operating over the next decade or so. Without attempting a comprehensive description or analysis of these policy areas, the discussion below

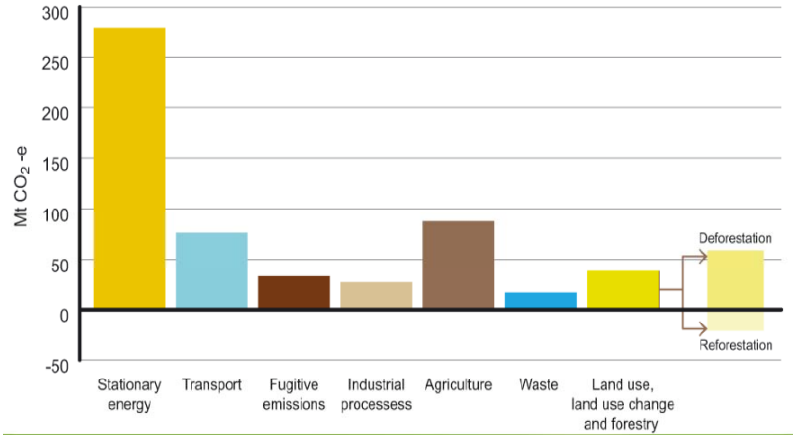
attempts to identify the policy questions and settings that are most critical, and the points that will need to be tracked most closely, from a food system perspective.

Climate Change

Moving from an economy that relies fundamentally on cheap fossil fuel energy, to a carbon-constrained economy that radically reduces net greenhouse gas emissions, is the deepest and broadest policy-driven structural change ever undertaken in Australia or anywhere else. It is difficult to overstate how profound the challenge is to correct what Nicholas Stern (2007) called the biggest market failure the world has ever seen. The market failure that Stern refers to is basically that the price of carbon, and of emitting greenhouse gases, has not reflected its true cost. Trying to work out what that cost should be, and how to ensure that it is reflected across the economy in the most efficient and effective manner to mitigate greenhouse gas emissions, is one central task of climate change policy.

The other is of course to develop and implement policies that assist in the enormous task of climate change adaptation. Humans have already more than doubled the CO2 concentration of the Earth's atmosphere from its pre-industrial levels, and we are already seeing major climate change impacts as discussed earlier. Those impacts will continue to ripple (or crash) through ecosystems, communities, industries and economies around the world for the foreseeable future, and we have no choice but to adapt to them. Victorian agriculture will be one of the hardest hit sectors in one of the hardest hit regions in one of the hardest hit countries, so the adaptation challenge is formidable.

Figure 3.24 Australia's greenhouse gas emissions in 2006 (DCC 2008)



However the focus in this section is on the mitigation dimension of climate change policy, as that is more likely to deliver step changes, surprises, unintended consequences and possibly perverse impacts.

The graph in Figure 3.24 above shows the Australian emissions profile for greenhouse gases in 2006. As mentioned earlier (Figure 2.9), our emissions profile is dominated by the stationary energy sector (power stations), which produce around 53% of total emissions (and an even higher proportion of Victoria's emissions). Agriculture is second at around 90 million tonnes of CO2 equivalents or 17% of total emissions. Note that agriculture is also a key player in the land use, land use change and forestry (LULUCF) sector, both as a source of emissions through land clearing (now less extensive in Victoria) and of sinks through revegetation on farms.

Carbon Pollution Reduction Scheme

The Australian Government has committed itself to the introduction of a Carbon Pollution Reduction Scheme in 2010, on an extremely ambitious time frame. It has recently released a Green Paper (DCC 2008) establishing the background to the scheme, introducing key elements and seeking public submissions. Treasury modeling that will inform the level of the initial cap on emissions from the sectors covered will be released in October 2008; a white paper, exposure draft legislation and medium term target range for emissions reduction will be released at the end of 2008; and enabling legislation will be introduced in 2009 in order for the scheme to be able to start in 2010 (DCC 2008).

Australia has been discussing carbon emissions trading for several years already. It is interesting that the Rudd government is deliberately changing the language to better reflect the objective — reducing carbon pollution — from the mechanisms, of which one is emissions trading. It is also important that the term 'carbon pollution' is starting to replace 'greenhouse gases', because ultimately that helps the community to understand that in essence, this is just a pollution issue — fiendishly large, difficult and complex — but a pollution issue nevertheless.

Reducing carbon pollution involves costs. Emissions trading is seen by many, including the Garnaut Review and the Australian Government, as the most efficient and cost effective way to reduce carbon pollution, and is emerging as the preferred mechanism for reducing carbon pollution internationally (DCC 2008).

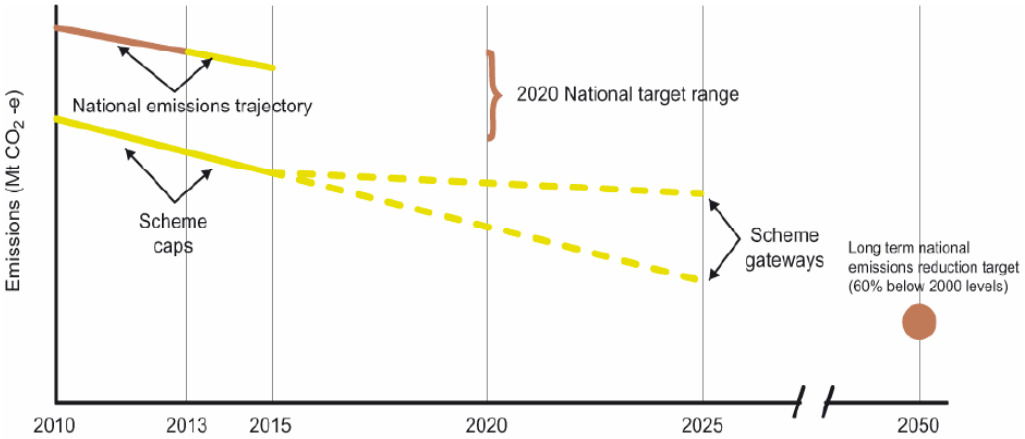
Climate change is clearly a global issue demanding a global response. Every country is affected by the emissions of every other country, although climate change manifests itself in different ways in different countries. Countries differ greatly in their emissions profiles, in their total emissions and their per capita emissions. Australia only represents about 1% of total global emissions, but we are the highest emitters per capita, we are the eighth largest emitter overall, and we are one of the countries hit the fastest and the hardest by climate change. Australia is not acting alone in introducing a carbon emissions trading scheme. A similar scheme is already operating in 27 European countries (see Box below) and New Zealand, 28 states and provinces in the US and Canada are introducing similar schemes, both US presidential candidates are committed to introducing schemes to reduce carbon pollution, and Japan is also considering introducing a scheme (DCC 2008).

There are two critical issues for this project arising from the Carbon Pollution Reduction Scheme (CPRS). The first is the level at which the cap on emissions is set initially, and what that means for the cost of energy and transport throughout the food system. The second is the timing and nature of the introduction of agriculture into the CPRS, which will affect the on-farm end of the food system.

Figure 3.25 below illustrates the relationship between current emissions (top left), the current target of a 60% reduction by 2050 (bottom right), and the cap on emissions, which obviously needs to be set below current emissions if emissions are to be reduced. There is considerable debate about the best way to structure the cap and thus set the trajectory of the emissions reduction path, with a wide range of views on a spectrum between two broad alternatives:

- making big reductions immediately to provide a very strong signal to emitters, establish a high price for carbon, create big incentives for innovation, grab 'early mover' advantages, lower emissions faster and reduce the ultimate cost of the scheme; versus
- taking a cautious approach, with a modest initial cap and thus a low price for carbon, avoiding immediate economic disruption, waiting to see what other big emitters do, and giving firms and industries time to plan and adjust.

Figure 3.25 Emissions trajectory and scheme caps towards a 2050 target (DCC 2008)



The Australian Government has said it will announce its medium term national emissions target range in late 2008 in its White Paper, informed by the Garnaut Review (September) and Treasury modelling (October). Acknowledging that expectations of future carbon prices will drive investment and behavioural change, the government will attempt to set its indicative trajectory five years in advance on a rolling basis (DCC 2008).

It is thus a bit soon to be predicting the initial cap (although it may become clearer towards the end of this project) but it is safe to assume that it will lead to modest increases in the price of energy. The government has said that any increases in fuel price due to the CPRS will be offset directly by commensurate reductions in fuel excise (with a review after three years for motorists, agriculture and fisheries and after one year for heavy road transport), and that poorer households and pensioners will be compensated for the impacts of the scheme. The government claims that every cent raised by the scheme will be reinvested in measures that assist households and businesses to adjust to the carbon price (DCC 2008).

The other crucial issue is the scheme's coverage. Initially, the CPRS will cover the six main "Kyoto gases"[48] and is estimated to encompass about 75% of total Australian emissions. Around 1000 firms will have mandatory obligations to report and reduce their emissions, including all large direct emitters,[49] all upstream liquid fuel, and fuel suppliers to small emitters.

Importantly, agriculture will not be included before 2015 due to the considerable technical difficulties in measuring agricultural emissions, the huge number of firms involved compared with other sectors, and the dynamic nature of agricultural emissions within and between years as the Green Paper notes:

> *"While the Government is disposed to eventually include agriculture, it recognises that considerable consultation and joint effort with the industry are still required to identify practical methods for inclusion, and to develop reliable and cost-effective methods of emissions estimation and reporting. Accordingly, the Government has decided that the earliest that agriculture should enter the Carbon Pollution Reduction Scheme would be 2015, with a final decision on inclusion or exclusion to be made in 2013 in the light of progress in overcoming practical difficulties and after extensive consultation with the industry."*

While the former Prime Minister's National Emissions Trading Task Group (2007) was in favour of carbon offsets such as sequestration through tree planting, as was Ross Garnaut (2007), at least as a transition measure, the government has said that the scope for offsets will be limited, noting with respect to agriculture:

> *"…if agriculture is to be included in the scheme in 2015—it makes little sense to develop offset methodologies and install the required administrative arrangements for such a short period, particularly given the questions raised above regarding baselines and the lack of additional abatement. Accordingly, the Government is not proposing to establish an offset scheme for the agriculture sector prior to a final decision being made in consultation with the industry on final inclusion of agriculture in the proposed Carbon Pollution Trading Scheme (in 2013)."*

If agriculture is included in the scheme, then in principle, activities undertaken by farmers that sequester carbon should be counted, as well as activities that generate carbon pollution. But in practice, issues such as measurement difficulties, security of property rights, additionality (i.e. over and above what would have occurred through 'normal' practices), certification and the internationally agreed rules will influence which on-farm practices are counted as offset measures.

While formal policy documents are non-committal about prospects for farmers being paid for their carbon, there is considerable interest in this possibility within the farming community, around soil carbon in particular. The box below contains an editorial from the *Stock & Land* capturing this sentiment, and Porteous and Smith (2008) look at the subject in more depth in *ECOS* magazine.

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[48] Parties to the Kyoto Protocol account for six greenhouse gases (Annex A of the Kyoto Protocol): carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

[49] Those emitting more than 25,000 tonnes (25kt) of CO_2 equivalents each year.

BOX 3.3

Existing Carbon Markets (from Campbell 2007)

There is already one formal, mandatory carbon offset market in Australia: the New South Wales **Greenhouse Gas Reduction Scheme** (GGAS), which has been operating since 2003 and was the first mandatory greenhouse emissions trading scheme in the world. GGAS requires electricity generators to meet specified targets for reducing their emissions, either through direct measures, or by purchasing Abatement Certificates, each of which represents one tonne of CO_2 or its equivalent. A recognised means of creating a certificate is through the use of eligible forests that form a carbon sequestration sink. Although most of the eligible forests registered within GGAS are conventional commercial tree plantations, environmental plantings established for other legitimate environmental purposes could also become part of a pool of carbon stocks managed under GGAS (Grieve et al 2007) — provided they are in New South Wales.

The most recognised scheme globally is the European Union **Emissions Trading Scheme** (EU ETS) which became active in January 2005. In 2006, approximately 992Mt (million tonnes) of CO_2e were traded on the EU ETS, representing about 62% of the global carbon emissions trading market (Point Carbon 2007, cited in Ribon & Scott 2007).

The market for voluntary carbon offsets, where businesses choose to offset their emissions as part of their greenhouse strategy — i.e. to become 'carbon neutral' — rather than to meet a regulatory compliance imperative, is growing and evolving rapidly. The **Chicago Climate Exchange** (CCX) is perhaps the best recognised voluntary carbon market. The CCX operates a voluntary "cap and trade" program, where CCX members commit to annual greenhouse gas reductions as a percentage of their baseline. Reductions beyond the contracted level can be sold to other CCX members. The program commenced in the USA, but has expanded to Europe and other countries (Clean Air-Cool Planet 2006, cited in Ribon & Scott 2007). In Australia, new entrants and new products emerge seemingly every week. Unsurprisingly for such an immature market, the voluntary carbon offsets market is highly fragmented, with lots of small players, little regulation and a variety of quality standards.

The gap between popular perceptions and expectations, and expert analysis, is fairly large with respect to the emissions profile of the average farm, how it changes through the influence of management practices and seasonal conditions, and how farmers might be able to participate in carbon emissions trading. This highlights the urgent need for investment in education, awareness, skills development and extension programs to achieve a sharp lift in the climate literacy of farmers and the people advising them. More on this later.

BOX 3.4

Could carbon trading be the next Landcare?

STOCK & LAND, VIC; 24/07/2008 5:22PM

Trading in carbon could be a real winner for farmers, if common sense prevails.

The politics of carbon trading are unfortunately well ahead of the science right now, particularly agricultural science. With most of the nation paranoid about what fuel, electricity and food will do under a carbon trading scheme, few have even thought of where the carbon offsets will come from to "save us all".

Any secondary school student will tell you, the role of agriculture in the carbon cycle is to take carbon from the atmosphere and place it in living things — plants, animals and soil microbes. Wow, that sounds like a great way to reduce atmospheric carbon! Yes cows and sheep belch and fart but common sense will tell you that agriculture's net effect has to be positive if farmers are doing their job properly and profitably.

The more efficiently carbon is fixed into living things, the better it should be for the environment. Inefficient use of fertiliser, fuel, feed or even fire, constitute losses of carbon. Farmers are in the business of growing a natural resource, not losing it and this fits in perfectly with carbon trading.

The advent of the Landcare movement in Victoria over 20 years ago, led to the recognition of farmers as good land managers, before the movement was sadly hijacked by bureaucracy and died. The carbon debate should again prove that good farmers build things from carbon — it's how they have made a living since the first seed was planted by man.

Could carbon trading be the next Landcare? The financial opportunities stemming from carbon trading could be enormous and systems in the United States are already rewarding farmers for their soil carbon management. You don't have to plant trees and leave them there forever to help save the planet. Stubble retention, minimum tillage and building up fertility in soil may well be a great way to make money as well as practice good agriculture.

All we need to wait for is some good science, good policies and hopefully some good seasons.

Stock & Land, Victoria **http://www.stockandland.com.au**

Drought policy

> *"We've really got to put in place a planning process, so that this word 'drought' disappears altogether. It's a fear thing, we've got to get the fear out of drought, because we're going to be living with dryness for the rest of our lives."*[50]

There is yet another national review of **drought policy** underway, with economic, social and climate science components. It is clear to most that the current system of drought assistance based on the notion of 'exceptional circumstances' is unsustainable and needs radical surgery. The CSIRO-BoM report (Hennessey et al 2008) referred to earlier found that the sorts of climatic extremes that are currently defined as 'exceptional circumstances' on the basis that they could only be expected to occur at most once every 20-25 years, will under current climate projections occur much more frequently (as often as every 1-2 years) in some regions. Clearly such circumstances will no longer be exceptional, but more the rule.

Current drought assistance measures are expensive. The Senate Standing Committee on Rural and Regional Affairs and Transport has just released an Interim Report from its Inquiry into Climate change and the Australian agricultural sector (Senate 2008), which found that:

- As at 1 February 2008, there were 24,180 farming families and 1,047 small businesses receiving Exceptional Circumstances Relief Payments. Total expenditure since 2001 exceeds $1 billion.
- As at 1 February 2008, there were 48,198 approved Exceptional Circumstances Interest Rate Subsidy applications for farmers and 1,115 for small businesses at the cost of over $1 billion.
- As at 30 September 2007, there were 36,865 Farm Management Deposit (FMD) holders with total holdings of $2.389 billion.

As there are only around 130,000 farm businesses in Australia, a significant proportion of these are relying on direct financial assistance from the government to survive. The proportion using Farm Management Deposits is actually a healthy number, as FMDs are a crucial, forward-looking risk management tool that encourage farmers to put funds aside in good years to tide them over bad ones. But the number of people relying on relief payments and interest rate subsidies is a major concern, given that the conditions we are experiencing now will not be exceptional in the future.

The poor performance of current farming systems costs us in many ways. It has profound social costs in terms of the stress it places on farm families and rural communities. It has significant financial costs in terms of lost income and drought relief payments and subsidies. And it has major environmental costs in terms of the pressure placed on the resource base.

These should be potent drivers for the development of better farming systems and practices. We are not starting from a clean sheet of paper however. There are very good farmers who are making money during this terrible run of dry seasons, and whose farms are in relatively good condition. We need to learn from their success, and ensure that a policy mix of juicy carrots and smart sticks sends clear signals in favour of such farming systems and practices.

It is notoriously difficult to reform drought policy — especially during a drought. Linda Botterill and Melanie Fisher (2003) provide an excellent discussion of the issue in their book *Beyond Drought*.

There have been numerous reviews over the last century or so, summarised by Jim McColl and Mike Young (2006), who found that most reviews of drought and structural adjustment policies have concluded that, *inter alia*, drought policy measures have:

- generally tended to impede adjustment rather than facilitate it;
- kept poor managers on the land longer, making it more difficult for better managers to buy them out, and exacerbating land degradation;

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[50] Peter Kenny from AgForce Queensland and Chair of the review into the social aspects of drought exceptional circumstances. http://www.abc.net.au/rural/news/content/200809/s2360649.htm

- rewarded people who overstock through subsidy measures like fodder and freight subsidies (while providing nothing for good managers who de-stock early);
- mainly helped the banks, underwriting their worst rural loans through interest rate subsidies; and
- overall, drought policy has failed to achieve its objectives.

I agree with Peter Kenny that we need to abolish the very word 'drought' from the national lexicon.[51] 'Drought' implies a climatic aberration — an unreasonable, unpredictable, unexpected event. But in southern Australia, and even more so in the Australia we are becoming, the conditions that we have previously associated with drought will occur so often that they should be seen as normal, and planned for accordingly.

This is not for a moment to suggest that farmers and farm businesses and the rural communities that depend on them should simply be abandoned to their fate. There are strong, valid, equity, welfare and health arguments for improving the full range of social services available to people who are doing it tough and suffering the debilitating effects of stress and associated social problems. There are also a wide range of potential assistance measures to improve risk management and climate adaptation among farmers, including the successful Farm Management Deposit scheme.

However the more fundamental, long term challenge is to develop farming systems that are more intrinsically Australian: that are resilient in the face of extreme weather and extreme variability; that are miserly with water and conserving of energy; that maintain groundcover and are kind to the soil; that sit lightly on the landscape and don't displace native wildlife or habitat; that are highly profitable in good seasons and don't lose money in bad seasons; that preserve and build their natural, human and financial capital; that recover quickly from shocks and stress; that attract and retain young, talented people on the land; that generate jobs and income in regional communities; and that produce things in high demand for good prices.

This brings us back to the food system. One of the big policy challenges for industries, communities and governments is to look for ways to return a bigger slice of the food price cake back to the producer. Just as climate change writ large represents a colossal market failure, the fact that the price paid for food by consumers does not reflect the full costs of production in terms of agriculture's environmental footprint, is also a market failure that fundamentally constrains the ability of farmers to produce food and fibre more sustainably.

Correcting the market failures within the food system so that consumers do pay a more realistic price for food, and so that farmers receive their due portion of that price, would be one of the most effective ways of assisting farmers to cope with the difficult climatic conditions ahead.

Water

It follows from the climate change discussion earlier and the drought discussion above, that there is likely to be less water available to the Victorian food and farming system in the future than there is even now. This obviously poses enormous challenges for the sector. This section reviews some of the key policy developments at a national level.

National Water Initiative

The overall objective of the National Water Initiative (NWI) is to achieve a nationally compatible market, regulatory and planning based system of managing surface and groundwater resources for rural and urban use that optimises economic, social and environmental outcomes.

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[51] Jay Arthur (2003), in a wonderful book called *The Default Country*, which she refers to as a 'lexical cartography', analyses word maps of 20th century Australia drawing from a wide range of formal and informal sources to interpret the relationship between Australian English and the country, between language and landscape. She argues that in our language and our writings it is clear that deep down, our default country is still England — green, soft, gentle, civilised, compact, with a reliable climate. Our daily language directs our thinking about normal features of Australia into notions of exception and anomaly. The classical example of this is the notion of 'exceptional circumstances' to refer to extended periods of hot, dry conditions — which would indeed be exceptional in England, but not here.

At the highest level, implementation of the National Water Initiative is intended to achieve:

1. clear and nationally-compatible characteristics for secure water access entitlements;
2. transparent, statutory-based water planning;
3. statutory provision for environmental and other public benefit outcomes, and improved environmental management practices;
4. complete the return of all currently over-allocated or overused systems to environmentally-sustainable levels of extraction;
5. progressive removal of barriers to trade in water and meeting other requirements to facilitate the broadening and deepening of the water market, with an open trading market to be in place;
6. clarity around the assignment of risk arising from future changes in the availability of water for the consumptive pool;
7. water accounting which is able to meet the information needs of different water systems in respect to planning, monitoring, trading, environmental management and on-farm management;
8. policy settings that facilitate water use efficiency and innovation in urban and rural areas;
9. addressing future adjustment issues that may impact on water users and communities; and
10. recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource.

The National Water Initiative agreement includes objectives, outcomes and agreed actions to be undertaken by governments across eight inter-related elements of water management, listed below.

Water access entitlements and planning framework
A key aim of the Initiative is to restore surface and groundwater systems to environmentally sustainable levels. Water sharing plans will help to bring certainty for consumers, and allow them greater scope to plan agricultural and other activities.

Water markets and trading
The NWI will work towards the removal of institutional barriers to trade in water. Water trading systems will have the widest possible geographic scope, and will not be restricted to within catchment areas.

Best practice water pricing
Water pricing and institutional arrangements under the NWI will promote economically efficient and sustainable use of water resources, water infrastructure assets, and government resources; ensure sufficient revenue streams to allow efficient delivery of services; facilitate the efficient functioning of water markets; give effect to the principles of consumption-based pricing and full cost recovery; and provide appropriate mechanisms for the release of unallocated water.

Integrated management of water for environmental and other public benefit outcomes
Identify within water resource planning frameworks the environmental and other public benefit outcomes sought for water systems and to develop and implement management practices and institutional arrangements that will achieve those outcomes.

Water resource accounting
The outcome of water resource accounting is to ensure that adequate measurement, monitoring and reporting systems are in place in all jurisdictions, to support public and investor confidence in the amount of water being traded, extracted for consumptive use, and recovered and managed for environmental and other public benefit outcomes.

Urban water reform
The NWI will ensure healthy, safe and reliable water supplies; increase water use efficiency in domestic and commercial settings; encourage the re-use and recycling of wastewater; facilitate water trading between and within the urban and rural sectors; encourage innovation in water supply sourcing, treatment, storage and discharge; and achieve improved pricing for metropolitan water.

Knowledge and capacity building
The NWI identifies areas where there is significant knowledge and capacity building needs for its ongoing implementation. Signatories to the Initiative have agreed to identify the key knowledge and capacity building priorities needed to support ongoing implementation of the Agreement, and identify and implement proposals to more effectively coordinate the national water knowledge effort.

Community partnerships and adjustment
Governments will engage water users and other stakeholders in achieving the objectives of the Initiative by improving certainty and building confidence in the reform processes; transparency in decision making; and ensuring sound information is available to all sectors at key decision points. New and improved measuring, monitoring, reporting and accounting procedures will be introduced, and improved public access to information will increase public acceptance of the Initiative.

Water for the Future

Water for the Future is a $12.9 billion, ten year package that sets out to accelerate the implementation of the NWI, represents a radical reform of water governance arrangements in Australia and provides a $450m investment into a new nationally consistent water accounting framework, with hydrological standards to be developed and overseen by a new hydrology division within the Bureau of Meteorology. It focuses on the Murray-Darling Basin, where the bulk of Australia's agricultural water is used, and the bulk of its food produced. Its key elements are:

- Accurately monitoring, assessing and forecasting the availability, condition and use of water resources through the $450 million Improving Water Information Program.
- Establishing the Murray-Darling Basin Authority which will develop a Basin-wide plan to identify risks to Basin water resources and develop strategies to manage those risks.
- Buying back water entitlements from willing sellers under the $3.1 billion Restoring the Balance in the Murray-Darling Basin program.
- Setting a new, scientifically informed cap on the amount of water that can be taken out of rivers and groundwater systems in the Basin.
- Investing in key rural water projects that save water by upgrading out-dated, leaky irrigation systems under the $5.8 billion Sustainable Rural Water Use and Infrastructure Program.
- Providing $250 million through the National Rainwater and Greywater Initiative to help households and surf lifesaving clubs to install rainwater tanks and greywater systems.
- Supporting businesses with high water usage to be more water-wise through the Water Efficiency Opportunities Program.
- Investing $1 billion through the National Urban Water and Desalination Plan to support desalination, water recycling and stormwater reuse, to reduce reliance on rainfall.
- The $250 million National Water Security Plan for Cities and Towns — projects like pipelines, water saving infrastructure and water treatment plants.

Water reform is a bit like drought policy reform, in that it is difficult to implement during periods of low rainfall when everyone is crying out for more water. Progress in implementing the NWI has been slow, hampered to a significant degree, not just by unprecedented low inflows into the system, but also by severe human capacity constraints within the water sector. More of that later.

[Steven Mills & the author inspecting an automatic, remote-controlled irrigation gate on Steve's irrigated dairy property in northern Victoria, March 2006. Jim Donaldson photo]

Nevertheless, there are some fairly clear implications for the Victorian food and farming system arising from the 100 clauses of the Intergovernmental Agreement underpinning the NWI, and from the $12.9 billion investment through Water for the Future.

- For the first time, Australia will have a comprehensive, nationally consistent water accounting framework, overseen by the Bureau of Meteorology, an agency with a long and proud history, a national mandate and a very strong institutional culture that understands long term spatial datasets and the importance of data integrity and continuity. We will finally have a good handle on how much water is being used, by whom, where and when. We will be able to benchmark water productivity as never before, by sector, by industry, by region, by property, by irrigation channel and so on. Apparent inefficiencies will be obvious, as will best practice. Double dipping from groundwater and surface water will no longer be tolerated — it is all the same water and will be managed accordingly.
- Continuing a process that commenced with the COAG Water Reform agreement of 1994, the price of water will increase to reflect the true cost of its provision and delivery. Water prices will continue to rise, sharply in some places. Inefficient users of water will find it increasingly difficult to afford.
- For businesses, industries or irrigation water providers with forward-looking, innovative proposals to renovate infrastructure and/or implement measures that will substantially lift water productivity and increase climate resilience, there are now realistic chances of success in attracting public investment to projects that have a good value proposition. Now is a very good time to be re-tooling irrigation systems to make much smarter use of water.
- Conversely, for those looking to get out of irrigated agriculture, there is now a large willing buyer for water entitlements.
- In catchments where water has been over-allocated (probably more the case in New South Wales than Victoria), there will be more radical reform to return water extractions to more sustainable levels. Producers in such regions should anticipate major changes — and opportunities for the most adroit and efficient operators.
- Urban water reform, urban water infrastructure improvements and an increasing number of reuse and recycling schemes will see greater availability of wastewater within and close to major population centres, potentially available for food production.
- Gradual freeing up of water trading, between and within the urban and rural sectors, will create opportunities for more water to move from the country to the city, and this potentially away from food production to other uses (depending on how it is used in the city).

The above points are just the tip of the iceberg in water policy at the national level. It is a very challenging and interesting time to be in water policy and management.

Carbon and water are being counted and valued as never before, which is a good thing. It has fundamental implications for our food system.

We are finally starting to understand the real cost of our food.

Agriculture and Natural Resource Management (NRM)

Water and carbon are dominating environmental and agricultural policy at the national level right now.

This is understandable given the water scarcity and climate change response imperatives. However there is a third side of the triangle, or third leg of the stool — and that is the terrestrial environment, the soils, vegetation and biodiversity.

These are crucial environmental assets in their own right, and their stewardship should be a high national priority irrespective of climate change. However they are also pivotal in the carbon and water agendas. Soils and vegetation contain all of the terrestrial carbon store, they can generate both significant carbon pollution and sequestration opportunities, and they comprise the catchments that largely determine water yields, water holding capacity and water quality.

Moreover, as discussed in more detail in a recent climate change primer targeted at catchment management authorities (Campbell 2008a), climate change will potentially have a big impact on biodiversity, weeds, feral animals, native vegetation, revegetation, salinity and soil management. These issues should be receiving more policy attention and investment. They remain important determinants of the sustainability of food production on-farm.

Caring for our Country

Caring for our Country is the Government's new natural resource management initiative. It commenced on 1 July 2008 and will invest $2.25 billion over five years to June 2013. It aims to integrate delivery of the Commonwealth's previous natural resource management programs, the Natural Heritage Trust (NHT), the National Action Plan for Salinity and Water Quality (NAP), the National Landcare Program, the Environmental Stewardship Program and the Working on Country Indigenous land and environmental program.

To a degree, Caring for our Country (CFoC) represents a move away from the regional model of program delivery through regional NRM bodies (like CMAs) that was so central to the NHT and the NAP. Regional NRM bodies will be supported by $636 million as secure base-level funding to invest in actions that complement and contribute to national priorities over the next five years, representing a substantial reduction from their previous levels of funding. However they will be able to bid for additional funds on a competitive basis against non-government organisations, other regional bodies, Local Government and State, Territory and Australian Government agencies, to deliver against priorities specified in annual CFoC business plans. Potentially, the more mature, better organised and better resourced regional bodies will be well placed to increase their funding base. Regional NRM bodies that were struggling under the previous funding model will find it even harder under Caring for our Country.

It is in the interests of the Victorian food and farming system to have professional, environmentally literate organisations, operating at a scale between state and local governments, and able to play a leadership role across government, community and industry boundaries in mapping out plans for the sustainable management of their catchments. Victoria is fortunate in that its ten main catchments are largely contiguous with regions with which the community identifies — they map well against the major country football leagues for example — and the Victorian government has done well to establish the most mature, professional and best-resourced catchment management framework in Australia.

Landcare

Landcare is a national voluntary community movement of around 4,000 groups who work cooperatively to improve natural resource management practices and conserve their local environment. It started in Victoria in the mid-1980s and involves around one third of farmers — more in some districts and some industries (Campbell 1994). The National Landcare Program (NLP) is a longstanding program within the Department of Agriculture, Fisheries and Forestry which supports the landcare movement and the sustainable use and management of natural resources. The NLP encourages landholders to undertake landcare and related conservation works by supporting collective action by communities to sustainably manage the environment and natural resources.

Landcare will continue to be supported by the Australian Government (Department of Agriculture, Fisheries and Forestry) to the tune of about $35 million per annum through Caring for our Country—Landcare. The partnership between government and the community remains critical to encouraging on-ground action to improve natural resource management at the farm, catchment and regional level.

Details of the delivery arrangements under Caring for our Country—Landcare from 2008-09 to 2011-12 are still being developed. However Landcare is likely to remain one of the main vehicles through which the Australian Government funds on-ground innovations that improve the sustainability of farming systems — particularly those that tackle problems at a scale bigger than individual properties and deliver public benefits. For on-farm innovations in the food system, Caring for our Country—Landcare is a potential source of development and demonstration funding.

Soils[52]

Soils play a fundamental role in the carbon cycle and the water cycle, as well as being the engine room of food production, an archive of human and natural history and host to extraordinary biodiversity.

Increasing world demand for food and energy in the face of tightening supply will create major economic opportunities for exporting countries like Australia. We will be able to capture those opportunities only if we rapidly improve the productivity and resilience of our farming systems, in the face of an increasingly variable and difficult climate and declining overall water availability. This will require exceptionally good soil management. Such management will also increase soil water storage, improve water quality, build soil carbon and reduce greenhouse gas emissions from agricultural soils.

Australia will struggle to meet its greenhouse objectives, manage its water supply crisis or improve the resilience and profitability of its farming systems without a renewed focus on and re-energising of efforts to improve soil management. That will require reinvestment in the underlying infrastructure of data, information and professional capacity, and the rebuilding of soils literacy among natural resource management (NRM) professionals in the field. There has been an overall increase in public concern about NRM issues, allied with a significant increase in public investment to tackle those issues. However soil management has been overshadowed by seemingly more urgent issues like climate and water. The connection between these issues and the soil is largely being forgotten or ignored.

Against this background, the National Committee on Soil and Terrain, a specialist advisory committee that sits under the Natural Resource Management Ministerial Council, last year commissioned a policy discussion paper to explore what a more coherent approach to soil management policy, research, extension and information in Australia might look like. That paper (Campbell 2008b), after a lengthy process of endorsement by all jurisdictions, is due to be released on behalf of the Ministerial Council by Tony Burke, federal Minister for Agriculture, in September 2008.

It will be interesting to see how governments respond to the discussion paper and the issues it raises, because soil management is a crucial issue for sustainable food production. A more coherent policy framework, with commensurate investment in soil information and an associated research and extension effort, would provide much needed assistance for farmers on issues like soil biology and soil carbon, managing nutrient cycling and soil moisture, and improving soil health and fertility during difficult climatic conditions. Such work is also necessary to underpin more comprehensive food certification and labelling systems.

Infrastructure

The main infrastructure issues that will affect the Victorian food system over the coming decade are associated with the transport system, the availability and affordability of renewable energy options, and the provision of adequate water infrastructure. More detail on some of the potential areas for infrastructure development is discussed in Section 6. This is both a national and a state issue, and will inevitably attract attention and funding from both levels.

In its 2008 budget, the Australian Government announced a $20 billion Building Australia fund and the establishment of Infrastructure Australia. The role of Infrastructure Australia is to advise governments, investors and owners of infrastructure concerning: nationally significant infrastructure priorities; policy and regulatory reforms to improve the utilisation of national infrastructure; options to remove impediments to the provision of efficient national infrastructure; the needs of users; and possible financing mechanisms. Infrastructure Australia will conduct regular audits to determine the adequacy of nationally significant infrastructure, taking into account forecast growth. It will develop a national infrastructure priority list for the Council of Australian Governments (COAG) to consider, and will monitor significant infrastructure investment.

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[52] This section draws heavily on Campbell (2008b) *Managing Australian Soils: a policy discussion paper* prepared on behalf of the Australian and State and Territory governments through the Ministerial Council on Natural Resource Management.

While $20 billion sounds like a lot of money, infrastructure projects tend to be large and expensive, and competition for these funds will be fierce. Projects are more likely to get up if they are backed by very sound analyses of their long-term economic, environmental and social benefits to the Australian community. Given the national significance of the Victorian food system, there may well be opportunities to access these funds, but the case would need to start being made now.

Food, health and population

Australia's National Food Industry Strategy commenced in 2002 and was completed in 2007. It was developed by an independent secretariat called the National Food Industry Strategy Ltd and overseen by a National Food Industry Council (NFIC) that included representatives from across the sector. That strategy was funded to the tune of $114 million over the five years to 30 June 2007, to support the NFIC and to fund a range of initiatives and programs aiming to: support innovation; develop export market opportunities; build more competitive supply chains; and improve national food safety and quality systems. Marketing and improving market access was the key focus of this strategy, with sustainability a relatively minor issue.

The Food Innovation Grants Program was terminated in March 2008. However the incoming federal government has announced a new Regional Food Producers Innovation and Productivity Program, the details of which are yet to be finalised. It will be important for the Victorian food and farming system to watch this space, because this program may well provide new funding opportunities for initiatives that can pilot new ways of improving the resilience and sustainability of the sector.

Australian demography

The Australian Bureau of Statistics (ABS 2008) has just released its latest population projections for Australia over the next fifty years. It estimates that by 2056, Australia's population is projected to increase to between 31 and 43 million people, with around 23% to 25% being 65 years or older, up from 13% of 21 million today. The number of people aged 65 or more will rise up to four times faster than the population. This would obviously put more pressure on retirement homes and aged care, health services and on taxation and employment policies. The population of Victoria is projected to increase 64% by 2056, and Victoria will be overtaken by Queensland as the second most populous state.

Water policy, carbon emission projections and climate change response strategies may need to be reworked in light of these new figures. Employers will have fewer people to choose from because the overall size of the working population will be smaller proportionately than it is now. Fewer people working will support more people in retirement, a situation that will call for changes in taxation policy. People will be encouraged to keep working until well past 65 years of age. Eating habits will change, as will retailing, with a likely trend towards more online shopping and home delivery.

The box below contains excerpts from a blog on Crikey.com.au that neatly encapsulates some of the key linkages between food, health, energy, transport, infrastructure and urban planning and design.

BOX 3.5

How can we ensure healthy foods remain affordable as fuel prices rise?

(from http://www.crikey.com.au/Blogs/Croakey/How-can-we-ensure-healthy-foods-remain-affordable-as-fuel-prices-rise.html accessed on 14.8.08)

Tuesday, 24 June 2008

Dr Tim Gill, public health nutrition researcher at the University of Sydney, writes:
"…with such high rates of overweight and obesity in Australia, rising food prices may actually achieve some good by encouraging us to eat less food." In fact, …rising food prices are more likely to have the opposite effect on weight and health as they are likely to contribute to changes in food purchasing behaviours that will worsen obesity and chronic disease problems associated with poor nutrition.

…Fresh produce is more sensitive to increases in production, transport and storage costs and the price of these products has been rising fastest. Vegetables, fruits, milk, beef, bread and rice have all risen steeply with basic commodity prices around 25% higher than last year, whilst processed products based on sugars and fats less so.

Most consumers are now feeling the pressure of food prices and seeking to reduce food costs and this will often mean purchasing less high nutrition, low calorie fresh produce (such as vegetables, fruits, milk etc) and a higher proportion of lower nutrition, high calorie processed foods, take away foods and snacks. Hence shrinking wallets and expanding waistlines.

Dr Rosemary Stanton; Tuesday, 24 June 2008 7:02:33 PM
… If we could encourage people to have greater respect for food — like the French — we could have more enjoyable and healthier food. We could also reduce our ranking in the world's obesity stakes (the French have about a quarter the obesity rate of the US, for example). How about we encourage people to grow some vegies (in the backyard or in neighbourhood garden plots), teach everyone how to cook fresh foods, make greater use of legumes and in-season produce, reduce waste and see junk foods for the waste of money they really are. This could all lead to us eating better for less.

If that's too big an ask… another alternative would be to price foods according to their true environmental cost. We'd need to take into account the use of resources in production (including the energy costs of all ingredients and additives), packaging costs (including disposal of waste), transport and storage. Packaged foods that are high in junk ingredients (some have up to 10-20 additives) would then become more expensive, while fresh, in-season foods would become relatively cheaper. Carbon taxes will eventually achieve this for us — but hurrying the process could assist the nation's health in the short term.

Public transport, cycleways and promotion of old-fashioned means of transport (using the legs) would also help reduce fuel use and improve the nation's health and fitness. Indeed, if we could emulate the 'active transport' example of the Netherlands, we might also drop from our current high ranking in the world obesity stakes to somewhere nearer to the healthier, slimmer Dutch.

Kathy Chapman, NSW Cancer Council, Wednesday, 25 June 2008 9:01:35 AM;
We know rising fuel prices can impact on grocery prices and lead to disparities between metropolitan and rural areas, but why is there also so much variation in prices across metropolitan areas? The Cancer Council's Healthy Food Basket Survey conducted in 2006 found extensive variability in the cost of a healthy food basket within and across areas in NSW. We … were surprised that food prices could vary so much across Sydney itself. We certainly need to understand all the factors impacting on food prices, and how fresh foods like fruits and vegetables can be made affordable for all.

Chris Rissel, Wednesday, 25 June 2008 9:19:28 AM
There is no doubt that there are already many households not having enough money to buy food, and therefore experiencing 'food insecurity'. …This can only worsen with rising food prices. Even more worrying is that these most disadvantaged areas are also often most poorly served by public transport, meaning that people depend on increasingly more expensive travel by car and access to shops is harder. …In South West Sydney and other designated growth areas, there are many market gardens... Clearing them for new housing may not be a smart planning decision. Governments should be encouraging community gardens and supporting the concept of 'edible gardens' by allocating land, subsidising relevant garden materials and providing information.

Food standards and labelling

It is axiomatic that one of the characteristics of a free market functioning efficiently is that sufficient information is available to all players in the market to ensure that transactions are grounded in a good understanding of the nature of the product or service being bought or sold. Importantly, that information should be 'symmetrical', meaning that both buyer and seller have access to a similar level of detail about the product or service sufficient to make a well-informed decision.

From the earlier discussion it should be clear that assessing the sustainability of a food system, or assessing the full environmental footprint of any particular product on a supermarket shelf, is far from

straightforward. Yet it is equally clear that the emergence of concepts such as 'food miles', 'embodied water' and 'slow foods' reflects a desire from a significant subset of consumers to know more about the production system and through chain behind their food, as this plea from an Australian consumer exemplifies:[53]

"For a long time now I have tried to buy things with less of an environmental impact, for example washing powder without harmful chemicals, free range meat, local produce (reducing transport fuel etc), but now there are so many things claiming to be "green", as it is now a selling point for the larger community. The other day I saw an ad for environmentally friendly fish oil tablets... which had copious amounts of plastic packaging. This is definitely an area which could do with better government attention/ standards/ testing. It is important that consumers know that the products that they are choosing to buy (and usually pay more for) are actually doing the thing that they claim (reducing environmental damage)."

At this stage, certainly in Australian and New Zealand, the main focus of the relevant authorities in this area remains food safety, rather than any broader notion of food system sustainability.

Food Standards Australia New Zealand (FSANZ) is an independent statutory agency established by the Food Standards Australia New Zealand Act 1991, within the Australian Government's Health and Ageing portfolio. Working within an integrated food regulatory system involving the governments of Australia and New Zealand, it sets food standards for both countries. FSANZ develops food standards, and joint codes of practice with industry, covering the content and labelling of food sold in Australia and New Zealand. It also develops Australia-only food standards that address food safety issues, including setting maximum residue limits for agricultural and veterinary chemicals.

According to the **FSANZ website**, its ultimate goal is "A safe food supply and well-informed consumers." It is clear that the emphasis in informing consumers is on food safety and nutrition:

> *"The type and amount of nutrition information found on food labels can sometimes be confusing or difficult to understand. We all lead busy lives and we don't have time to spend in the supermarket trying to 'translate' what it all means. One of the main aims of Food Standards Australia New Zealand is to ensure there is adequate information relating to food to allow you to make informed choices so that you can use the label to help select healthier foods and plan nutritious meals for you and your family."*

Since 2001, it has been mandatory for Genetically Modified (GM) foods to be identified on food labels in Australia and New Zealand. GM foods and ingredients (including food additives and processing aids from GM sources) must be identified on labels with the words 'genetically modified', if novel DNA and/or novel protein from an approved GM variety is present in the final food. GM foods must also be labeled if they have altered characteristics. For example, if a GM food has an increased level of a particular nutrient, such as a vitamin, or has to be cooked or prepared in a different way compared to the conventional food, then this also needs to be stated on the label. Some exemptions are allowed under the labelling requirements. For example, foods not containing novel DNA or protein, such as highly refined or processed foods such as vegetable oils or sugars, do not have to be labelled. However, if these foods also have altered characteristics (e.g. a refined oil with an altered fatty acid profile) then the food must be labeled accordingly.[54]

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53 from Leah Marrone in Crikey.com.au 'Your Say' 12 August 2008

54 http://www.foodstandards.gov.au/foodmatters/gmfoods/

We are as yet a long way away from having a broader food certification and labelling system that encompasses the full environmental, animal welfare, food safety and nutrition information that consumers seek. Some aspects of food production systems are covered by established labels, such as 'organic', 'biodynamic' and 'free range', that have long-established standards and certification measures. However each of these just covers part of the on-farm picture. None cover carbon pollution, nor do they encompass the through chain to the point of purchase.

Table 3.26 below sets out a proposed framework for environmental reporting in the Australian food industry developed by the Bureau of Rural Sciences as part of the Signposts for Agriculture project of the National Land & Water Resources Audit (Chesson et al 2006). It covers land stewardship, and it makes a useful distinction between what the system consumes in terms of water, energy and materials, and what it emits or discharges to the atmosphere, receiving waters or in solid wastes. It does not purport to cover animal welfare, or fair trade, or the through chain as a whole.

Table 3.26 Components of a proposed environmental reporting framework for the Australian food industry (Chesson et al 2006)

Component	Objective	Suggested Indicator[1]
Stewardship of land	Satisfy society's need for a mix of services	Amount of land 'held' combined with the three indicators below
Productive capacity	No reduction in productive capacity	Under development[2]
Biodiversity conservation	Maintain/enhance biodiversity	Proportion of land covered by native vegetation in 'good' condition
Cultural services	Maintain/enhance cultural (non-material) services	Under development[2]
Removals from the environment		
Energy	Reduce/minimise	Direct energy use (joules)
Water	Reduce/minimise	Total water use (cubic metres)
Other	Reduce/minimise	Total material use (tonnes)
Emissions and discharges to the environment		
Air		
Greenhouse	Reduce/minimise	Total greenhouse gas emissions (tonnes of CO_2 equivalent)
Ozone depleting	Reduce/minimise	Total emissions of ozone depleting substances (tonnes of CFC-11 equiv.)
Other	Reduce/minimise	As appropriate
Water	Reduce/minimise	Significant discharges to water (tonnes)
Land	Reduce/minimise	Total amount of solid waste (tonnes)

1 (Expressed as total and per unit of product or service). Each outcome indicator can be accompanied by a list of initiatives taken to address the component. The information will be useful for the sector in question but is not amenable to aggregation along the food value chain.
2 Suitable indicators for these components are being considered in the Signposts project. They can be added to the reporting framework as they become available.

As the table makes clear, many of the metrics, even for this limited framework, are still under development. There is no agreement as yet, even at a technical level, about the units of measurement or appropriate baselines and benchmarks, for several of these parameters. This is much more complex than a five star rating system for the energy efficiency of a fridge or the water efficiency of a washing machine. It is naïve to expect that we will ever get to a single sustainability metric for food. Nevertheless, we need to do much better than the status quo, where a mish mash of claims and labels based on partial measurement of some components of the system compete for consumers' attention on supermarket shelves.

It would seem realistic and sensible to aim for a system of food accreditation and labelling that could encompass, in addition to the existing panel of nutritional and additives information, another panel with a five star rating system for each of emissions of CO2 equivalents, water use, energy use, waste (some index of packaging efficiency, biodegradability or degree of recycling) and animal welfare. Such a 5x5 matrix, if standardised across Australia and New Zealand, and well-designed, could enable consumers to compare alternative products relatively quickly, thus meeting the FSANZ objective of 'well-informed consumers'. This would not preclude industries and firms developing brands that claim to meet even higher sustainability standards, or regional distinctiveness, or social aspects such as fair trade, as a further point of differentiation.

3.3 State policy settings

This section looks at recent policy developments in Victoria that have most bearing on the food and farming system. Again, it does not purport to be comprehensive, but tries to draw out the main influences on the food and farming system.

The Future Farming strategy

How well does this set up the Victorian food system against the external drivers mapped earlier? What is lacking that would better position the food system for the future?

On 23 April 2008 the Victorian Government launched the Future Farming strategy to improve the productivity, competitiveness and sustainability of farm businesses, citing a background of uncertain prices and demand, climate change and competitive global markets (DPI 2008). The Future Farming strategy will invest $205 million over four years across seven broad Action Areas to build a strong and secure future for the farming sector. These Action Areas are summarised below.

Boosting productivity through new technology and changes in farming practices
Major new investment of $103.5 million to expand agricultural research, development and practice change services in Victoria, including the development of new generations of drought, cold and salt resistant crops, improved plant and animal disease control, and new technologies to lift productivity.

Building skills and attracting young people to farming
A number of strategies are being implemented to build skills for the farm sector and attract young people to farming. These measures will boost regional education and training opportunities related to farming and its support industries, including new trade wings at secondary colleges for trades that are in short supply in primary industries.

Understanding and managing climate change
New support of $11.5 million to help farm businesses to plan for climate change and to provide farmers in key industries with new technologies to adapt their farming systems to future climate conditions.

Strengthening land and water management
Additional investment of $24 million for managing weeds and pests, as well as new actions to assist farm businesses to improve land and water management.

Helping farm families to secure their futures
A $12 million boost for services to support farmers and rural communities in adjusting to change, including a new National Centre for Farmer Health to improve the health and wellbeing of farmers, farm workers and their families.

Developing new products and securing new markets
An $11 million package to help farm businesses capture new domestic and international market opportunities. This includes enhancing Victoria's biosecurity preparedness and identifying new investment opportunities and alliances.

Transporting products to market
A $43 million investment in country rail freight lines serving the grains industry to ensure the rail system can continue to deliver future crops to market. Other major investments are the deepening of the Port Phillip Bay channel and the development of a new wholesale market at Epping.

Overall, the Future Farming strategy maps fairly well against the foregoing analysis in this report and the broad areas of investment required, such as climate change preparedness, infrastructure, skills and marketing. One can always argue about the amount of funding committed to specific areas, and it is difficult to assess whether the investment proposed is adequate without a detailed understanding of the existing expenditure and resources to which this $205m over four years is added. While there are no glaring gaps in the high-level analysis of the operating context at the start of the strategy, there are areas where more depth would have been helpful. From the perspective of this project, it would have been good to see more detail on: measures to prepare Victorian agriculture for emissions trading;

more emphasis on undertaking comprehensive life cycle analyses to identify opportunities for systemic improvement in carbon, water, nutrients and energy performance; more emphasis on biomass energy opportunities on-farm; greater attention to soil health; more depth on the skills agenda; and more explicit recognition of the linkages between the farming system, the food system and the health system.

Strategies such as this are inevitably evolutionary rather than revolutionary. But on the whole, the document comes across more as an adjustment package than as a master plan for a new approach to agriculture in Victoria.

BOX 3.7

Victorian Innovation in Sustainable Natural Resource Management

Victoria has been a pioneer and an innovator in recognising land and water degradation issues and in getting on the front foot in dealing with them. In several areas Victorian leadership and innovation has been very influential nationally, including:

- the systematic appraisal of rural landscapes and rigorous application of explicit criteria, combined with extensive public consultation processes, to recommend appropriate land uses for public lands through the Land Conservation Council (LCC) established in 1970;
- the fostering of non-government and philanthropic approaches to nature conservation on private lands through the **Trust for Nature** in 1972 and **Land for Wildlife** in 1981;
- the early recognition of the emerging salinity problem and the establishment of the Salinity Bureau in the Premiers Department in the early 1980s;
- the initiation and development of LandCare (now **landcare**) in the mid 1980s (Campbell 1994);
- the development of landcare in schools and the use of citizen science approaches through programs like **Saltwatch**, **Waterwatch** and **Frogwatch** to involve large numbers of people in voluntary activities to monitor and better understand their local environment (Terry White et al 1996);
- the development of Whole Farm Planning (called Property Management Planning nationally) in the late 1980s;
- the establishment of a statutory framework for **catchment management** with a strong community base in the 1990s, and;
- the pioneering in recent years of innovative new approaches (e.g. **Bush Tender**) based on experimental economics to develop market-based incentives for biodiversity conservation on private lands.

Green Paper on Land & Biodiversity in a time of Climate Change

A few weeks earlier than the Future Farming Strategy, on 6 April 2008, the Victorian Government released its Green Paper on Land and Biodiversity in a time of Climate Change (DSE 2008). The Green Paper represents the second stage in the process for developing the final White Paper or statement of the State Government's policy and intentions in this area. The Green Paper outlines the ongoing decline in land health and biodiversity and suggests approaches for tackling these problems.

The White Paper, due for release in 2009, will:

- set the direction for Victorian Government policy and investment priorities in natural resource management, land health and biodiversity for the next 20-50 years;
- consider how environment and natural resource management activity at the regional, catchment, local and farm scale, and on public land, is contributing to Victoria's overall environmental health; and
- make sure Victorian Government policy and investment is responsive to new threats and opportunities.

The 1997 Biodiversity Strategy is being updated in parallel with the development of the White Paper. There is a great deal of useful background material about Victoria's biodiversity and environmental services in the Land and Biodiversity Green Paper, and a logical and coherent framework of visions, outcomes, goals and high level objectives. There are also some interesting discussions of broad areas of activity that the Victorian government might choose to pursue in maintaining its biodiversity and the

environmental services it provides in the face of significant external pressures from climate change and development. As mentioned earlier, pressures on Victoria's biodiversity are likely to intensify.

However — especially in light of Box 3.7 above noting Victoria's proud tradition of innovation in sustainable natural resource management, in community engagement, in the strategic use of new policy instruments and in establishing far-sighted institutions — the Green Paper fails to 'push the envelope' in setting out a new agenda for land and biodiversity in a time of climate change. Given its 20-50 year target timeframe, it needs to stretch our thinking, but it reads too much like an extrapolation of recent trends. Marginal improvements on business as usual will not be good enough.

Moreover — and maybe it is the nature of a Green Paper as opposed to a White Paper that sets out what the government intends to do — I found myself continually wanting to see the next level of detail about how the government intends to deliver on the worthy aspirations set out in the Green Paper. It stays at a generic, helicopter level, rarely getting grounded in practical actions on specific issues.

This was a particular frustration in looking at the Green Paper through the lens of the Victorian food system. Given the environmental footprint of the food system, and the pressures that will squeeze it through climate change, increasing demands and rising input costs, the potential for Victoria's biodiversity to suffer collateral damage is very real. Opportunities to think through how premium food lines with high sustainability credentials could be linked to biodiversity and habitat protection or enhancement; or how whole food chains could be modified to consider biodiversity along the chain; are missed. Soil biodiversity is another gap.

At face value there should be a substantial overlap between the Future Farming Strategy and the Land & Biodiversity Green Paper, around sustainable farming systems, smart water management at farm and landscape scales, the carbon and renewable energy agendas, and land use planning in peri-urban areas in particular. However the overlap in the middle of this Venn diagram is frustratingly hollow. It is almost as if the people drafting the respective statements within the two lead agencies deliberately skirted around issues that overlapped each other's responsibilities. There is insufficient attention to detail in either policy statement on the farming systems needed in order to meet the Victorian and wider community's growing needs for food, fibre, renewable energy and carbon sequestration, while looking after the productive capacity of soils, the ecological integrity of waters and vegetation, and securing the long-term prospects for Victoria's biodiversity and the ecosystem services it provides.

Water and Energy

Box 3.8 below introduces the Food Bowl Modernisation project in the Goulburn Murray Irrigation District. This is the biggest project of the ***Our Water, Our Future*** water strategy announced in 2004 that set out 110 initiatives for water conservation aimed at every sector of the community, seeking to provide water to sustain growth over the next 50 years. The *Our Water, Our Future* strategy represents a $4.9 billion renovation of Victoria's water infrastructure, which includes significant upgrading of both the Eastern and Western Treatment Plants, expansion of water recycling schemes (reducing discharges into Port Phillip Bay) and a new desalination plant on the coast near Wonthaggi that will produce about half of Melbourne's water needs.

> *"in many northern systems, the amount of water extracted from rivers and aquifers is higher than that which can sustain existing ecological objectives. This has resulted in the decline in the ecological health of our rivers and aquifers, as well as impacting on towns and industries that depend on reliable, high-quality water."*[55]

This study has not looked at the food bowl modernisation project in detail, but notes two key concerns. Firstly, it is critical that such a large public investment in irrigation infrastructure is designed around the farming systems and irrigation needs of the future, not those of the past or the present. It should be predicated on the systems and benchmarks of the best of current practices (or better) rather than the average. Secondly, while it is desirable to reduce the leakiness in an irrigation system, it should be recognised that some losses from the system are environmentally beneficial, finding their way into wetlands, aquifers and the baseflow of river systems. Reducing leakiness

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55 Northern Region Sustainable Water Strategy Discussion Paper (p22) http://www.ourwater.vic.gov.au/programs/sws/northern/strategy

increases the imperative to make explicit allocations of water for the environment – and to deliver those allocations, not just the leftovers from consumptive use. Unless the government deals with the fundamental problem of existing over-allocation, modernising the irrigation system *per se* will not improve the ecological health of rivers and aquifers and the communities that depend on them.

BOX 3.8

Food bowl modernisation

(from http://www.ourwater.vic.gov.au/programs/irrigation-renewal)

Up to 900 gigalitres (GL) of water in the Goulburn and Murray irrigation systems is currently lost through leaks, evaporation and other inefficiencies from the antiquated water delivery infrastructure. This translates to around one quarter of Lake Eildon's capacity. It is estimated that around half this water – 425GL – can be captured through replacing old and ageing infrastructure with more efficient and effective modern technology.

In December 2007, the Government created a new entity — the Northern Victoria Irrigation Renewal Project — to deliver a major modernisation of the irrigation infrastructure of the Goulburn Murray Irrigation District.

The first stage of the project will secure savings of up to 225GL annually by reducing losses and automating the backbone of the irrigation system — the main trunks and carriers. The second stage will extend further out into the branches of the system, replacing Dethridge Wheels with modern automated metering systems and further reducing leakages, to capture a further 200GL.

One billion dollars has been committed for the first stage of the project, with $600 million coming from the Victorian Government, $300 million from Melbourne water users and $100 million from Goulburn-Murray Water. The water savings from Stage One will be shared equally between the 14,000 irrigators relying on the system, the environment and Melbourne households and businesses, with Melbourne receiving a maximum of 75GL through the new Sugarloaf pipeline.

The Commonwealth has agreed in principle to fund 90 per cent of the cost of stage two, up to $1 billion. This is subject to a due diligence assessment and delivery of half the gains in additional flows in the Murray River and half to irrigators. Stage Two water savings will be shared equally between irrigators and the environment.

Draft Sustainable Water Strategies for the four water regions under Our Water, Our Future are due out later this year, and the final strategies are due in 2009. These are crucial documents for the long term sustainability and resilience of the Victorian food system.

Energy

> *The current energy backbone of Victoria involves mining fossil fuels from concentrated reserves as either gases (natural gas), liquids (crude oil) or solids (brown coal) and distributing the energy to the community via electrical, gas, liquid or solid fuel distribution networks. As of 2007 Victoria had substantial reserves of coal (99 per cent remaining), declining reserves of natural gas (43 per cent remaining) and depleted reserves of oil (14 per cent remaining). Electricity production from brown coal is currently the most carbon dioxide (CO_2) intensive method of electrical energy production (1.16-1.58 kilograms carbon dioxide equivalent per kilowatt hour ($kgCO_2e/kWh$)) and places Victoria in the unenviable position of being the clear Australian leader in electricity related emissions.*[56]

The Victorian Government announced the Victorian Renewable Energy Target (VRET) scheme in late 2006, whereby energy retailers are required to purchase a minimum of 10% renewable energy by 2016. This equates to a cut in greenhouse gas emissions of 27 million tonnes and it is estimated this will lead to $2 billion in new investments and 2200 jobs in the renewable energy sector in Victoria. The Renewable Energy Authority Victoria (Amendment) Act 2000 established the Sustainable Energy Authority Victoria to *"support and facilitate the development and use of sustainable energy options to achieve environmental and economic benefits for the Victorian community."* On 1 October 2005, the Sustainable Energy Authority Victoria and EcoRecycle Victoria joined forces to become Sustainability Victoria.

Chapter 6 discusses the potential for biomass energy production to be integrated into both extensive and intensive farming systems. The VRET scheme could help to facilitate this.

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[56] Crucible Carbon (2008 p2)

Chapter 4. International developments, pointers and lessons

There is a great deal of international concern about the way we produce, process, distribute and consume food — in other words about trends in the evolution of modern food systems. These concerns are coming from five key directions:

- the human health impacts of the 'western diet' with increasing consumption of fats, sugars, salts and food additives, and parallel increases in 'western diseases' such as obesity, diabetes, cardio-vascular disease and cancer (which remain much less prevalent in countries with a traditional diet still dominated by fresh, whole foods and much lower meat consumption);
- food safety in terms of additives and contaminants, and food-borne illnesses;
- the environmental impacts of modern industrial farming systems in terms of greenhouse gas emissions and nutrient pollution, soil degradation, water consumption and loss of biodiversity;
- the ability of the world to double food production over coming decades from existing land and water resources, while adapting to climate change, developing climate change response strategies and absorbing substantial increases in the price of energy and nutrients; and
- the enormous and increasing costs in many OECD countries of agricultural support policies, the fact that most farmers in these countries could not survive without subsidies, the declining viability of many farming communities and of the attractiveness of agriculture as a career, and a nagging sense that taxpayers are subsidising the production of food that is not good for them at the expense of the land, farmers and rural communities.

In response to these concerns, there is considerable policy attention being paid to food systems in other countries. This section does not purport to undertake a comprehensive international comparative analysis of food policy. That would be a very interesting and valuable task, but is way beyond the scope or resources of this project. Rather, this section identifies some of the international developments that may contain useful insights or lessons for the Victorian food and farming system.

4.1 United Kingdom

> *The scale of the challenge of raising output to feed a larger, wealthier human population, adapting to climate change and mitigating food-related emissions, all at once, is not to be understated.*[57]

The UK has the most developed fresh food retailing market in the world (O'Keefe 2008). The work that Britain is doing in fundamentally rethinking its food system has been a revelation in this project. It is clearly led by a strong commitment from the Prime Minister down, and it is broadly based and deeply grounded across a wide range of agencies and industries.

Such a focus is understandable in the context of the BSE scares of the 1980s and 1990s and the 2001 foot-and-mouth disease outbreak, in addition to the overarching concerns listed above, which also resonate strongly in Britain. Appendix F lists some key statistics about the agriculture-food-health linkages in both the UK and the USA. In 2001, the British government established the independent Curry Commission which recommended that in order to develop a new agriculture and food policy, several departments and agencies should coordinate their activities: the Department for the Environment, Food and Rural Affairs (DEFRA), the Food Standards Agency (FSA) and the Department of Health, the food sector, public procurement agencies, and the Department of Education and local education authorities. Simultaneously, an economic analysis of the agrifood sector led to the 2002 launch of the Strategy for Sustainable Farming and Food (SSFF), designed to foster a sustainable farming community and the production of safe and nutritious food products.

[57] UK Cabinet Office (2008)

BOX 4.1

Supermarkets and the greening of the UK food system

"We recognise that Woolworths can take a more prominent role in the debates around sustainability. It is fair to say that Australian and New Zealand retailers have lagged behind companies in the United Kingdom and Europe."[58]

One of the things that the UK has in common with Australia is the dominance of supermarkets in food retailing, and the concentration of supermarket ownership among a handful of firms. Australia has a high concentration of supermarket ownership, with Woolworths and Coles accounting for 70% of packaged grocery sales and 50% of fresh food sales (ACCC 2008). In the UK, supermarkets account for 73% of consumer grocery sales, and four firms (Tesco, Asda, Sainsbury's and Morrisons) controlled over 70% of the UK grocery market in 2007 (SDC 2008).

"Government cannot resolve the problems of obesity, waste or climate change alone. Given the enormous influence wielded by supermarkets, working with them effectively is essential." — Professor Tim Lang, SDC Commissioner.

The **Sustainable Development Commission** is the British Government's independent adviser on sustainable development, reporting to the Prime Minister, the First Ministers of Scotland and Wales and the First Minister and Deputy First Minister of Northern Ireland. It undertakes advocacy, advice and appraisal, and has just completed a review of government's role in supporting sustainable supermarket food in the UK (SDC 2008). That review found that supermarkets are frustrated by a perceived lack of long-term government strategy on how the food sector can best contribute to government policy goals. In the course of the review, supermarkets said they were willing to work with government to develop a coherent vision for a green, healthy and fair food system, with a roadmap that identifies priorities for retailers, continues to build the evidence base and implements the range of policy tools that will enable progress. The SDC review identified six key priority areas for government and supermarket action on: Climate Change; Waste; Water; Ecosystems; Nutrition and obesity; and Fair Supply Chains.

Tesco has the biggest slice of the British grocery market, with just over 30% of the market (almost twice as big as its nearest competitor) and on an upward trend (SDC 2008). It has one of the world's most sophisticated loyalty programs (the Tesco Clubcard) and consequently a very fine-grained understanding of its customers and their preferences (Humby et al 2007). About one quarter of Tesco customers are strongly motivated by sustainability issues in their buying choices. A further quarter are interested at the right price. Against this background, a recent speech in Beijing by Sir Terry Leahy, the Chief Executive of Tesco, included the following points:

"…some argue that it is impossible for an economy or a company to go green and grow at the same time. I fundamentally disagree – you can do both. And I would go further still, and say that if we want long term growth, we must go green. Why? Because only by acting now on cutting emissions will we save money in the future. For every £1 we spend now on tackling climate change, we are saving our children anywhere between £5 and £20 at today's value. Failure to act means risking economic and social disruption on the scale of the great wars and economic depression of the last century. So if we cherish growth, we must act.

…We need a new approach to government that understands that government, business and consumers are inter-dependent and are more powerful when they work together.

…If we are to move to a low-carbon economy, policies – such as tax and planning – must reward low-carbon activities and investment. And too often governments fail to harness the 21st century power of consumers, incentives and markets and bring these to bear on tackling climate change too.

…Consumers account directly and indirectly for 60% of carbon emissions. Get the consumer on side and the task of tackling climate change becomes possible. I trust and listen to consumers. I believe in the power of consumers. I see the consumer as part of the solution to climate change, not part of the problem. Tesco's core purpose is to create value for customers to earn their lifetime loyalty. Customers tell us that they want to go green and do their bit to protect the environment. The challenge for us retailers is to help them do that.

Tesco is a global company: each week, over 30 million people shop in our stores around the world. To serve them, we employ 400,000 people. And then there are the countless people who work in firms and businesses, supplying our stores. Imagine if all those people acted to cut carbon emissions in all they did. This would be true collective action. The supply chain, and gradually the economy as a whole, would begin to turn green.

…our strategy at Tesco falls into three parts. First, greening Tesco itself. Second, helping turn the supply chain green. And third, by helping our customers by making green choices easier and more affordable.

… we have measured our carbon footprint, which was 4.47 million tonnes of carbon dioxide equivalent for the entire Tesco Group in 2007. To cut this, we have set the entire group some clear targets, with 2006 as our baseline. For example, we aim to halve emissions from our Group's stores and distribution centres by 2020. To halve the carbon emissions from all new stores we build between now and 2020. To halve, by 2012, the amount of CO2 used in our distribution network to deliver a case of goods.

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58 Woolworths Limited. *Doing the right thing* | ***Sustainability Strategy*** *2007–2015* page 3.

To achieve these goals, we've changed every aspect of how Tesco operates.

We're saving energy in our stores – like hanging curtains on freezer doors, better insulation, low energy lighting, new refrigeration systems. In South Korea and Thailand, for example, we are using ice thermal storage, and creating biogas from recycled waste. Here in China we are installing energy management systems on the refrigeration in all of our existing stores this year that will reduce the power consumption of these systems by 15%. Next year we will expand this to include the air-conditioning. ...Next year our Chinese business will begin water saving initiatives, like rainwater harvesting and using grey water for things like car washing and toilets. ...at the end of next month we're opening two stores here in China – in Wuxi and Tianjin – which will use 25% less energy. In California, our distribution centre has one of the largest solar panel roofs in the US.

*We've set up a £100 million **Sustainable Technology Fund** support low-carbon technologies like wind, solar and ground source heat.*

*... in the UK, we have invested £25 million in the new **Sustainable Consumption Institute**, to research how we make the transition to a low carbon economy, and the role that sustainable consumption can play in this. ...In particular, the Institute will aim to contribute to the development of an internationally-recognised carbon footprint methodology, and help us understand how customers read labels and respond to them. ...We want the SCI to make the widest contribution to tackling climate change: cooperative in its approach, authoritative in its findings, and influential in the debate. ... this crucial contribution will be led by Professor Mohan Munasinghe, Vice-Chair of the IPCC - which was a co-winner of the 2007 Nobel Peace Prize.*

...By the end of this year, our UK energy use per square foot will be half what it was in 2000. Last year, our Group carbon intensity per square foot of sales space fell by 4.7%. Here in China, just this year alone, we have saved over 4,000 tonnes of cardboard by using reusable plastic trays, reduced our carbon emissions per case by over 4%, and reduced C02 emissions per square foot by over 6%.

And we're achieving this while Tesco grows. That's the critical point: the choice is not "green or grow". ...Reducing emissions does not merely fight climate change, it also cuts costs, reducing the pressure on a company's bottom line. At a time when energy costs are soaring, that's something that every business should want to achieve.

A green supply chain in the developing world is, in some ways, easier to achieve than in the developed world. ...there is no reason why, when we set up in developing countries, we cannot create new, green supply lines from scratch.

... our clothing business has worked with some of our suppliers in Sri Lanka to develop "green factories" which are solar powered, and where water is recycled, energy saved and toxins controlled. We've an online database in the UK, into which suppliers can enter information about their packaging so we can help them reduce it.

...we're developing a label that will tell customers the size of a product's carbon footprint. Armed with that information, customers can begin to choose products with smaller footprints. ... Suppliers worldwide need to prepare for this, as I believe it will change customers' behaviour.

...The good news is that consumers want to help, and want help. Over the last decade, concern about climate change and a wish to protect the environment have become part of consumers' mental map. ...If the budget for the weekly shop becomes tighter, we need to be sure that going green is not seen as an expensive optional extra, but is within everyone's reach. And we need to spell out that going green can often save money. Consider energy saving lightbulbs. At a time when energy prices are rising, they don't just cut carbon, but also cut fuel bills. ...in the UK we have permanently halved the price of energy efficient light bulbs. We've sold over 10 million energy saving light bulbs in the UK in just over a year, up from 2 million the year before. In October, we'll be launching our own brand energy saving light-bulbs here in China.

In the UK, in just two years, we have saved almost 2 billion bags. In Poland, by providing a greater range of reusable bags, we have saved 400 million plastic bags. ... going green is not just good for the environment, and right in principle. It is also saves money – saves us money, saves suppliers money and saves consumers money. So the economic downturn in the West, far from damaging the green agenda, could promote it.

If you deliver value for customers and earn their loyalty, they will reward you with not merely their custom but – in the case of the green agenda – a change in behaviour. Billions of purchases send a signal to cut carbon right down the supply chain and right through the economy. Each time a product is swiped through a checkout, that sale can reduce CO2 emissions. Each consumer who buys a green product is joining the mass movement in green consumption.

That movement is what we are seeking to create.

I've quoted from this speech at some length (read it in full **here**), because it is illustrative of where one of the world's leading food retailers is heading (with big implications for its suppliers in all countries) — and also because I've not seen anything quite like it from any CEO of a top 100 company in Australia.

Notwithstanding Terry Leahy's enthusiasm, he faces a tough audience, as the SDC (2008, p34) review found:

"Overall though, many non-retail stakeholders felt that the majority of supermarkets are not yet doing enough to improve sustainability in the food supply chain. There are high levels of cynicism about motives being purely financial, for PR purposes or to pre-empt legislation. Many are also skeptical about supermarkets actually delivering on their claims."

The UK Strategy for Sustainable Farming and Food has been taken to a new level entirely over the last year or so. In September 2007, the Prime Minister commissioned the UK Cabinet Office Strategy Unit to undertake a major project on food and food policy. The aims of the work were: to review the main trends in food production and consumption in the UK; to analyse the implications of those trends for the economy, society and the environment; to assess the robustness of the current policy framework for food; and to determine what the objectives of future food strategy should be and the measures needed to achieve them.

A major analytical report was published in January 2008, followed by stakeholder consultation and then a final report was published on the 7th July 2008, called *Food Matters: Towards a Strategy for the 21st Century*. Food Matters outlines a future strategic framework for food policy and practical measures for addressing issues around food and health, food and the environment and other concerns. There are 20 key actions set out in the Food Matters framework. It is noteworthy that the Cabinet Office web site identifies and provides the email addresses of the individual people with lead responsibility for each action, across a wide range of government agencies.

It would be instructive for Victoria to track the implementation of this strategy closely.

4.2 Europe and Scandinavia[59]

Norway

Among European countries, Norway provides one of the earliest examples of an integrated agri-food-health strategy. In 1975, Norway launched a Nutrition and Food Policy designed to combat the country's high incidence of cardiovascular disease, which accounted for about half the nation's deaths (Norum 1997 cited in Tyrchniewicz and McDonald 2007). The main goal was to reduce the proportion of fat in the diet from 40% to 35% of the food energy supply, a goal first achieved in 1991 (National Nutrition Council 1994 cited in Tyrchniewicz and McDonald 2007). Norway is one of the few countries that has from the outset included the agricultural community in its attempts to improve food and health policy. The farm lobby saw the value of adapting to the emerging diet-health paradigm and helped introduce an effective national food policy, linking together policies on agriculture, food processing, consumers, health and rural affairs (Helsing 1987).

Finland

One of the more successful strategic attempts to change to a more healthy diet comes from Finland. In the early 1970s, Finland had the world's highest recorded coronary mortality rate (Pietinen 1996 cited in Tyrchniewicz and McDonald 2007). The Finnish government worked with the country's health services to change dietary behaviour. The North Karelia project targeted smoking, blood pressure control and diet, and preventative activities throughout the country. Finns doubled their vegetable consumption within a decade, while the proportion of saturated fats in total fat consumption declined and fish consumption rose. These and other dietary shifts were stimulated by public policy support. The health agencies worked with the food industry to alter the food supply, thereby linking supply push with demand pull. Male deaths from coronary heart disease dropped by 55% from 1972-92. Changes have been even greater for women (Pietinen 1996 cited in Tyrchniewicz and McDonald 2007). The secret was close integration between health agencies and other agencies. For example, once dietary guidelines were designed for school lunches, guidelines were developed and implemented for other social groups including day care facilities, the elderly and the armed forces. This strategy was rolled out in a systematic, planned approach with a clear overall vision.

Sweden

Sweden has set itself some of the most ambitious targets in both preparing for and in combating climate change — including an overall plan to halve resource use by 2021 (Swedish EPA 1999 cited in

[59] Much of this section draws on an excellent Canadian review of international agri-food-health policies in Tyrchniewicz and McDonald (2007)

Tyrchniewicz and McDonald 2007). It has also seen the links between farming, food, the environment and health. In the 1990s, Sweden launched an attempt to integrate public and environmental health with employment and food quality objectives, following heavy criticism about monocultures in forestry and farming. Both the Agriculture and Environment ministries are developing programs to reduce fossil fuel and energy use and to meet health targets. Sweden is also exploring how to achieve tough targets on reducing greenhouse gases emitted from the entire food supply chain (Carlsson-Kanyama 1998).

BOX 4.2

Biomass energy in the Nordic countries[60]

For a tantalising glimpse of the potential for farm forestry to play a role in distributed biomass energy production systems, we can shift our gaze far north, to the Nordic countries.

Let's take Finland, a country with a similar population and land area to Victoria, but with a shorter growing season and more difficult climate, so trees grow much more slowly than in Victoria. Finnish forests produce an average of only around 4 cubic metres per hectare per year, resulting in rotation lengths of 60-120 years. The three main commercial species are Norway pine, Sitka spruce and birch.

Yet the use of by-products of forestry and timber processing as fuel, produces 23% of Finland's primary energy, over 75% of domestic and industrial thermal energy needs, and 20% of Finland's electricity generated from woody biomass in Combined Heat and Power (CHP) plants of up to 500MW.

In Australia the contribution of biomass to total national energy production is minute and mostly from sugar cane waste (bagasse). In Denmark, the contribution from bioenergy is about 6%, and this is mainly as straw and woody biomass. In Sweden it is closer to 20% (aiming for 40%) and far exceeds other forms of renewable energy. In Finland overall it is about 24% and in central Finland closer to 50%. The national energy requirement for these three countries splits roughly to 50% for heating, 25% as electricity and 25% as transport fuels.

The 570MW Averdøre-2 CHP plant in Denmark, which began operating in 2002, is designed to be fueled by either straw, wood pellets or natural gas. When first planned in 1994, it was assumed that natural gas would supply 85% of the fuel needs, but a leap in gas price meant that in early 2001 biofuels were decided upon as the main fuel source. Denmark has a policy to move away from coal as the primary fuel for energy. Averdøre-2 was designed to replace three coal fired plants and thereby reduce net emissions of CO2 by 10%, nitrous oxide by 20% and sulphur dioxide by 30%. It combines gas turbines, a fossil fuel boiler and a biomass boiler. In co-generation mode, the new plant is a world leader for efficiency in converting up to 95% of the fuel into useable energy.

Electricity output from Averdøre-2 is about 485 MW. It supplies ~20% of the demand for eastern Denmark, or enough electricity for ~800,000 households. It generates 570MW thermal energy supply for the district heating needs for ~180,000 homes in Greater Copenhagen, from ~150,000 tonnes of straw and 300,000 tonnes of wood pellets annually.

The photo at left shows a non-commercial thinning in one of my *Pinus radiata* superannuation woodlots on my farm in western Victoria. These pines are eight years old. The high-pruned standing trees will be sold as clear veneer logs sometime between 2030 and 2035, hopefully for a very good price. Two thirds of the original trees planted were cut down in this thinning, which was originally anticipated to produce posts. But with the closing of a local mill, that market is no longer economic for small lots such as this 20 hectares. In Scandinavia, thinnings like this are used to produce biomass energy, thus turning a farm forestry thinning operation such as this into a revenue earner and saving carbon pollution, rather than costing money (about $14,000 to thin the 20 hectares), generating CO2 emissions as hundreds of tonnes of biomass per hectare rot on the ground, and creating a serious fire hazard.

60 The information in this box is drawn mainly from the reports from a study tour funded by a Gottstein Fellowship, undertaken by Andrew Lang of Lismore, Chairman of the SMART timbers cooperative in western Victoria.

France[61]

"nature abandoned by the farmer becomes nature in mourning" — President Georges Pompidou, 1971

While people in the Anglosphere (Australia, North America and the United Kingdom) get ever fatter, and agonise about how we might re-connect our farming systems with our food systems, the French affect bemused detachment, satisfied that their cuisine is the best in the world, their rural landscapes the most beautiful, and their physiques more slender and healthy than *les gros Anglo-Saxons*…

I spent almost two years in southern France in 1993-5 studying the social drivers of French agricultural and environmental policies, and I was struck even then by how intimately the French associate their food with its origins, and how puzzled they were that other countries could even question agricultural support measures. I revisited the area in June 2007 and was struck by how little things had changed over the intervening fourteen years. This section draws on both experiences.

Le Causse Méjan is an elevated calcareous plateau of 35,000 hectares, about 1000 metres above sea level in the south of the Massif Centrale of France, just north of the famous new bridge at Millau. It has the lowest population density in France (1.4 person/km2) and in 1994 had 58 farms (compared with 62 in 1970). It is remote, having enjoyed the connection of electricity, the reticulation of water, the arrival of the telephone and the sealing of its roads, only in the last 20 years. The temperature can drop to 30 degrees below zero in winter, and the plateau can be cut-off from traffic from the outside world for weeks during extended cold snaps, much as it used to be all winter before roads were sealed.

Sheep have been farmed on Le Causse Méjan for more than a thousand years. For the vast majority of this time, the only external inputs have been sunlight and rainfall. Farming systems are traditionally (and still typically) diverse, with a flock of milking ewes as well as a sheep meat breeding operation, cows for milking, and pigs, chooks, ducks, geese, rabbits and vegetables for eating. Just under 10 percent of the plateau is arable, and this has traditionally been farmed for hay and cereal crops. There is no timber on the plateau, just limitless stone.

The traditional buildings seem to have grown from the earth itself, with stone walls about 1.4 metres thick at the base, vaulted ceilings and stone roofs. Farm buildings are typically nestled into the side of a hill, with three storeys. It is only in recent decades that people on the plateau do not share their dwelling with their stock. In the past, during the cold months, animals would be kept inside on the ground level, humans would live in the middle, and the granary/hay shed would fill the top level, thus insulating the humans between the musty warmth of their animals and closely stacked hay and grain. To this day, in the warmer months sheep are watched by shepherds as they graze native pastures of rosemary, lavender and other local herbs, coming in to be milked in the evenings, staying inside overnight until after their morning milking. The need to 'make hay while the sun shines' is intense, as winters are long and severe, and every square metre of arable land is needed to provide enough food for the winter.

The main changes to farming systems in recent years have seen the introduction of fertilisers and more productive crop and

[61] This section draws heavily on Campbell (2000) *Contrasting perspectives – young countries in old landscapes and old countries in young landscapes* The paper was presented at the 1999 *Future Landscapes* Fenner Conference on the Environment in Canberra. http://www.triplehelix.com.au/index.html

pasture varieties, the modernisation of milking systems, increases in flock sizes and occasionally purchase of stock feeds from outside the plateau, something inconceivable 20 or 30 years ago. However, with a carrying capacity averaging one sheep per hectare, the Causse has always been, and always will be, marginal grazing country. Maximising production has never been a dominant theme for agriculture on the Causse, compared with more favoured regions.

Yet Le Causse Méjan has defied the dominant trend of rural decline in similarly marginal areas of rural France over the last forty years. The real revolution on the Causse Méjan has been the rapid evolution of agriculture-based tourism, associated with local processing and value-adding for traditional farm produce, development of regional branding and a marketable identity for the Causse and its food products, targeted to key niches and direct contact with consumers, on-farm and through dedicated outlets in Paris.

The **Parc National des Cevennes** (established in 1972, the first National Park in France) covers a significant portion of the plateau. Most of the National Park is on private land. The Park provides walking tracks and interpretive facilities for hikers, cyclists and motorists. It defines the sheep farmer as its key endangered species, as sheep grazing is crucial to maintain the floristic diversity of the pastures. The open 'steppique' landscapes which characterise the plateau, attract the nature lovers and are crucial nesting sites for migratory bird species. When a farm is abandoned (*'desertification'*) and sheep disappear, shrubs reinvade, the landscape closes up and nesting sites are gone.

This scenario was lamented by President Pompidou in 1971 (Deverre 1995) in a peculiarly French perspective: *"nature abandoned by the farmer becomes nature in mourning".*

The Park is also preoccupied with the extraordinary built heritage of the plateau. Farmers receive generous subsidies to maintain their old buildings in the traditional way. Most regard this as a nuisance, as the old doorways are too low and narrow to take front-end loaders and other modern equipment, the stone is heavy and maintenance tedious compared with new concrete sheds with smooth concrete floors and tin roofs. Farmers may be allowed to build a new shed, but the Park authorities advise on the siting, orientation, colour and roofing materials of the new building to minimise negative visual impacts, and they may still insist on maintaining the old buildings. Many farmers resent being 'forced to remain primitive' in the interests of an externally defined aesthetic.

When the Park, in an attempt to recognise explicitly the role that traditional grazing practices play in reproducing the landscape which visitors find so attractive (especially urban French in search of *la France profonde*), introduced a new form of assistance for farmers under the title *'Jardiniers du Paysage'* (gardeners of the countryside), some farmers responded by setting fire to a government pine plantation. They deeply resent being seen by government as 'gardeners', and have an entrenched self-image as sheep farmers, a self-image often at odds with their main sources of income.

The strategies employed to maintain farm and community viability on the Causse have not all been reactive. A late 1970s-early 80s combination of an enlightened Mayor, an energetic agricultural extension officer and a cohort of young farming couples open to new ideas, developed a coherent vision of what the Causse had to offer and what it could become. They knew they could not compete in production terms with more fertile regions closer to markets. They knew they had to capitalise on their low inputs, their unique products such as the famous Rocquefort blue sheep cheese, the hearty soups, casseroles and tender roasts of herb-fed mutton, their open space, pure spring water, tranquillity, vast empty landscapes and crystal clear star-studded skies, the sheep bells tinkling across the plateau and the tranquil images of the shepherd tending the flock — in short, something closer to the 'eternal pastoral symphony' more usually attributed to rural England (Deverre 1995).

This vision was designed to, and did, appeal to urban (Parisian) elites. At one stage L'Association Méjan, the community-based organisation initiated by a handful of families, had enrolled several hundred influential Parisiens to prevent developments on the Causse (a Swiss resort hotel complete with golf courses, airport and swimming pool) which did not accord with their vision. They did eventually allow an airport, but only for gliders so as not to disturb the grazing sheep…. A complex array of subsidies, mostly French but with some imaginative local interpretations of EU-derived measures, evolved to support the distinctive Caussenard system.

It is easy to understand the attraction of the Causse and its traditional farming systems for the political

elites of Paris. Apart from appreciating traditional foods and recipes, images of the peasant farmer occupy a special place in French history, as noted by Deverre (1995): *"Peasants were, to put it simply, the cement of the nation, from the time of Napoleon to the First World War, and beyond to Petain."*

From a sustainability perspective, the agricultural policy context in France is much more complex than the stereotypical images of militant farmers holding a sentimental and gullible public to ransom to protect their inefficient farms and rustic lifestyles. I counted 52 different types of support schemes (distinct from direct price support mechanisms which have been virtually eliminated), including: low-cost loans, start-up grants and specialist technical support linked through cross-compliance to farm business management training, to target and assist young people to get established on farms; and similar schemes to help older people who have left the land to find another pursuit; schemes encouraging diversification, value-adding, regional brand identification and niche marketing; mechanisms to facilitate collective management of resources such as expensive equipment and local processing facilities; and schemes based on environmental concerns.

Deverre (1995) notes two main classes of agriculture-induced land degradation in France: those caused by activities such as pollution by nitrates and pesticides, soil erosion, and damage to sensitive habitats; and those caused by inactivity — the abandonment of agriculture and livestock farming causing landslides, fires, declining floral diversity of pastures, and woody shrub invasion.

As an aside, it was fascinating for me as an outsider in Europe during three years of intense debate on the Common Agricultural Policy, to observe how differently the same measures emerging from Brussels were interpreted and applied in different countries. For example, for the purposes of working out how to apply Article 19, the agro-environmental measures, Britain developed measures for England, Scotland and Wales, whereas France interpreted these measures at the level of the Département, of which there are 94 in France — enabling much more fine-grained responses to local circumstances.

While the reality is more complex and nuanced, I remain attracted to the caricature of Deverre (1995), who notes, tongue in cheek: *"the agro-environmental approach was imposed on France by its European neighbours, or at least the more powerful of them: for example, the British (a nation of keen landscape gardeners and birdwatchers); the Germans, reacting to the early electoral success of the Greens and shocked by the destruction of their forests by acid rain; and the Dutch, drowning in a tide of unwanted animal slurry."*

Despite what appears to be a success story in the struggle against rural decline, almost one-third of the farms remaining on the Causse Méjan have no obvious successor, subsidies typically represent 65-80% of farm turnover, increasing tourism and ecological pressures (shrub encroachment) threaten agriculture as currently practised, and the younger generation on farms does not seem to exhibit the same solidarity or shared collective vision of their parents. There remains a diverse range of perspectives on what a more sustainable agriculture, or rural landscape, might look like on the Causse Méjan, both within the farming community, and between farmers and other sectors. Not all the younger generation are enthused about what they see as an emerging role as extras in a great agrarian theme park, subsidised by society to keep their production systems in a time warp. Not all farmers have the people skills to adapt to tourism-based enterprises. Some of them seem to prefer empty landscapes such as the Causse because they don't like crowds, especially traipsing across their land or camping in their fields. Others see that their only hope of maintaining a satisfactory lifestyle in their own region is to adapt to societal preferences by producing an internally-coherent suite of products embracing landscape, cuisine, built heritage, accommodation and leisure activities (Bessiere 1995).

This is consistent with a broader phenomenon across western Europe that has seen perceptions of the countryside change from a simple locus of production of raw food and fibre, to a more complex arena of consumption — of lifestyles, landscapes and leisure experiences (Marsden et al 1993).

Neil Barr (2005) suggests that a similar process has been underway in Victoria for some years. We have decried the European notion of 'multifunctionality', but we have much to learn from it, and we have been doing it by default in any case, especially in peri-urban areas..

4.3 United States of America

"We're borrowing money from China to buy oil from the Persian Gulf to burn it in ways that destroy the planet. Every bit of that's got to change."[62]

Le Causse Méjan might as well be on another planet from the perspective of the vast corn and soybean fields of the American Mid-West, the massive feedlot operations of the south or the sophisticated, irrigated, vertically integrated fruit and vegetable operations of California. There could be few western countries further apart in their attitude to food than the Americans and the French.

> *"What nutritionism sees when it looks at the French paradox*[63] *is a lot of slender French people eating gobs of saturated fat washed down with wine. What it fails to see is a people with a completely different relationship to food than we have. Nutritionists pay far more attention to the chemistry of food than to the sociology or ecology of eating. All their studies of the benefits of red wine or foie gras overlook the fact that the French eat very differently than we do. They seldom snack, and they eat most of their meals shared with other people. They eat small portions and don't come back for seconds. And they spend considerably more time eating than we do. Taken together, these habits contribute to a food culture in which the French consume fewer calories than we do, yet manage to enjoy them far more."*[64]

As in many aspects of human endeavour, in the United States of America you can find the most grossly disturbing and depressing examples of problems with food and farming systems in the modern world, and if you look a little deeper you can also find the most inspiring glimpses of innovation and new possibilities — not to mention the writings of Aldo Leopold, Wendell Berry, Wes Jackson, Jim Hightower, Barbara Kingsolver and Michael Pollan.

Michael Pollan, in a series of remarkable best-selling books[65] has perhaps done more than anyone since Rachel Carson to bell the cat about problems with the modern industrial agri-food system and the so-called Western diet (and consequently the so-called Western diseases of obesity, diabetes, cardio-vascular diseases and cancer) to which it is inextricably linked. In 1960, Americans spent 17.5% of their income on food, and 5.2% of national income on healthcare. These figures have now flipped, as expenditure on food has dropped to 9.9% and spending on healthcare has tripled to 16% (Pollan 2008). Pollan posits that by spending a little more on healthier food, Americans might save on healthcare. Food has become cheaper, but not evenly. Since 1980, the price of sweeteners and added fats (mostly from subsidised corn and soybeans) has dropped by 20%, but the price of fresh fruit and vegetables has risen by 40%. Helped by subsidies designed to keep food cheap, American farmers produced 600 more calories per person per day in 2000 than they did in 1980, and Americans consume 300 more calories each day than they did in 1980 — mostly of the cheaper, less healthy kind (Pollan 2008). Pollan argues that western food science has reduced food to nutrients (nutritionism), and replaced common sense with confusion.

US AGRICULTURAL SUBSIDIES over US$1 billion 1985-2002	
1. Corn	34,552,627,460
2. Wheat	17,247,966,489
3. Conservation Reserve Program	13,018,173,430
4. Soybean	10,967,530,537
5. Cotton	10,663,566,847
6. Rice	7,795,799,116
7. Sorghum	3,193,985,171
8. Livestock	2,256,567,708
9. Dairy	2,018,407,457
10. Barley	1,411,386,147
11. Peanuts	1,265,735,609
TOTAL	104,391,745,971

Pollan, Professor of Journalism at UC Berkeley and a scholarly social historian, joins the dots in exquisite detail between soil and our treatment of it, plants and our relationship with them through human history, American farming practices, the agri-industrial food system, farm policy, American diets and eating practices, and the health (or lack of it) of Americans. He does so patiently and with a journalist's curiosity to ask and explain why things are as they are, when the outcomes appear to be so counter-productive for the long-term good of the country, its farmers and its people.

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62 Former Vice President and Nobel Peace Prize winner Al Gore sums up his perspective on the current US approach.

63 The French Paradox is a term coined by American nutritionists *"who can't fathom how a people who enjoy their food as much as the French do, and blithely eat so many nutrients deemed toxic by nutritionists, could have substantially lower rates of heat disease than we do on our elaborately engineered low-fat diets."* Pollan (2008:9)

64 Michael Pollan 2008 (p182-3).

65 *Second Nature: a gardener's education* (Grove Press, New York 1991); *The Botany of Desire: a plant's eye view of the world* (Random House, New York 2001); *The Omnivore's Dilemma* (The Penguin Press, New York 2006); and *In Defense of Food: an eater's manifesto* (The Penguin Press, New York 2008).

Pollan is not starry-eyed about organic or other forms of alternative agriculture, pointing out that what he calls 'Big Organic' now mimics many of the corporatised characteristics of the food system that organic agriculture in the 1960s and 70s was a response to, and in many cases has substituted oil or cheap labour for synthetic fertilisers and pesticides, with only marginally better energy and carbon efficiency than high artificial input systems. Organic food in the US is often sourced from China or Latin America, and can be far from fresh by the time it hits an American plate. Nevertheless, Pollan finds that – for those people unable to grow their own food – the best of organic farming, combined with short food chains such as farmer's markets, offers the best combination of healthy foods from sustainable production systems.

BOX 4.3

YOU DON'T NEED OIL[66]

Have you grasped it? Resistance to this idea is ingrained, and you may involuntarily mumble in disagreement, but try to fight through that. That's the addiction talking. Trust me: the idea that "we need oil" has been inculcated into the deepest fibers of your brain by decades upon decades of relentless GM and Exxon advertising.

True, we do need liquid fuels for certain mission-critical applications, but that is a small portion of total usage, and can be substituted with alternatives such as electricity (electric scooters/cars/rail), nuclear power and biofuels. The vast majority of liquid fuel is being used in optional lifestyle bullshit, like suburban living and massive traffic jams. See Alan Drake's detailed plans for a non-oil transportation system in the U.S. **here** and **here**. That will help you visualize the world without oil.

But oil's at $100, what should we do?
Wise up, and stop using. Oil prices are like a big truck coming down the street. Get out of the way. There's a whole range of solutions. **Carpool**. Ride the bus. Move closer to your job. Buy a scooter. Buy an electric bicycle. Telecommute. Walk. Ride your bike. Get a space heater. Buy a faggy-assed little electric car, like the **Takeoka Milieu**.

But, but, but...
Yeah, I know. This is where all the excuses start, and folks resort to feeble stuff like: "Car pooling won't work in America" or "There aren't enough scooters" or "Fat people can't ride bikes" or "People would laugh at me if I did that" or "I can't walk because there's no sidewalk" etc. etc. It's quite sad, really, how the doomer position collapses into this kind of piffle at its foundations.

Michael Pollan's (2008) manifesto is very simple: eat food; not too much; mostly plants; and don't eat anything your great-grandmother would not recognise. This is unpacked further in Appendix E.

[67]

[66] From the entertaining and provocative **http://peakoildebunked.blogspot.com/**

In the US, a project was recently initiated by the **Prevention Institute** that advocates a "big tent" cross-sector collaboration approach to an integrated agrifood and health strategy. The objective of the Cultivating Common Ground project is to create a synergistic movement between the health sector and sustainable agriculture, and to build momentum for the development of a just, sustainable health-promoting food system. In particular, the project is looking at how to engage health professionals as advocates for sustainable agriculture. It proposes the development of a leadership group of broad thinkers from the sustainable agriculture, health, environment, and social justice fields.

Such a group might be a good starting point for greater collaboration across the Victorian food, farming and health systems.

BOX 4.4

Is farming becoming trendy (again)?[68]

When Tamara Hicks went to post her "Goat Milker Wanted – $10/hr" ad on San Francisco's **Craigslist** in January, she wasn't sure where to file it. Unsurprisingly, "Agriculture" isn't a job category on the site. With only 1% of Americans still in the business nationally, even the Census doesn't count "Farmer" as a job anymore. So Hicks decided on "General Labor," and settled in for the long, slow wait for someone willing to drive 20 miles out of Petaluma for a part-time shift mucking stalls and milking goats, at a salary that would barely cover the gas to get there.

Then something went terribly right. *"Within five minutes of that posting going up, the responses were pouring in. And they kept coming for weeks. I got 300 applicants,"* says Hicks.

She could have pulled the ad the next day, but she was drawn in by the stories unfolding in her inbox. *"There were the chefs… people who had been in the restaurant business for years, but felt somehow out of touch with food. There were the cubicle people, who made much more than $10 an hour, but were up late at night looking on Craigslist for a way out. And there were the animal people, who had more experience with cats and hamsters than goats. But 95% of the applicants who wrote were really serious. They were trying to make it work."*

… After decades of young people fleeing family farms for big cities, America's rural communities are seeing a resurgence of interest, particularly in the fast-growing world of alternative agriculture: organics, local food, farmers' market fare. According to the USDA, nearly 20% of organic farmers are younger than 35, while fewer than 6% of their conventional counterparts are. And their numbers appear to be growing.

They say that influential trends in the western world often start in California, for good (e.g. removing lead from petrol) and for bad (you name it). So maybe the tale in Box 4.4 above hints at a widening realisation that growing good, healthy food is a vital profession for smart people to be getting into.

4.4 Canada

> *Canada in 2007 faces the same major issues that the OECD[69] identified in 1981: a wealthier population that isn't necessarily getting healthier – in fact increasingly out of shape and even obese – and government ministries working potentially at odds and largely in isolation from one another. Meanwhile, Canada is struggling to improve farm incomes and cope with high and increasing health costs. Solutions must be found; an integrated agrifood and health policy would certainly be one of the measures that could benefit the agriculture industry and the diets and health of Canadian society.*[70]

It has been remarked of Canada that here is a country that could have enjoyed a great blend of French culture, British institutions, and American business acumen, but instead seems to have wound up with American culture, French institutions and British business. Unfortunately for Canadians, this facile pun does seem to have a grain of truth when it comes to food culture, agribusiness and farm policies, where it is afflicted by many of the illnesses of its giant southern neighbour. According to results from

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67 Organic berries at the farmers' market in downtown Santa Barbara, September 2007.

68 From a blog posted on the excellent website of the Slow Food Nation 08 conference, San Francisco, **http://slowfoodnation.org/blog/category/farms/**

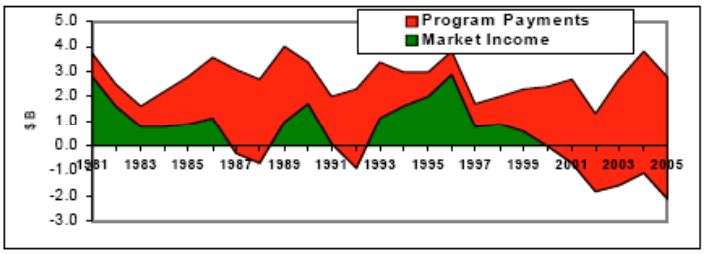
69 In 1981, the Organisation for Economic Co-operation and Development (OECD) published a landmark report (*Food Policy*), which was prescient in observing that by attaining a higher standard of living, developed nations have just as much opportunity to worsen their diet, and thus their health, as improve it.

70 From the Canadian Agri-food Policy Institute, December 2007. Tyrchniewicz and McDonald (2007) **http://www.capi-icpa.ca/pubs.html**

the Canadian Community Health Survey (CCHS) published in 2004, obesity rates among the general population of Canada have increased substantially during the past 25 years. In 1978/79, 3 percent of children aged 2 to 17 were obese. By 2004, 8%, or an estimated 500,000 children, were obese. Among adults, the growth in obesity was even more dramatic. In 1978/79, the age-adjusted adult obesity rate was 14 percent. A quarter century later, 5.5 million people (23% of adults) were obese. Unsurprisingly, these grim statistics are showing up in healthcare expenditure, which is growing significantly faster than GDP in Canada. Between 1975 and 2005, the total expenditure on health care (in real terms) as a percent of GDP increased from 7% to 10.5%. Meanwhile, Canadian health expenditures per capita more than doubled from ~$1,700 to ~$3,600 over the same period, directly linked to the sharp rise in chronic diseases including obesity, type II diabetes and cardio-vascular disease (CVD) (Tyrchniewicz and McDonald 2007).

The blight of ever increasing farm subsidies propping up a sector that is simply not viable at current commodity prices, and the associated social problems of farmers depending on government cheques for their survival, is just as prevalent in Canada as in the US, as the graph below shows.

Figure 4.1 Canadian Net Farm Income and Program Payments 1981-2005[71]

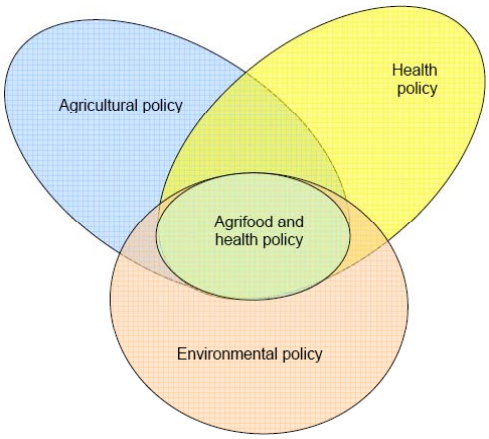


This graph is grim reading for any agricultural policy maker, minister or farm leader. Canadian agriculture has literally been in the red for the entire 21st Century thus far. In a synthesis report for the Canadian Agri-food Policy Institute, Dr Ed Tyrchniewicz and Bruce McDonald (2007) dare to think the unthinkable:

It is risky to generalize that Canadian agriculture is in the mature or declining stage of its life cycle. Yet it would appear that some parts of agriculture, particularly traditional export commodities, clearly are in such a stage. New products and approaches are needed.

Figure 4.2 Conceptual Framework for an Integrated Agri-food and Health Policy[52]

Ed Tyrchniewicz and Bruce McDonald (2007) propose that Canada has an urgent need to develop an integrated policy framework for looking at agriculture, food, health and the environment more holistically — which they call an Integrated Agri-food and Health Policy. The diagram at right depicts how they see such a policy as being at the intersection of agricultural policy, health policy and environment policy.



Tyrchniewicz and McDonald (2007) go on to suggest that such a policy framework must have five key components:

1. **Strategic collaboration:** Meaningful collaboration takes place among the stakeholders in agriculture, food and health — within government, across different levels of government, internationally, and involving industry, health and research organisations and the public. Collaboration goes beyond perfunctory consultative exercises, and includes joint setting of goals and objectives, synergistic research collaboration, as well as ownership of the policy and resource commitments.
2. **Regulatory and economic framework:** A clearly defined set of regulations, guidelines and economic incentives support the objectives of the integrated agrifood and health policy, while

71 From the Canadian Agri-food Policy Institute, December 2007. Tyrchniewicz and McDonald (2007) http://www.capi-icpa.ca/pubs.html

regulations and incentives that serve as barriers to integrated food policy are reduced or eliminated.

3. **Population health and education:** Population health is focused on developing an understanding of the health of individuals and communities, and educating government, politicians, industry, and the public, recognising the win-win potentials of healthier individuals and a healthier population. A population health strategy reduces disparities among individuals and groups and improves the health of all sectors of the population.
4. **Monitoring and evaluation:** Once integrated policies are initiated, an independent body should undertake monitoring and data collection to assess impacts regularly.
5. **Research and innovation:** The policy should be underpinned by strategic and focused multidisciplinary research and knowledge brokering programs aimed at achieving the goals of the policy. Science should also underpin innovative product and technology development.

The Canadians say they are starting from well back in developing a more integrated approach to agriculture, food and health policy, but the framework above would be a good start.

4.5 New Zealand

> *"In a global context New Zealand can be described as being in the business of pampering the palates and passions of the world's more prosperous citizens. We do this through exporting our foods, fibres, wines, films and delivering great visitor experiences in our Gondwanan landscapes. New Zealanders are highly dependent on our natural capital — our waters, soils and biodiversity — for sustaining these wealth-generating capabilities."*[72]

Agriculture and emissions trading

The contribution of agriculture to New Zealand's greenhouse gas emissions profile is unique internationally. Agriculture makes up almost 50 percent of New Zealand's total greenhouse gas (GHG) emissions, compared with about 12% in most developed countries' emissions and 17% in Australia. New Zealand has no choice but to tackle emissions from this sector promptly. Australia can learn a lot from how NZ incorporates agriculture into its emissions trading scheme, as we are currently scheduled to bring agriculture in at least two years after New Zealand has done so.

Agriculture is joining the New Zealand Emissions Trading Scheme (NZETS) on 1 January 2013. The NZ Government intends to provide the agricultural sector with considerable free allocation — an emissions allowance at no cost. The scheme started on 1 January 2008 with forestry. Liquid fossil fuels will come in on 1 January 2009, stationary energy and industrial processes 1 January 2010 and waste along with agriculture on 1 January 2013. This delay recognises that ensuring systems are in place to meaningfully monitor and verify agricultural emissions is difficult, and devising the right solutions will take some time. New Zealand wants to allow time for R&D on reducing methane-related emissions to produce results.

The NZ Government has not reached a final decision on where to place the primary obligations of the emissions trading scheme for agriculture. Its initial preference is for dairy and meat processors and fertiliser companies to be the primary points of obligation, and therefore have responsibility to report emissions and surrender units on behalf of the sector. The NZ Government expects the farming sector to start taking steps towards reducing emissions before 2013, and it will require the sector to monitor and report its emissions as early as 2011. The five-year period before agriculture enters the scheme will also provide opportunities for pilot farm level monitoring and reporting of emissions; increased contribution from the sector towards research into mitigation and adaptation; and roll out of mitigation technology and energy efficiency on farms.

At this stage, the opportunities for NZ farmers to reduce emissions (other than by reducing output) are limited, but they do exist. There is currently greater opportunity to reduce nitrous oxide emissions, such as through the use of nitrogen inhibitors and more effective fertiliser use, which would also

[72] From the preface by Dr Morgan Williams to *Growing for Good: intensive farming, sustainability and New Zealand's environment* (PCE 2004)

reduce impacts on water quality (that are significant — see below). Improvements in productivity will also reduce nitrous oxide and methane per unit of production. For example, the level of emissions per unit of milk solids has been decreasing by around 1.2% a year over recent years. The NZETS will help encourage the development of emissions-reducing technology. The NZETS will also ensure that the cost of carbon is factored into farmers' investment decisions, such as the conversion of land to production systems that result in higher emissions.

The environmental footprint of New Zealand agriculture

New Zealand agriculture also has a significant environmental footprint in other areas (PCE 2004).

> *"the high, and still rising, use of synthetic nitrogen fertiliser appears to be leading to farming systems that are financially and environmentally 'brittle'"*
>
> *"A key trend across dairying, horticulture, sheep and beef, and viticulture is that our natural capital is under intense pressure. In dairying, the number of cows increased by 34% between 1994 and 2002 while the land area used for dairying grew by just 12%. In the sheep and beef sector, increased lambing rates and livestock weights reflect improved animal nutrition through new pasture mixes and increases in fertiliser use.*
>
> *Synthetic fertiliser use across all sectors grew by 21% between 1994 and 2002, while the use of urea fertilisers soared by 160%. There is strong evidence our waterways and lakes are becoming nutrient enriched and degraded from nitrogen, animal faecal matter, and eroded sediment.*
>
> *Many of our key export markets in Europe and Asia will not want products sourced from farms that are polluting the environment."*

Agricultural land use accounts for three quarters of the nitrogen and 46 percent of the phosphorus entering Lake Rotorua (PCE 2006). Agriculture in New Zealand is coming under increasing pressure to 'clean up its act' and better manage the negative externalities associated with intensification of production. The NZETS in time should lead to significant incentives for NZ farmers to become more efficient in their use of nitrogen fertiliser and to look more creatively at production systems that fix their own nitrogen and do not leak nutrients into surface waters and aquifers.

Future foods

New Zealand is doing some interesting work on foods, including food science work that is looking at tailoring New Zealand foods to match people's genes. Nutrigenomics is the study of the response of humans to food and food components using genomics, proteomics and metabolomics approaches. The goal of nutrigenomics is to develop foods that can be matched to individual human genotypes to benefit the health of those individuals and enhance normal physiological processes. Nutrigenomics will lead to the development of new foods for individualised health and nutritional benefit.

Renewable energy

New Zealand has set a target of achieving 90% of its energy from renewable sources by 2025. New Zealand already generates one third of its total energy requirement and two-thirds of its electricity from renewable sources, predominantly hydro-electric and geothermal energy resources, and biomass energy already contributes around 5-6% of total NZ energy production.

The Parliamentary Commissioner for the Environment (PCE 2006b) looked at the potential for more distributed, local energy systems in New Zealand, making some important points:

> *New Zealand's electricity generating system is under pressure as electricity consumption rises each year. But, in local energy systems, there is an alternative to building more big power plants. At the core of these systems are technologies that produce electricity or heat on a small scale, close to where it is used. The advantages of local energy systems include:*
> - *using energy sources, particularly renewable sources, that are not suitable for big generating plants*
> - *raising the overall efficiency and resilience of energy systems by spreading generation throughout the network*
> - *improving energy security by making end-users more self-reliant*
> - *promoting competition and innovation by introducing new technologies into the marketplace*
> - *encouraging regional development by creating jobs for designers, manufacturers, and tradespeople*
> - *raising people's awareness of energy use*

— improving health and reducing 'fuel poverty' by delivering warmer homes at lower running costs.

There is compelling evidence in favour of government intervention to kick-start local energy systems in New Zealand.

These points also apply in Victoria.

4.6 Cuba

Any discussion of the future of food systems in an energy-constrained world would be remiss not to mention Cuba. In terms of resource constraints, it has already experienced shock therapy. Cuban agriculture was forced to go cold turkey on synthetic fertilisers and other external inputs including chemicals and to a large extent, oil. There are many lessons in this experience and the Cuban response.

But the background is important — here is a potted history (from Zepeda 2003 and McKibben 2005).

- From 1492 to 1898, Cuba was a Spanish colony. Both the native Taino people and the forest were annihilated to make way for large cattle and sugar farms in the hands of a few wealthy owners, worked by slaves. In 1895, Jose Marti, poet, journalist and beloved by Cubans as the father of their country, led an uprising against Spain.
- In 1898, the United States entered into the Spanish-American war when the USS Maine mysteriously blew up in Havana harbour. Spain was easily defeated, and Cuba was under US military rule from 1898 to 1902. Over the next few decades, US businesses and individuals acquired some of the best land, and US marines were stationed in Cuba to protect US interests. Sugar production increased at the expense of food production, causing greater reliance on food imports. Wealth was concentrated, and the vast majority of Cubans continued to live in poverty without access to land.
- On December 31, 1958, the Batista government was overthrown, and a socialist government took power. The expropriation of US property in Cuba led to a US policy of isolation. By 1960, the isolationist policies caused Fidel Castro to become 'an accidental communist' and turn to the Soviet Bloc. By 1962, Cuba effectively was a Soviet satellite. Cuban agricultural policies followed the Soviet model—large monolithic state farms were highly mechanised and heavily reliant on chemical fertilisers and pesticides. Cuban agriculture used more fertiliser and nearly as many tractors per hectare as the United States. The USSR subsidised this industrial model by trading its oil, chemicals, and machinery for Cuban sugar at preferential rates.
- The Berlin Wall fell in 1989. Almost overnight, US$6 billion in Soviet subsidies to Cuba disappeared. At the same time, the US trade embargo tightened, and Cuba was plunged into an economic crisis. GDP shrank by 25% between 1989 and 1991. Cuba entered what is euphemistically called the Special Period. Oil imports fell by 50%; the availability of fertilisers and pesticides fell by 70%; food and other imports fell by 50%; and most devastatingly, food intake fell from 3000 calories per person per day to 1900.
- Further exacerbating the economic crisis, in 1992 the United States passed the Cuban Democracy Act, which prohibited assistance to Cuba in the form of food, medicine, and medical supplies. The US trade embargo was further strengthened in 1996.

In the words of Bill McKibben (2005):

"With the sudden collapse of the Soviet Union, Cuba fell off a cliff of its own. ... Cuba became an island. Not just a real island, surrounded by water, but something much rarer: an island outside the international economic system, a moon base whose supply ships had suddenly stopped coming."

In a richly descriptive article in *Harper's Magazine*, McKibben traces how the Cubans picked up the pieces from the bottom of that cliff, and gradually worked out how to feed themselves again, with greatly reduced access to external energy and nutrient resources. Here's how they did it.

Radical reforms were built on five basic principles:

- Focus on **agroecological technology**, supported by the state/university research, education and extension system. There had been researchers, outreach specialists, and faculty devoted

to agroecology before the crisis. The crisis not only brought them to the forefront, but universities, research centres, and agricultural policies were reoriented to make agroecology the dominant paradigm.

- **Land reform**; state farms were transformed to cooperatives or broken into smaller private units, and anyone wishing to farm could do so rent free — in effect, a right-to-farm policy.
- **Fair prices to farmers**. Farmers can sell their excess production at farmers' markets; average incomes of farmers are three times that of other workers in Cuba.
- **E**mphasis on **local production** in order to reduce transportation (and hence energy) costs. Urban agriculture, a key to this reform, produces nearly the recommended daily allowance of 300 grams per person of produce.
- F**armer-to-farmer training** as the backbone of the extension system.

The results were startling. Production of tubers and plantains tripled and vegetable production quadrupled between 1994 and 1999, while bean production increased by 60% and citrus by 110%. Potato production went up by 75%, and cereals by 83% between 1994 and 1998. Calorie intake rose to 2,580 per capita per day—just under the minimum recommended by the World Health Organisation.

The conversion of Cuba's agriculture to more sustainable practices has focused on urban agriculture and domestic crops. Indeed, these practices seem to free up scarce chemicals for the traditional export crop, sugar. Sugar continues to be produced in monoculture, but increasing amounts of organic sugar are being produced for export. Urban agricultural production climbed from negligible in 1994 to more than 600,000 tonnes in 2000. There are more than 200,000 urban farm plots ranging in size from a few metres to a hectare. Production practices rely on organic matter, vermiculture, raised beds, crop rotation, companion cropping and biopesticides. Yields range between 6 and 30 kg/m2 (60-300 tonnes/ha) and are predominantly roots, tubers, and vegetables. Agricultural science in Cuban universities plays a critical role, with research underpinning the farmer to farmer extension system.

The reforms have not yielded dramatic results for sugar, meat, or dairy, nor for traditional import crops (rice and beans). Cuba continues to rely on food imports, as it has since it was colonised — including rice, beans, milk products, feed grains, soybeans, chicken, pork, cooking oil, soybean meal and malt. Because of the US embargo, Cuba has to buy these products from distant countries, adding 30% to the cost of food imports.

Bill McKibben (2005) asks the obvious question:
"Does the Cuban experiment mean anything for the rest of the world? An agronomist would call the country's farming "low-input," the reverse of the Green Revolution model, with its reliance on irrigation, oil, and chemistry. If we're running out of water in lots of places... and if the oil and natural gas used to make fertilizer and run our megafarms are changing the climate (or running out), and if the pesticides are poisoning farmers and killing other organisms, and if everything at the Stop & Shop has traveled across a continent to get there and tastes pretty much like crap, might there be some real future for low-input farming for the rest of us? Or are its yields simply too low? Would we all starve without the supermarket and the corporate farm?

Then McKibben adds a cautionary note:
...the island's success may not carry any larger lesson. Cuban agriculture isn't economically competitive with industrial farming... mostly because it is highly labor-intensive. Moreover, Cuba is a one-party police state filled with political prisons, which may have some slight effect on its ability to mobilize its people—in any case, hardly an "advantage" one would want to emulate elsewhere.

and finally concludes that the answer might lie somewhere between the Cuban solution and conventional industrial agriculture as practised in the US:
...Not everyone is happy with the set of possibilities that the multinational corporate world provides. People are beginning to feel around for other choices. The world isn't going to look like Cuba—Cuba won't look like Cuba once Cubans have some say in the matter. But it may not necessarily look like Nebraska either."[73]

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[73] Bill McKibben, "The Cuba Diet: What will you be eating when the Revolution comes?" *Harper's Magazine*, April 2005
http://www.harpers.org/archive/2005/04/0080501

Chapter 5. Exploring Scenarios for the Victorian food & farming system

"The most important failure was one of imagination."[74]

"While we're talking; envious time is fleeing: seize the day, put no trust in the future."[75]

5.1 There are no facts about the future

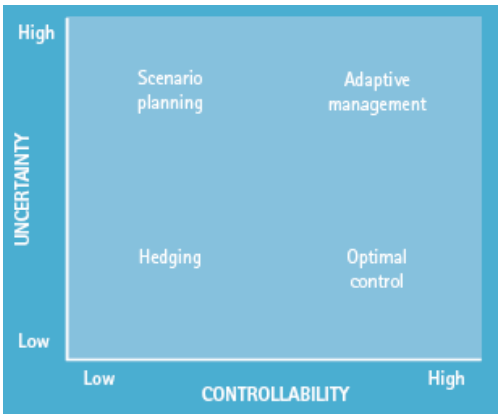
In contemplating the future, we are in a mental dance between fate and desire.

We know that 'what's coming at us' will generate all sorts of possibilities and constraints that will have a major shaping influence. For Victorian agriculture, such macro forces include the drivers discussed in Section 3 above, and the basket of forces and trends that are captured under globalisation; including market forces and the progress of technology. For the purposes of this discussion, we can assume that we have no control over what is coming at us. Such shapers are certainly within our domain of concern, but well outside the domain of influence for most of us.

Irrespective of the tide of events over which we have no control, we still have choices. Our domain of influence may be smaller than our domain of concern, but it exists. Any discussion of possible futures cannot discount human agency, as Phillip Adams notes: [76]

"The future is not some place we are going but one we are creating. The paths to it are made, not found."

A starting point for envisaging possible futures might be to extrapolate current trends and to explore the implications should we continue on our current trajectory. This can be an intellectually stimulating exercise, provided one accepts that the future is most unlikely to be an extrapolation from the present. Progress is riven with discontinuities, more likely to be characterised by sudden breaks with the past and by highly differentiated responses, than by linear development through time and space. Leaps of imagination (such as in the best science fiction) are as likely to be accurate as careful calculation when it comes to envisaging the future.



Futures thinking is most useful when we are uncertain about what could happen and we have little control over what does happen, as in the diagram at right (from Cork et al 2004), which illustrates different types of planning approaches for various combinations of uncertainty and control. Futures thinking uses a range of techniques (including foresighting and scenario planning) that harness the power of experience and imagination to explore possible futures are and what we might need to do to prepare ourselves (Cork et al 2004). It is potentially useful in teasing out assumptions and identifying key uncertainties that, depending how they eventuate, could cause fundamental transformations. Being aware of such factors and their drivers can assist in being ready for them and better placed to respond to them.

One of the most common forms of futures thinking is scenario planning. This planning tool has been applied very successfully in the corporate sector since the 1960s[77] and is very useful as a component of a strategic planning process (Campbell and Schofield 2007). It is well-suited to involving groups of people in exploring ideas about the future interactively. Group brainstorming can spark ideas, expose

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74 US Independent Commission into the September 11 terror attacks, cited in Cork et al (2004)

75 Horace (Quintus Horatius Flaccus 65-8 BC) *Odes* book 1, no 11, 1.7

76 Phillip Adams, writing in *The Australian*, cited in Campbell (1994).

77 Cork et al (2004) list firms including Shell, Duke Energy, Electricité de France, BHP Billiton, Telstra, Alcatel, Vodafone, British Telecom, IBM, British Aerospace, Federal Express, Levi-Strauss, Insurance Australia Group and CSC Australia that have successfully used futures approaches to 'steal a lead on their competitors'.

untested assumptions and help an organisation, industry or community to think 'outside the box' in structured ways that open up new possibilities. Choices taken now will shape the future of the Victorian food system. Scenario planning can help to shed light on some of those critical choices.

This section briefly reviews some recent scenario planning exercises.

5.2 Scenario analyses

Land & Water Australia

In 2004, in the development of a new Strategic R&D Plan for the 2005-10 period, Land & Water Australia (LWA) undertook a scenario planning exercise to explore more widely the factors that could impact on its future research funding priorities. One of the key dimensions identified in that process, was that the way in which we think about an issue has a fundamental influence on the types of inputs that we are prepared to consider, and the types of hypotheses or conclusions we are likely to draw. This is represented in the diagram below (from Cork et al 2004). This does not set out four alternative imagined snapshots of the future, as many scenario analyses do. Rather, it identifies four ways of thinking about the future, depending on whether one relies solely on scientific analyses, as opposed to drawing on other ways of knowing, and also on whether one looks at the whole system, as opposed to just parts of the system.

	Parts of systems	Whole systems
All ways of knowing	My Backyard: Focus on specific issues for emotional or philosophical reasons (eg. lobby groups, local or specific interest groups, everyone falls into this quadrant on some issues)	'Country': Thinking about whole systems from a range of philosophical viewpoints (eg. Gaian philosophies, the perception of sustainability in the minds of many non-scientists)
Science way of knowing	Hothouse: Focus on the most important individual issues from a scientific point of view (eg. scientific research organisations have most of their activity here for practical and career reasons)	Botanic Garden: Thinking about whole systems from a scientific perspective (eg. multi-disciplinary, ecosystem scale scientific research)

In exploring the future of the Victorian food system, it is tempting to break the system down into its constituent parts, then to apply traditional scientific approaches to try to understand each part in turn. The difficulty with that approach — apart from the obvious point that imagination is more useful than reductionism in thinking about the future — is how to put all the component analyses back together again and to make sense of the thing as a whole. Given that so much of the food system is driven by human aspirations and behaviour, lifestyle choices and consumer preferences, it seems fruitful to at least attempt to spend some time in the *Country* quadrant, as well as the other three quadrants, in order to develop a richer picture of possibilities for the Victorian food system.

Business Council of Australia

In 2004 the Business Council of Australia (BCA), to mark its 20th anniversary, published what it claimed to be the most comprehensive scenario project ever undertaken in Australia, involving eighty prominent and/or expert people from business and other sectors in exploring scenarios for Australia in 2025 (BCA 2004). That project developed three scenarios, called *Riding the Wave*, *Stormy Seas* and *Changing the Crew*.

In *Riding the Wave*, Australia booms from 2005-10, but under-invests in the fundamentals and lacks direction in a time of plenty. A decline in Australia's economic performance and social capital ultimately leads to a re-examination of political structures, with a radical shift to two tiers of government — national and territories — at the 2021 referendum that establishes the Republic of Australia (BCA 2004). In *Stormy Seas*, an initial period of high growth gives way to a sustained decline in Asia Pacific stability and security and a resurgence of terrorism and refugees (a boom in the security industry and the introduction of an ID card), challenging Australia's international and economic relations. In *Changing the Crew*, demographics are the main driver, with a new generation of pioneers creating a sharper-edged Australia, resulting in friction with other generations and a growing gap between rich and poor. The great complementarity of the Australian economy with that of China as it grows, leads to sustained improvements in Australia's terms of trade (BCA 2004).

In developing the scenarios, the BCA project identified what it called 'branching points' — the critical uncertainties, including:

- What is the future of social cohesion and shared values — between generations, and different cultural/ethnic and socio-economic groups?
- How stable is our region?
- How will Australia evolve its political and social systems to adapt and respond to external uncertainties?
- What is the speed and direction of economic growth?
- Does Australia have the capacity to respond to a positive external environment?
- Can tiers of government in Australia work together for the benefit of the nation?
- What is Australia's capacity to build world scale critical mass in scientific and technological innovation?
- How will local environmental issues be handled — are we doing enough to ensure a stable physical base for future growth?

Noting that the main development of the BCA scenario project was in 2003, it is interesting to ponder just five years on, how certain some of their 'givens' really were, and also some of the major factors that seemingly were missed by the 80 CEOs and community leaders involved. The notion of limits to oil availability and rising energy prices hardly rate a mention — the main risk is seen to be under-investment in infrastructure and clumsy regulation. Nor does the possibility of a carbon market, despite proposals for a carbon tax having already been floated at this time. These oversights reflect a general complacency in the document about climate change. Food security is not mentioned once in 120 pages, even in the context of regional problems and increasing conflict and refugee flows, and the only mention of agriculture is the prospect of being out-competed by Brazil in *Riding the Wave*.

Goulburn Broken Irrigation Futures

Clearly the food system was not central in the thinking of business leaders in 2003-4, but it certainly was in the minds of the 120 people from the catchments of the Goulburn and Broken rivers who participated in the 'Irrigation Futures of the Goulburn Broken Catchment' project in 2006-7. This innovative collaboration between a range of regional, state and national organisations, managed by DPI Victoria and the CRC for Irrigation Futures, explored the future of irrigated agriculture in the Goulburn Broken region (Robertson et al 2007).

The Goulburn Broken Catchment is probably Australia's best-known food bowl, with brands like Ardmona, SPC and Devondale closely associated with the region. It covers 2.4 million hectares and has a population of around 200,000 people (DSE 2005). Irrigated agriculture is a major business engine in the region, producing more than $1.6 billion at the farm gate in 2004-05 from about 280,000 hectares of irrigated agricultural land. Investment in on-farm and processing infrastructure is about $100 million per year (Young 2001). This region, largely on the back of irrigation, is a major contributor to the state and national economy.

However the outlook for irrigation in the Goulburn Broken region is far from certain. Free-trade agreements, climate change, water reform and technological developments will have a significant influence. As one of the oldest gravity irrigation systems in Australia [Dethridge water meter on open earthen channel in photo at left], Goulburn-Murray Water's irrigation system needs substantial renewal of its ageing infrastructure in the next 20 years — which the Food Bowl Modernisation project is tackling. The way these and other factors play out will affect the region's economy, environment and social fabric.

Against this backdrop, 120 people from the region in 2006-7 developed and explored four scenarios: *Moving On*; *New Frontiers*; *Pendulum*; and *Drying Up* (Robertson et al 2007).

- ***Moving On*** envisages a continually drying climate, many rural towns are in terminal decline and radical increases in water prices as the privatised water companies seek to reinvest in infrastructure and to provide a decent return to their investors. Many irrigators leave the industry, but those remaining are efficient and make good use of new technologies while minimising environmental impacts.
- ***New Frontiers*** sees the region, to use Neil Barr's (2005) model, transition from an agricultural production landscape to an amenity landscape, with a much higher proportion of lifestyle landholders and widespread telecommuting. These newcomers are politically powerful and their lifestyle preferences see increasing environmental regulation and use of water for environmental flows.
- ***Pendulum*** sees Green parties with the balance of power at state and federal levels in the 2005-20 period, and ratification of the Kyoto Protocol and other international agreements leading to trade in carbon and other environmental services. After 2020, a conservative federal government, concerned with reinvigorating regional economies, assumes control over water and reallocates water from the environmental reserve, auctioning entitlements on the open market. With a return to wetter conditions, agriculture within the region goes through a renaissance, ecosystems recover and the region regains prosperity.
- ***Drying Up*** envisages a major recession in the USA during the 2005-12 period, causing the US dollar to drop and making US agricultural products increasingly competitive, encroaching on traditional Australian markets. Horticultural industries focus on high quality fresh fruit for the domestic market, while the dairy industry attempts to capitalise on markets for value-added products, such as nutriceuticals. Post-2020, the global economy recovers, many Asian and South American countries become more affluent, and the World Trade Organisation (WTO) removes agricultural subsidies. International and domestic consumers increasingly demand food with credence values, particularly those offering health benefits and GM-free.

It is interesting that — in three out of four of their scenarios — the 120 interested community, industry and agency representatives in the Goulburn Broken region in 2006-7 envisaged a return to wetter conditions (and higher water use) after an initial extended drought. Only in *New Frontiers* is the drying trend of the 2005-20 period sustained. Whether this reflects wishful thinking, or a belief that the current story is one of decadal variability rather than a permanent step-shift in climate, it was inconsistent with the weight of scientific opinion then, and certainly is now (I think it may have been Mark Twain who said *"de Nile aint just a river in Egypt…"*). Again, the impact of rising energy prices is not given much weight and the prospect of markets for carbon is also barely mentioned. The key branching points, to use the BCA term, include the operation of world markets, the attitude of consumers (and governments) to genetically modified foods, the degree of investment in infrastructure and the way in which water is allocated. Some events envisaged well into the future — the federal government takeover of water, importing guest workers to pick fruit and the removal of the barrages at the bottom of the system — have either occurred already or seem imminent.

In their introduction, Robertson et al (2007) make the critical point that these scenarios highlight the enormous range of possible development trajectories for the Goulburn Broken region, with some marked differences in the demands on the irrigation system and hence its infrastructure. They note that this has big implications for the way in which the necessary refurbishment and modernisation of the region's irrigation infrastructure is carried out, and suggest that flexibility should be a key design criterion in developing any new system, so that components of the system can be closed down if necessary, or their introduction delayed according to demand and water availability.

It will be crucial that the Food Bowl Modernisation project anticipates future farming, irrigation and land use systems, rather than just retrofitting the status quo. A similar point was made by the late Peter Cullen, succinct as ever: *"we should not concrete in the mistakes of the past"*.

Victorian Catchment Management Council vision for 2025

The Goulburn Broken scenarios are typical of the sorts of images of future conditions that emerge from discussions involving many people over several months. The pictures that emerge contain lots of elements, not all of which appear to be coherent within that scenario, and can seem a bit messy and confusing, especially to someone reading them who did not participate in their development. Reality is often messy and not as coherent as we would like, with discordant elements and opposing forces and trends, so this is not necessarily a problem. The important point is that the critical assumptions, uncertainties and decision points are drawn out, and alternative futures discussed, in ways that help people to think about them, and to respond to them should they eventuate.

Another form of futures thinking is to develop a vision statement about a preferred future, and then to work systematically backwards from that preferred future to identify the steps that would need to be put in place for the vision to be realised. A good example of such a vision statement was developed by the Victorian Catchment Management Council, in its 2007 Catchment Condition Report (VCMC 2007), as set out in the Box below.

In 2025, the State is covered with a mosaic of land uses that match capability. The mosaic includes a mix of intensive agriculture and land formerly used for farming instead producing ecosystem services, supporting rural lifestyles and nature conservation. Intensive agriculture is thriving in efficient closed systems at targeted, specially planned sites around the State. Sustainable agriculture is servicing primarily local and national needs, as well as demands for produce in international markets, particularly Asia. There is very little notion of waste in industry, with the waste from one industry feeding the resource needs of another.

The continued urbanisation of the State has led to an increasing recognition that there is a credible threat to ecosystems and the services they supply. Urban and peri-urban communities recognise the impact of consumer preferences and are paying to protect identified environmental assets. This manifests itself in payment to rural Victorians for supplying life-sustaining ecosystem services. The provision of ecosystem services by rural landholders is now a major land use across the State. It is the newest form of sustainable primary production, underpinning Victoria's social and economic health.

By 2025 the mosaic landscape accommodates 40% coverage of native vegetation in healthy condition across the State. The 20-year strategy has targeted ecosystem and native biodiversity asset protection and restoration works across all asset types, such as waterways, floodplains, grasslands and woodlands, and in key areas that presented the best opportunity to rebuild our rural landscapes. At first, the focus was to protect the best remaining ecosystems. Over the past decade we have been able to broaden the rehabilitation efforts to other more modified areas of the landscape.

Research and new technologies have evolved new agricultural industries based on natural systems, ones which are adapted to low water, nutrient and energy inputs and that complement more traditional, high value environmentally and economically sustainable agricultural pursuits.

The mosaic also includes large amenity and lifestyle areas. Typified by residents with off-farm income, these new landscapes also incorporate ecosystem service provision and nature conservation at a smaller scale. The quest for knowledge and technical innovation has driven many to provide technology-related services and information to surrounding regional centres and communities. The growth in ecosystem services, establishing a real price for these services, is a boon for those with a traditional agricultural history in land management. On-going rehabilitation and management services are in high demand, providing a range of employment and service opportunities.

Similarly, the amenity and ecosystem services dominated landscapes are attracting a variety of interstate, international and (importantly) intrastate urban people for relaxation and recreation. There is a proliferation of farm stay businesses, bed and breakfast and ecotourism providers across the State. Key sections of the State are presented as 'wild' landscapes for tourism. Victoria, with its relatively small area and diversity of climate and topography, offers tourists an enormous range of ecosystems in a compact area.

Landscape management decisions are supported by a vast, improved and accessible knowledge base. Consequently, our approach is more balanced with more intelligent emphasis on good science and accurate information. Information about ecological processes is as important as information about resource condition. Land and water managers have a high level of appreciation for the values of aquatic ecosystems and there has been a real reduction in the extent and severity of our soil health issues, due to effective land management programs.

New industries have emerged as significant employers to support the innovation and change processes across the landscape.

By 2025, there exists robust climate data to validate 30 years of climate projections. We are in a position to be significantly more confident about future projections. The community's ability to understand and plan for further climate change is greatly enhanced by regionally specific and multi-sectoral projections. Hotter, drier summers and overall reduced rainfall (except in East Gippsland) have led to permanent shifts in water consumption by urban and rural communities and industry and agriculture. Iteration 3 of the successful 'Adaptation to Climate Change' program is being implemented. Funding to plan for and invest in this program, including strategically placed biolinks, is significantly enhanced as a result of greater awareness across Government and the community.

This is one possible context for food production in Victoria.

Possible agricultural futures

This section explores several potential trajectories for Victorian agriculture and food production. The shorthand names for these scenarios are Corporate HiTech; Landscape Stewardship; Back to Earth; and Farming like an Australian. The variables that are mixed in different ways in each scenario include the type and application of new technologies, the prevailing policy and institutional framework at local and national levels, the extent of engagement with world markets, the regional social and economic context, and finally prevailing community attitudes and norms.

These scenarios may imply a coherence and internal consistency that in reality is unlikely to be realised. Different farm businesses are likely to combine different elements of these scenarios in combinations quite different from those suggested here, and the spatial distribution of these across a given region, the state or the continent as a whole is likely to be complex. New technologies that improve resource use efficiency and profitability might be adopted under any of these scenarios, and some of the institutional responses to environmental issues are likely to affect all of them. The use of scenarios in this way is an heuristic device, to enrich the discussion, not a forecasting device.

Corporate HiTech

This scenario sees a predominance of large scale, vertically integrated operations growing various combinations of generic commodities, functional foods and nutriceuticals on contract to multinationals and targeting world markets. They use GM cultivars and farm to very tight specifications, fully certified at all stages of the production chain, with every unit of product DNA-barcoded and traceable at any point from the plate back to the paddock. Such operations make maximum use of automation: applying technologies such as the use of satellites and telemetry to precisely monitor, map and meter inputs; micro-drip sub-surface irrigation and fertigation. Spraying is done at night by robots on satellite-guided controlled-traffic systems. All inputs and outputs (nutrients, sediments, water, energy, carbon) are monitored and accounted for with a high degree of sophistication at all stages, tracked remotely from head offices in capital cities in Australia and overseas. Inputs of water, biocides and nutrients per unit output are at least an order of magnitude less than now. The whole landscape is managed for environmental services, including bioenergy from waste streams, but only profitable soils are farmed.

In this scenario, all inputs and tactical decisions (including trading in water and on futures markets) are closely coupled with fine resolution climate models over short-term, seasonal, annual and decadal cycles. The only surviving simulation models are those that evolved from simple ones based on what decision makers actually did, rather than those based on what scientists thought scientists knew and decision makers should do. Financial institutions make extensive use of such models and have regional staff skilled in their interpretation. They require borrowers to hedge against climate risk.

Landscape Stewardship

This scenario no longer conflates ‘rural’ with ‘agricultural’.

As modern agriculture develops more intensive, industrial and vertically integrated production, there is a complementary trend towards diversification and extensification, where rural landscapes are valued as arenas of consumption (of landscapes, lifestyles and non-urban experiences) as well as, or even rather than, as engines of food, fibre and clean energy production. The central tenet of this scenario is that agricultural and horticultural products are recognised as just some of many outputs from rural landscapes, and are no longer the only ones valorised.

Catchment Management Authorities are responsible for all the environmental services in the catchment, and for delivering environmental services downstream. These CMAs have their rating powers restored and increased, and purchase environmental services from all landholders within the catchment, with payment applying only to that portion of the service that is over and above a clearly articulated duty of care not to degrade the resource base. CMAs receive external revenue from the Commonwealth for the nationally significant services they deliver, and from the market for exports such as clean water and bio-energy.

Under this scenario and the one above, water prices are never less than the full cost of supply

(including a loading for restoration of historical damage and externalities), but in effect competition for the scarce resource will keep water prices way above this statutory floor. Some resources — streams, floodplains, wetlands, critical habitat — are managed as common property resources. Irrigators trade actively in water futures.

All rural subdivisions have body corporate structures accredited by the catchment board to manage water supplies, driveways, underground services, reticulated waste water, fire protection and pest and weed management consistent with the catchment plan. The distinction between hobby farmers and other farmers dissolves as few landholders have an exclusively agricultural income. The majority of farm income is derived off-farm, usually in one of the myriad service industries that have emerged to support rapidly growing regional populations and corporate farms. The old notion that to have an off-farm income somehow implies 'failure' as a farmer has long been supplanted by recognition that, in a highly variable climate, off-farm income from a sector other than agriculture is a highly rational strategy that characterises the best farmers.

In this scenario, environmental goods and services are the biggest sector of the economy derived from rural landscapes in terms of turnover, employment, contribution to GDP (itself superseded by triple bottom line measures) and exports. The environment industries are already bigger than any of the primary industries other than mining. Add in tourism, and non-agricultural products from rural landscapes already exceed agricultural outputs by value. The biggest component (more than half by turnover) of the environment industries is water supply and management, with the rest including renewable energy, waste management and the quest for more sustainable systems in transport, construction, urban design — in fact most sectors of the economy.

Australia has world class science in many of the environment industries and a significant potential competitive advantage on world markets. But we will not capture and exploit these advantages while we continue to see rural landscapes only through agricultural lenses.

Farming like an Australian

After well over two centuries persisting with the species that arrived on the First Fleet — sheep, cattle, wheat etc — Australians finally develop land use systems based on Australian species. Native herbs in large scale cultivation enter the Asian cuisine market, as well as increasing market share in pharmaceuticals. Sustainably produced Australian bush foods are celebrated by celebrity chefs and establish a new global market niche among wealthy consumers in a synergistic alliance with the tourism, wine, fashion and film industries. An increasingly health conscious society is attracted to the inherently lean and high protein qualities and the non-synthetic 'natural' image of Australian bush foods. Systematic bio-prospecting of Australian biota by Australian companies and multinationals yields medical breakthroughs. Tasmania emerges as the world's premium producer of high value 'natural' medicines and exclusive lifestyle products.

Back to Earth

Consumer distrust of industrial agriculture is leading many consumers in OECD countries to want direct contact with their food production. Biological agriculture in its various forms — organic, biodynamic, permaculture — has a significant market share of rusted-on consumers and a rapidly growing share of the total market. Farmers' markets; city farming on rooftops, balconies and urban wastelands; and community gardens give people direct engagement with and confidence in how their food is produced. Supermarkets play a key role by ensuring high profile branding of the products from these systems and strict segregation from the GM products of the Corporate Hi Tech scenario. Many communities on the eastern seaboard of Australia approach self-sufficiency with a wide range of locally produced foods. This scenario is likely to blend with the one above, with both integrated into regional tourism and regional niche marketing.

It is important to re-emphasise that these scenarios are far from mutually exclusive, even down at the farm scale. Elements here can be blended in many different ways at a range of scales.

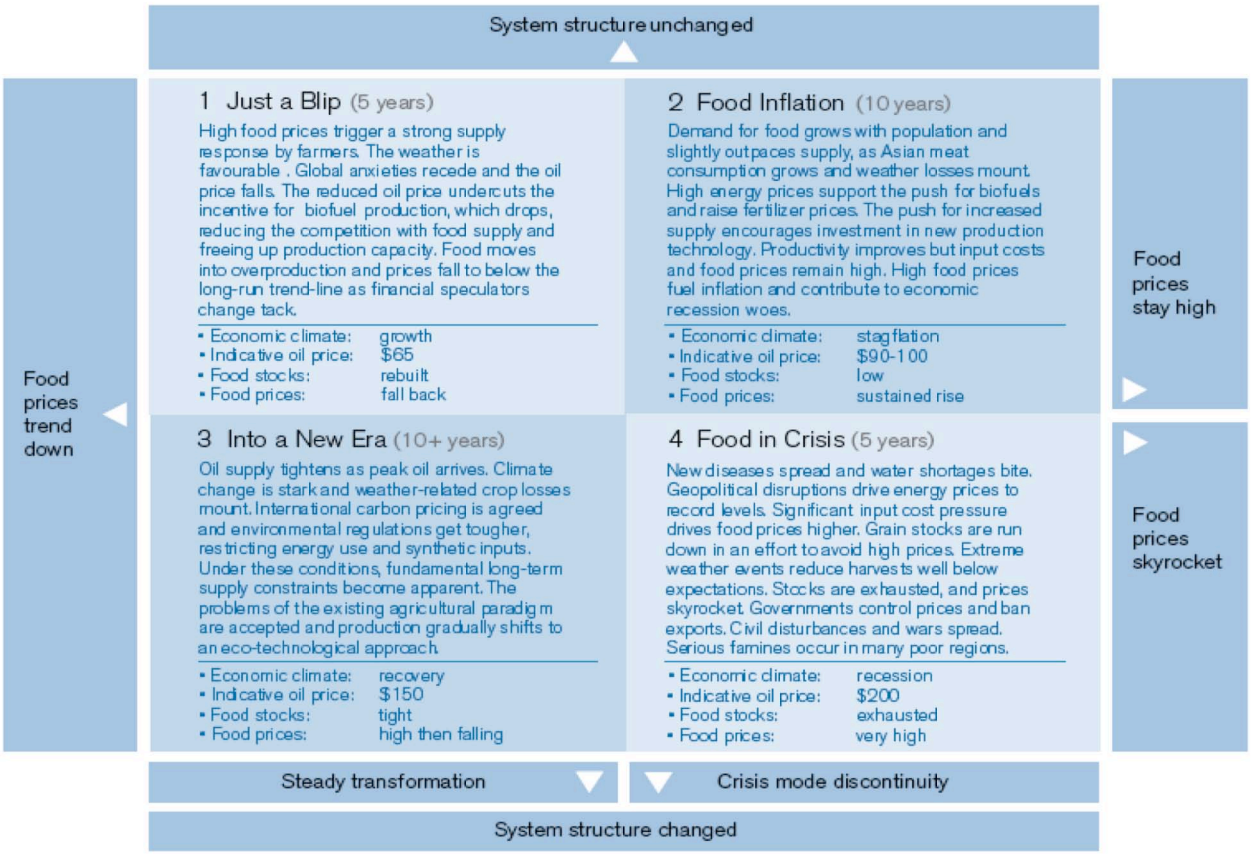
The Chatham House food supply scenarios

The best food-focused scenario planning encountered during this project has been carried out by [Chatham House], the well-known independent think tank, and home of the Royal Institute of International Affairs in the United Kingdom. 'Thinking About the Future of Food' is a Chatham House policy-related research project examining the effects of global trends on the networks that supply two staples, wheat and dairy, to the UK market. The work is built around a core panel of stakeholders with research expertise drawn from centres of excellence around the UK, against the following backdrop:[78]

> *Research undertaken between March and November 2007 included a series of interviews and discussions with leading players within and around Britain's wheat and dairy supply networks. The work indicates that there are widespread doubts about the ability of global food production to meet rising demand, with constraints on the availability of energy, water and land frequently identified as issues of particular significance. Overall, there is an expectation of significant structural change in existing food supply arrangements and the policies that support them; and there is a belief that Britain as a society has a number of important choices to make if it is to secure the kind of supply arrangements that best support its interests.*

The global analysis undertaken by Chatham House reached very similar conclusions to this project about the constraints on world food supply being able to keep up with ever-increasing demand. The Chatham House team has done a superb job in developing analytical axes that enable a more systematic approach to scenario exploration, based on their background research. Their four scenarios are presented in Figure 5.1 below.

Figure 5.1 Chatham House Food Supply Scenarios



The horizontal axis in this diagram is food prices, with a downward trend to the left, and an upward trend to the right, with prices skyrocketing in the bottom right quadrant. The vertical axis is the

[78] http://www.chathamhouse.org.uk/research/global_trends/

degree of structural change in the UK food system, with little change at the top and significant structural reform at the bottom, through a steady transformation in the bottom left quadrant (*Into a New Era*) and a major crisis-driven discontinuity in the bottom right quadrant (*Food in Crisis*). Each of these quadrants is characterised by an internally logical combination of settings in terms of the oil price, food stocks and the economic climate.

The four scenarios were fleshed out at stakeholder workshops over four days in January and March 2008. They are medium term — five years or less for *Just a Blip* and *Food in Crisis*, but perhaps ten years or more for *Food Inflation* and *Into a New Era*. The on-going research recognises that these scenarios could be sequential, for example *Into a New Era* could emerge from either *Food Inflation* or *Food in Crisis*. It is noteworthy that the food system players and experts involved in the project believe that of these four scenarios, *Just a Blip* is the least credible and least likely. For many products, the conditions described in *Food Inflation* already exist in the UK now. The question is whether that inflation will be sustained with a range of factors staying in a delicate balance, or whether it will trip into another stage like *Into a New Era* or *Food in Crisis*.

A new agricultural paradigm?

One of the more interesting possibilities floated in the Chatham House scenarios is that of a new 'eco-technological' agricultural paradigm emerging in *Into a New Era*. This emergence is described in the scenario (Chatham House 2008) as follows:

> *"…food production per person is in decline, food shortages are more frequent and prices are climbing. Under these conditions, it becomes clear that food production is hitting fundamental long-term constraints. The media refer to this as 'peak food'. Social values and preferences shift decisively towards what are broadly viewed as 'sustainable' methods, and wherever there are affluent consumers, the demand for local, seasonal, increasingly vegetarian, fairly traded and organic food continues to rise.*
>
> *At the same time, high food prices permit investment in new agricultural technologies aimed at increasing production while addressing environmental issues – soil degradation, water contamination, pest resistance, biodiversity loss and greenhouse gas emissions. Over a period of ten years and beyond, a new eco-technological production approach emerges that includes: crop rotation, cover cropping, agro-forestry, 'green' fertilizers derived from agricultural and food waste, new varieties (that have resilient, pest-resistant, nitrogen-fixing qualities), more efficient use of inputs through advanced information technology, and reduced water use.*
>
> *The new approach has a smaller environmental footprint, fewer synthetic inputs, better health outcomes and higher yields."*

This new 'eco-technological paradigm' has many elements of the 'regenerative agriculture' for which Jules Pretty has been arguing passionately for well over a decade (Pretty 1995, Conway and Pretty 1991, Pretty 2001). Regenerative agriculture (essentially what Cuba is doing) relies on internal or available resources and integrates regenerative processes (such as nutrient cycling, nitrogen fixation, soil regeneration and natural enemies of pests) into food production processes, applying technologies such as land rehabilitation, green manuring, cover cropping, agroforestry, integrated pest management and others (Altieri 1987). Yields may be lower than conventional farming systems relying on external fertilisers, herbicides and pesticides, but they are often higher than the current average yields in developing countries (Pretty et al 2006). In comparison with conventional high-external input agriculture in developed countries, the inputs of regenerative systems are usually much lower. Consequently, their profitability can be higher than conventional industrial agriculture, especially if energy, fertiliser and chemical costs are rising. The greenhouse gases and other pollution generated by regenerative systems is significantly less, so they require less hidden subsidies in environmental costs such as carbon emissions and other pollution, and loss of soil and biodiversity, that are not borne by the polluter, but are often imposed on the wider community. Jules Pretty (2001) observes:

> *For most of human history, the daily lives of humans have been played out close to the land. For a hundred thousand generations, we were hunters and gatherers. We have been agriculturalists for five hundred generations, industrialised for eight to ten, and have had industrialised agriculture for just two. Once again, the time has come to change from one system to another, to replace the bad with the good, and to find ways to define exactly what we want from our rural, farming and food systems. In this process we will come to see modern industrialised farming, I believe, as a temporary diversion.*

Moving closer to home, several approaches, each with their passionate advocates, compete for attention and support in Australia that would claim to fit under Jules Pretty's umbrella term of regenerative agriculture. These include organic, biodynamic and biological farming, holistic resource management, time-controlled grazing, pasture cropping, natural sequence farming and keyline farming. More mainstream practices such as conservation farming, raised beds, fixed beds, minimum tillage, no-till farming and precision agriculture also claim to improve soil structure and fertility, reduce soil erosion and compaction, and increase soil carbon and water holding capacity (Campbell 2008b).

Landholders could be forgiven for feeling confused in the face of sometimes competing claims and a fragmented, haphazard extension effort.

Well-understood core metrics around soil structure, fertility, carbon storage and water balance, with associated user-friendly assessment tools, would enable relatively objective independent evaluation of the performance of diverse farming systems in a given location, or of existing farming systems in new locations. Soil pH is probably the only such metric at the moment. Such assessment tools would support soil conservation extension activities delivered by various combinations of state agency staff, specialist consultants and contractors, grower groups, industry associations and catchment bodies; with various degrees of public support according to the wider public benefit and the potential for commercial returns (Campbell 2008b).

These are just the parameters associated with the soil. Fundamental though that is, it would need to be complemented by a wider suite of metrics around carbon, energy, water, biodiversity, waste and animal welfare to comprise a comprehensive picture of farming system and food system performance.

5.3 Key assumptions, branching points and uncertainties

So what lessons do the various scenario planning exercises that have been and are being undertaken around the world hold for the future of the Victorian food system?

Firstly, they remind us that there are many possible futures, most of them very different from today.

Secondly, they help us to tease out the critical drivers and branching points that lead to different future scenarios, and to identify the uncertainties that underlie them.

We can use these findings in several ways. An immediate task is to see whether some critical uncertainties can be reduced by seeking or generating more or better information to inform our planning and decision-making. We can also use the diverse scenarios to test some of our existing plans, policies and investments, or future iterations of them. For example, would a planned infrastructure development be a robust and sensible investment under any of the envisaged scenarios? If the answer is yes, then that investment is likely to be a 'no regrets' measure that can be undertaken with a reasonable degree of confidence. But if such an investment (which could as easily be a proposed research program, or a change in policy) looks to be redundant, counter-productive or just plain silly under one or more scenarios, then the risk of that scenario eventuating needs to be taken very seriously, and contingency plans developed accordingly.

Assumptions

Reviewing the various scenarios discussed here, the analysis of external drivers summarised earlier and the background research supporting this project, the following drivers have a high probability of occurring and will shape the future development of the Victorian food and farming system:

- A drying, warming climate, with more frequent and intense droughts, much lower run off into storages, a less Mediterranean seasonality with shorter growing seasons, more extreme and unpredictable weather events, and greater risk of losses due to storms, floods, bushfires, pests and weeds;
- A doubling of world food demand over the next forty years, coupled with severe supply constraints and rising input prices, will lead to sustained increases in the real price of food,

exacerbating inequitable food distribution problems, and intensifying public and political concern about food;

- The looming end to the era of cheap fossil fuels, the increased cost of alternatives and a price on carbon will see sustained rises in the cost of fuel, fertiliser and chemicals;
- Affluent consumers will continue to seek, and will be prepared to pay whatever it costs, for highly differentiated food of known quality and origins that meets defined and accredited standards in terms of environmental footprint (carbon, water, land, biodiversity, waste) and 'free from' concerns (pesticides, antibiotics, hormones, preservatives, allergens, GMOs). This differentiation could also be based on 'socially accredited' produce eg. to support small farmers, local, seasonal production, preservation of breeds, free range animal rearing etc;
- The rising cost of obesity and related problems will see renewed focus on the linkages between the food system, the health system and the planning system, greater interest in transport and lifestyle factors affecting health, functional foods and nutriceuticals, and more public investment in promotion of foods that 'are good for you and good for the environment';
- Intensifying public concern about climate change and food (including food insecurity for increasing numbers of people) could see more individuals and communities taking an active role in their food choices and suppliers. This will range from increased attention to accredited environmental, animal welfare and health credentials; through changed dietary choices; to active participation in local food systems (including home and community production) to improve access.
- Victoria will move to a more decentralised and distributed energy supply system, with increasing incentives for firms and households to generate their own energy, giving farmers the opportunity to become net energy producers rather than consumers; and
- Rising food demand, food shortages and food price rises will see increasing technological development and investment in more industrialised production of food off-farm, in factories and fermentation vats, for bulk generic ingredients produced to minimum defined standards at lowest cost.

[79]

[79] Borodell winery on the flanks of Mount Canobolas (1000m ASL), Orange, February 2008.

Taken together, these assumptions give rise to an emerging image of two parallel food systems: one producing highly differentiated products for discerning consumers, with a high degree of specification, through chain integrity and independent certification, attracting good prices; and the other producing generic commodities in large volumes extremely efficiently, sourcing ingredients from diverse countries at least cost, meeting the minimum regulated standards and selling in very price-competitive markets. Major retailers are already operating in this way, with some aisles presenting highly differentiated products, with presentation and advertising emphasising quality and distinctiveness, and others presenting home brands and other generics with advertising mainly focused on price.

The question for food producers is which part of the supermarket do they want their products to be in? Prices will undoubtedly be higher for the first option, but so will the management and business skill required, and the requirement to get more involved off-farm, further down the food chain.

This of course is just one scenario. Kirsten Larsen (*pers comm.*) posits that, if carbon, energy and fertiliser costs rise sharply enough, then low external input farming systems producing distinctive local whole foods may turn out to be cheaper than more industrial commodity production systems.[80]

As these challenges converge, it is likely that different food production and distribution systems will become more socially and economically viable. Production systems that are less reliant on external inputs and irrigation allocations, or less vulnerable to pests or climate shocks (such as mixed farms), may become more competitive than they have been in the past. Systems that have lower greenhouse gas emissions, use less energy and store more carbon will become more attractive. As transport costs become a significant factor in the price of food, an increase in the relative competitiveness and desirability of local, urban and peri-urban food production is also likely.

There are also obvious political and social problems with the envisaged dichotomy between affluent people buying their high quality, healthy niche foods, while the masses gorge themselves on home brands of what Michael Pollan calls "edible food like substances" produced in huge industrial vats. The health dimension is a key one. Governments in western countries are starting to look harder at the dietary causes of chronic disease and escalating health costs, and to become less sympathetic to food industry assurances about voluntary self-regulation. Current subsidies tend to reduce the cost of the wrong sorts of calories, but some tweaking of those subsidies could change that balance in favour of fresh whole foods grown in sustainable systems.

Moreover, it is not only rich people who are interested in eating healthy, tasty food. Food choices are as much about values as affluence. Of course affordability plays a big part, but people from low socio-economic groups also buy organic food. A lot of the international activity on community food systems (consumer led redesign and innovation), also increasing in Australia, is based on the idea of 'food sovereignty' — that communities have a right and a responsibility to control their own food supplies. Food insecurity rarely affects the affluent, so these movements have tended to be driven from the bottom up, including disadvantaged groups. For example, the **Cultivating Community** project that now supports more than 20 community gardens in Melbourne, started in 1990 with tenants on the Collingwood Housing Estate. You don't have to be rich to see that the system is not working and to want change…

> *Farm income can be derived from four key areas: primary unprocessed farm commodities, "value added" processed food and other agricultural product production, products of the knowledge-based bio-economy, and ecological goods and services. Farm incomes can certainly be improved through products of the knowledge-based bioeconomy, including health food products. However, the markets for these products are small, and considerable management skills are needed to market them successfully.*[81]

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[80] According to a recent British study, Kirsten may be right, at least in the UK. The farm business consultancy, Andersons found that the production of organic combinable crops, such as wheat, barley and canola, could become more profitable compared to non-organic as the price of oil increases to $200 per barrel. At $200 per barrel of oil (and the associated cost of synthetic fertilisers) the margins of non-organic combinable crop systems range from £296 to £348 whilst the organic margins range from £371 to £411. With oil at $135 per barrel (as it was when the financial analysis was done), the margins for organic and non-organic production of a combinable crops system are similar. For rotations that include potatoes, non-organic systems are more profitable than organic with oil at $135 per barrel, and remain so $200/barrel, but the gap between the two systems narrows appreciably. http://www.soilassociation.org/web/sa/saweb.nsf/848d689047cb466780256a6b00298980/f3a8098756cdfd73802574b9002d526c!OpenDocument

[81] From the Canadian Agri-food Policy Institute, December 2007. Tyrchniewicz and McDonald (2007) http://www.capi-icpa.ca/pubs.html

This quote from the Canadian Agri-food Policy Institute expands the two broad options above into four trajectories, making a useful distinction between value adding to normal farm produce, and producing novel products of the '*knowledge-based bioeconomy*', and noting the extra skills required to operate successfully in premium markets. Carbon is the wild card. If carbon prices are high enough (which will flow into energy and other input prices), then provision of environmental goods and services in terms of carbon offsets and bio-energy will become increasingly viable products for farmers. Food production in urban and peri-urban areas will also increase. But if the farm gate price of food climbs just as steeply, it may remain more profitable for farmers to stick with food production than to diversify into these other income streams that may demand higher management skills, at least in the early stages.

Branching points and uncertainties

Notwithstanding the above assumptions about the future context for the Victorian food and farming system, there remain some key questions or branching points that are not at all clear, and yet will have a major influence on the direction of the system. These include:

- Will agriculture be part of a national carbon emissions trading scheme, if so then when, and how will it be treated — the bottom line being will the carbon price be high enough to offer real incentives for farmers to operate in ways that deliver net sequestration of carbon rather than net emissions of greenhouse gases, and what will be the net impact on farm input costs?
- Will there be any incentives over and above the CPRS (Carbon Pollution Reduction Scheme) for farmers to deliver environmental services such as habitat protection or water quality improvement — or to limit the likelihood of the carbon push having perverse outcomes for biodiversity or water?
- Can Australia and Victoria get its act together on infrastructure — such as transport, renewable energy and water — fast enough for the food system to anticipate and respond to rising demand for food, competing internationally while coping with a much more difficult climate, rising energy, nutrient and carbon prices, and the need to reduce carbon pollution?
- Are alternative (closed loop, regenerative, energy efficient etc) agro-ecological food production systems able to produce enough food to meet demand?
- Is it possible to have a food system simultaneously delivering both agricultural paradigms, and both premium and generic food product trajectories, or are the types of infrastructure, value systems, human behaviour and policy settings so different that co-existence is unlikely?
- Will huge demand pressures simply lead to even more industrialised agriculture, making environmental and health concerns a policy-driven luxury that governments can no longer afford?
- Will a consensus evolve around the metrics to measure and certify the performance of farming systems and the food chain in terms of environmental impact, human health, animal welfare and socio-economic factors such as fair trade and support for local producers; and will such consensus translate into well-accepted accreditation and food labelling systems in Australia and internationally?

As mentioned at the start of this chapter, the future is most unlikely to be a smooth trajectory. Progress is riven with discontinuities, more likely to be characterised by sudden breaks with the past and by highly differentiated responses, than by linear development through time and space. Leaps of imagination are as valid as scientific deduction or extrapolation in envisaging the future. Here are just some of many potential shocks that could change the course of history quite quickly:

- The Greenland Ice Sheet is melting much faster than the IPCC worst case scenario. Sea levels could rise metres this century, not just 20cm as is currently predicted.
- The Himalayan glaciers feed rivers that water India, Pakistan & Bangladesh (among others). As they dry up, there is huge potential for conflict and massive refugee flows.
- The gulf stream 'conveyor belt' that warms western Europe could flip, tipping it into a mini Ice Age.
- The disappearance of the Arctic Sea Ice in summer (for the first time in millions of years) could lead to a rapid acceleration in warming through the albedo effect, potentially accelerating tipping points.
- Trade barriers and farm subsidies may go up — especially if there is a global pandemic. Countries may hoard oil.
- Good, well-watered land will become as strategic as oil reserves are now. There will be wars over it.

Chapter 6. Key vulnerabilities and areas for improvement

This section starts to zoom in on the areas in which the Victorian food and farming system is most vulnerable to the external drivers discussed earlier, and the challenges it needs to meet. It then works through the key types of responses that are required in terms of policy, infrastructure, human capacity, knowledge and innovation.

Table 6.1 overleaf, summarises the discussion in this section into a matrix that maps the challenges against these response areas. This is a potential starting point for a strategy to improve the resilience of the Victorian food and farming system.

Let's recap on the key challenges facing the Victorian food system over the next decade or so.

6.1 Adapting to climate change

"You can't drought proof Australia.
We need to learn to live with the landscape, not try to fight against it all the time.'[82]

The single biggest challenge is adapting to climate change, especially on-farm.

The most critical step in this process happens between the ears. We need to make a fundamental mind-shift, analogous to the step-shift in climate that appears to be taking place in southern Australia. That mind-shift is to accept that the climate has changed, to get over the notion that this is just another drought from which we will re-emerge into a run of good seasons like we used to have 20-30 years ago. Southern Australia is already much drier, and may become more so, and seasons are likely to remain 'out of whack' with a much less distinctively Mediterranean pattern. We can no longer rely on an autumn break, a wet winter and spring, or a very dry January/February. This is difficult stuff.

People who can make that mental leap will be able to look at their farming systems in a new light. Farming systems that are losing money now because their input costs are too high and/or their returns are too low, are likely to keep on losing money in the future. These farming systems need to be redesigned from the ground up. Farming systems that are still making good money now, in historically difficult climatic conditions — provided they are not doing so at the expense of the resource base — are a good platform on which to build businesses that can withstand and recover from climatic shocks with their natural, human and financial capital intact.

Two useful ways of thinking about adaptation are as risk management and reducing vulnerability and/or increasing resilience (Campbell 2008a). The latter approach is often more helpful at regional, catchment or sectoral scales. A risk management approach is likely to be more helpful at the enterprise level. The most popular generic framework for assessing the vulnerability of a region or sector to climate change, from the Third Intergovernmental Panel on Climate Change Assessment Report (McCarthy et al. 2001), suggests that vulnerability is a function of exposure, sensitivity, and coping or adaptive capacity, as outlined in Figure 6.1 below. Polly Eriksen (2008) makes the important point that there are both social and ecological dimensions to each of these factors.

Figure 6.1 Factors determining vulnerability to climate change (from Campbell 2008a)

[82] The late Peter Cullen, quoted in an obituary by Asa Wahlquist, rural writer for *The Australian* http://asawahlquist.com/content/view/26/2/

Table 6.1 Summary of Key Challenges and Responses

Challenges \ Responses	Knowledge	Skills & Talent	Innovation	Infrastructure	Policy
Adapting to Climate Change	Understanding climate risk by region, district and commodity. Understanding where existing best practice is good enough to handle projected climate change — and where it is not. R&D on new products & farming systems that thrive in extended dry conditions	Leadership training across the food & farming system and along the food value chain; climate change literacy across the whole community; lift climate risk management skills among farmers and advisers; develop advisers on low-input systems.	A Research Alliance on Sustainable Food Systems; new farming systems that use rain when it falls, maintain groundcover and are drought resilient – e.g. EverGraze, EverCrop, low-input systems. The Foodies – biannual sustainable food awards	Improve public transport; add a comprehensive network of freight depots to the existing rail network; an international Centre of Excellence in Sustainable Food Systems; pilot project on Food Sensitive Urban Design for winner of international design competition.	Improve policy linkages across the farming, food and health systems; rethink drought policies; shift the emphasis to resilience and managing climate risk; joint understanding across agencies on adaptation options for the food system;
Mitigating Carbon Pollution	Understanding carbon footprint. Life Cycle Analyses for all components of the food system; Options for methane reduction in livestock; Analysis of waste streams and the potential to harvest energy, water and nutrients from them	Make it easy for people to acquire the skills to know their carbon footprint and the main mitigation options. Overhaul tertiary and TAFE courses to hard-wire in carbon literacy; environmental literacy programs at a community level	On-farm biomass energy systems; sequestration options for farmers; methane digesters in the intensive industries; fully evaluate soil carbon options; low input farming systems; look at what OS firms are doing to cut through-chain emissions & pilot best options	Revitalise the rail network — regional and urban; roll out LNG distribution and supply system; explore renewable energy plants in cities (e.g. biodiesel from cooking oils or tallow); grid-connected solar farms; solar-thermal bolt-ons to existing coal-fired power stations	Study carefully how NZ handles ag and food in its ETS and learn the lessons; remove impediments and explore incentives to make it easier for food industry firms to reduce emissions; high profile prize for biggest GHG savings in through chain
Making best use of scarce water	Irrigation system harmonisation; automated metering and delivery systems; management of environmental water; re-use and recycling options that don't accumulate salt & contaminants.	Build on existing centres of excellence and try to attract world's best talent in water management to create a new cadre of top water engineers and managers.	Linking urban food production with stormwater and wastewater facilities; targeted rainfall enhancement technologies; "water miser of the year" competition across the food system.	Smart irrigation infrastructure; facilitate recycling of water, especially in urban areas; Water Sensitive Urban Design in all new developments.	Pilot project on reconfiguration of irrigation landscapes in northern Victoria. Accelerate the implementation of the National Water Initiative; Introduce household-level water trading.
Smart Energy	Understanding the profile of energy use across the food system and opportunities to reduce or switch to renewables; R&D on bionergy options for both extensive and intensive farming systems.	Tools (smart meters etc) and training to help people to identify new options. Build new teams that can develop biomass energy options.	A non-oil-dependent tractor drivetrain; ways of organising methane digesters etc across multiple farms; harvesting systems for biomass energy.	Rejig the system to unite farmers' markets and the rail network; a pilot plant for producing green energy from lignocellulose	Facilitate grid-connected renewables and introduce generous feed-in tariffs; integrated assessment of carbon, water and energy options
Soil & other resource constraints	A decent soil assessment and monitoring system; serious investment in soil biology research to improve understanding of microbial N fixation under different systems and conditions; better metrics for soil health and carbon	A campaign to make agriculture sexy for school leavers (which may mean rebranding it) and better link it to the food and health systems; rebuild soils extension capability. Serious investment in agroecology teaching at all levels.	Tools and systems for utilising waste streams to mine them for nutrients, water and energy; options to incorporate wastes into agricultural soils to build soil carbon and fertility; how to tweak the CPRS to protect biodiversity and soil health	Develop an integrated remote sensing, monitoring and analytical capability to track the condition of Victorian ecosystems and to predict trends in the environmental services derived from them.	Develop a cohesive policy position across government to secure good soils for food production – in urban as well as rural areas.

BOX 6.1

The high road or the low road?

At a strategic level, faced with the unprecedented scale and complexity of the climate change challenge, industries and regions need to work out where they want to position themselves between two broad stances: getting on the front foot and trying to be at the sharp end of climate change responses; or taking a defensive position and trying to maintain the status quo for as long as possible, then pleading for external adjustment support.

In essence, regions, businesses and industries need to decide whether they want to behave like a tobacco company (or General Motors which announced a US16 billion loss for the last quarter after massive write downs on its inventory of gas-guzzling, high-emissions pick-up trucks that it can't sell), seeking to sustain business as usual for as long as possible; or instead act more like a Google (now among the world's largest companies, yet it did not even exist fifteen years ago), seeking to redefine business as usual and to innovate to stay ahead of the game.

Barney Foran[83] describes this choice in more colourful terms, setting out a challenge for regions:

The Federal Government's release of its emissions trading green paper signals that Australia is prepared to change from its past stance of environmental vandal to a new, if somewhat reluctant, status of a reformed drunk needing the weekly AA meetings provided by an ETS to maintain its reforming zeal.

The green paper spares regional areas the initial financial blows from the ETS by initially shielding agricultural activities, land clearing and forestry activities. Regional industries should use this period of grace to embrace global environmental realities and develop the production niches that give them global advantages in affluent markets, where carbon neutrality reeks of virtue, and might one day return a market premium.

Leadership by regional industries and local governments will separate the wheat from the chaff in the global race for carbon accreditation where goods and services with a low carbon content and therefore environmental impact, will attract investment and the new breed of environmental entrepreneurs

However recent press headlines report a long list of carbon dole bludgers, industries whose King Canute-like CEOs held back the greenhouse tide for a decade or so, but now seem to require billion dollar lifebuoys so they can stay afloat. Insightful regions would be wise to let these CEOs float out to sea, but stream their trained workers towards the low carbon industries of the future. The stone age did not pass because of a market shortage of stones. Protecting these dumb and dirty industries will inevitably cause a sharper and more painful transition down the line.

...renewable energy sources are here and they promise truckloads of financial and employment opportunities for much of regional Australia. The sunshine, moderate wind resources and relatively cheap flat land could locate solar thermal arrays and forests of wind turbines far from the NIMBY sensibilities of the urban elites, but close enough to the major nodes of electricity demand.

...the real challenge is to produce transport fuels that are carbon neutral. This can only be achieved in a physical sense by growing vast areas of wood on cleared farmland, and converting wood to bio-alcohols through thermochemical conversion processes. Current biofuel systems that convert sugar cane and grain to ethanol offer a short-term bridge, but can never give the volumes and carbon savings that the second generation processes based on wood can.

Regional areas can also use wood to generate bio-electricity and heat services. ...regions have opportunities to help their household transition towards low carbon lifestyles, but only if they think 'big picture' and act aggressively to build the infrastructure, grow the fuels and develop the rewards of local employment and financial activity.

Human capital in regions will be sorely pressed to underpin the new low-carbon carbon economy because it relies on good skills in maths, engineering, chemistry and systems thinking. Australia's transition to a rock gouging economy has left it poorly prepared for the environmental realities of the 21st century. Regional universities could be central to the low carbon transition but only if they re-engage with basic sciences and work in close partnership with regional industries.

It's not long till the promised ETS starts to throttle the windpipe of many of Australia's agricultural sectors particularly through the methane budgets of livestock production and the nitrous oxide emissions from fertiliser application. Proper accounting methods will reveal these realities on supermarket shelves and export consignment labels. We can't hide behind the politicians' skirts forever.

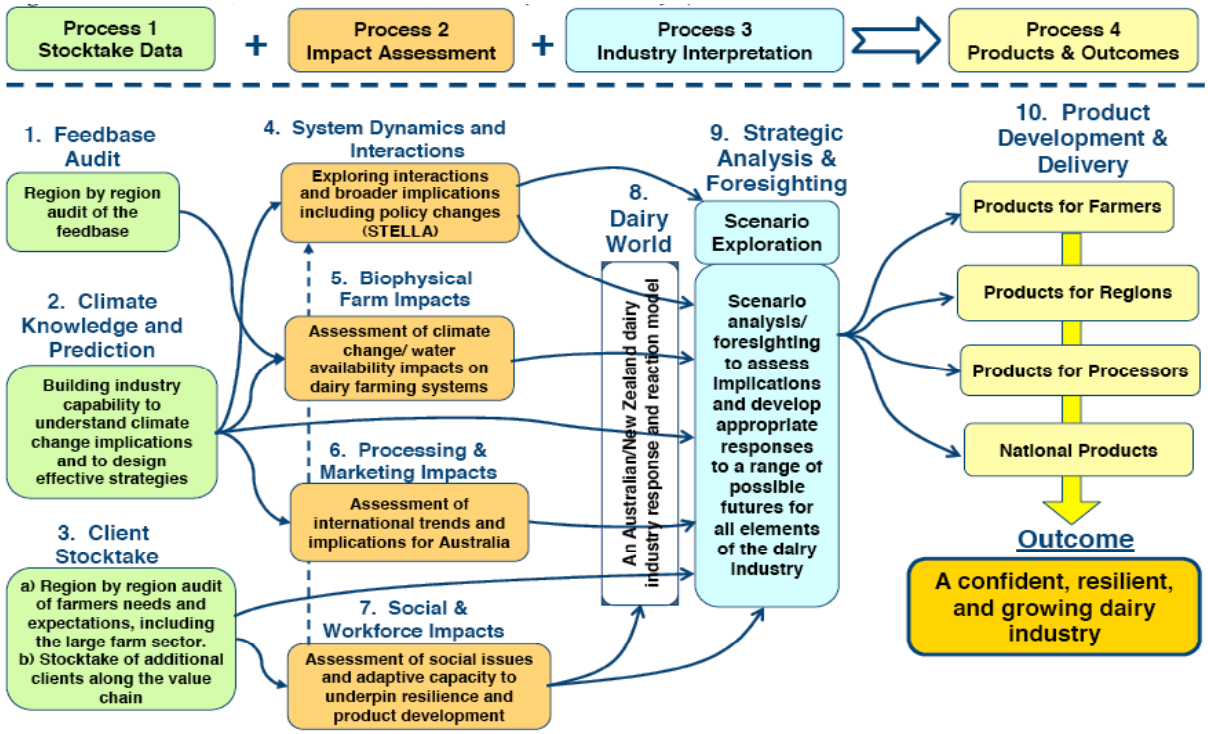
Wise regions will embrace the future aggressively and fuel their own prosperity by seeking partners for the widescale deployment of renewable electricity infrastructure, and development of carbon neutral production systems for transport fuels. The ETS is nearly here and the future is in our own hands.

The dairy industry appears to be getting on the front foot, as Figure 6.2 below illustrates. This is the conceptual framework for Dairy Australia's *Confidence to Grow* project, which is seeking to better position the Australian dairy industry to handle climate change and to exploit any opportunities that

[83] *Barney Foran retired from CSIRO in 2005. He is now an adjunct research fellow at Charles Sturt University's Institute for Land, Water and Society in Albury. These excerpts are from an article published by the Institute on 14 August 2008.*

emerge from it. There is a strong emphasis on resilience in the *Confidence to Grow* business case — i.e. improving the ability of the dairy industry to withstand and recover from external shocks with its human, natural and financial capital intact.

Figure 6.2 Dairy Australia's *Confidence to Grow* project[84]



Dairy Australia has listed the assumptions underpinning this industry-wide approach as follows:

- Climate and climate variability have always been major farming systems and value chain challenges and these challenges will be exacerbated by climate change;
- There will be major differences in scale and significance of climate change impacts between regions, along the value chain and between international dairy industries;
- There are likely to be significant differences in the ability of farmers, farming systems and other elements of the value chain to adjust to climate change;
- A better understanding of the complexities and uncertainties associated with climate and climate change is an essential component of increasing industry resilience and confidence to grow;
- On-going investment and growth within the dairy industry is dependent upon internal and external stakeholders being confident that the dairy industry can prosper during climate change.

The point about investment confidence is a crucial one. Adapting to climate change is as much a psychological challenge as it is a technical, biophysical or economic challenge. Climate change, and the myriad policy and market responses to it, can seem complex and intimidating. But if it is broken down into manageable chunks, and if industry bodies like Dairy Australia get on the front foot and take a strategic approach, then it can be framed in terms of the same challenges that Australian farmers have been meeting more or less successfully for two hundred years.

There are many examples showing how good farmers have successfully adapted their operations to increasing levels of climate variability. A good place to start is the Managing Climate Variability R&D Program, and in particular its Masters of the Climate case studies, which illustrate how dozens of top

84 From the Dairy Australia business case for the Confidence to Grow project at http://www.dairyaustralia.com.au/content/view/610/451/

operations across a wide range of commodities have been re-engineering their farming systems over the last decade or so to handle extreme weather conditions and increasing levels of climate variability. There is a fascinating series of case studies based on interviews with leading farm businesses in 1999, and again with the same people in 2004. A common thread in 1999 was technological optimism and faith that developments in long range and seasonal forecasting would soon enable much greater levels of accuracy in predicting future rainfall, growing season soil moisture and so on. By 2004, and probably even more so today, the common theme was one of the importance of resilience, managing risk, and preparedness — being able to be opportunistic in quickly responding to unseasonal rainfall or worsening conditions.

Complementing industry-based programs like that of Dairy Australia, and government-based services like that of the DPI, farming systems research groups like the Birchip Cropping Group (Wimmera/Mallee) and Southern Farming Systems (higher rainfall) are also active in developing practical options for broadacre farmers in adapting to a more challenging and variable climate, and some dedicated climate change networks have emerged, such as the South-West Climate Change Forum focused on south-west Victoria.

Making best use of scarce water

The northern Victorian dairy industry is the biggest user of diverted water in the state. After several very dry years, innovative new irrigation options are emerging that save water and energy while increasing production, including:

- sub-surface drip irrigation for lucern pastures, which uses less water and is less energy-intensive than centre-pivot spray irrigation; and
- super-fast flood irrigation systems (which use gravity and are thus very energy-efficient) that irrigate each bay in 15 minutes compared to the conventional four hours, ensuring that water just reaches the root zone and no further, halving water use and reducing salinity risk.

UniWater (a joint research centre between Melbourne and Monash Universities directed by Prof John Langford) is exploring new irrigation systems for northern Victoria and finding that very significant efficiency and productivity gains are possible (John Langford *pers.comm.*).

6.2 Mitigating carbon pollution

On-farm

The first step for farmers seeking to mitigate their greenhouse gas emissions is to understand their emissions profile. Dr Richard Eckard, from DPI Victoria and the University of Melbourne, with colleagues has developed a series of relatively straightforward greenhouse gas emissions calculators for dairy, beef, sheep and grains farms. These are available from the GHG Tools section of the Greenhouse in Agriculture (GIA) website. The Greenhouse in Agriculture program is a major program of the DPI. It is overseeing a range of research developing options for reducing on-farm methane and nitrous oxide emissions, including farming systems, dietary supplements, genomics, modelling and breeding projects, under the science leadership of Richard Eckard. These projects are already generating useful information for broadacre farmers interested in reducing net greenhouse gas emissions in Victoria.

Farmers with more intensive livestock systems could start to look for options to capture methane and turn it into a revenue stream. With current technologies and pricing, this is difficult to justify unless you have a large scale and intensity of emissions. Dairy Australia is funding a pilot methane digester system at Shepparton — the first of its kind in Australia. In this system a covered lagoon costs in the order of $200,000 so it is not something that can be rolled out on every farm at this stage — costs are high, as is the need for on-going technical support. In the United States, 30% of methane digesters fail in their first year due to lack of follow-up support (Cathy Phelps *pers.comm.*). But down the track as they become more common, and as the price of carbon increases, the value proposition will improve and costs are likely to come down.

While the Greenhouse in Agriculture and other research programs are working on longer term solutions

and are generating findings that can reduce emissions now, it is clear that there is unlikely to be a magic bullet breakthrough on livestock emissions any time soon.

Fortunately, Victorian farmers have many opportunities to offset their emissions through planting trees. This can be an important transition measure until other options are available, and it potentially generates a range of ancillary benefits on-farm and at a landscape scale, as the photo below illustrates. Through well-planned revegetation, Victorian farmers can relatively easily achieve a 'carbon neutral' emissions profile. This then opens up potential opportunities to market the produce from such farms as 'carbon neutral' or 'carbon plus' foods.

[85]

Campbell (2007) makes the distinction between 'industrial carbon' and 'charismatic carbon' in existing carbon offset schemes. The former tends to be large scale forestry plantations generating large offsets at a relatively low price per tonne of carbon under the formal NSW Greenhouse Gas Abatement Scheme. In this case, the firms purchasing carbon offsets are large electricity generators who are motivated by achieving the largest possible offset at the lowest possible price. However there is a parallel voluntary carbon offset market, in which a large number of schemes offer people and firms opportunities to offset their emissions — whether it be an international flight or an annual car registration or whatever. Several of the offset providers operating in this market are at pains to emphasise that you are not just buying carbon when you purchase from their scheme, but you are also helping biodiversity (e.g. creating Cassowary habitat in the Daintree) or filtering run-off on to the Great Barrier Reef, or saving rainforests in the Amazon etc. This is 'charismatic carbon'.

The question is whether products like milk, beef or sheep meat could be marketed — using images like the one above — as 'carbon neutral' or even 'carbon plus', emphasising the wider landscape benefits of the production systems. This would obviously require investment in robust accreditation and verification systems to underpin a serious marketing effort if any price premium is to be gained.

Along the food value chain

David Pimentel and colleagues (2008) have done a comprehensive analysis of the energy consumed in the US food chain. I have been unable to find comparable studies in Australia. The US probably has a more energy- and nutrient-intensive agriculture, and associated greater greenhouse gas emissions than Australia. Although when the volume of outputs is considered, the gap may not be so large in terms of emissions per unit of product in kilocalories (kcal) or per capita. While the US numbers may differ, the principles are likely to hold here just as well.

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[85] Jigsaw Farms, Melville Forest, October 2004. This image captures both the emissions from ruminant livestock, and the potential for offsetting those emissions through well-planned revegetation for shade, shelter, biodiversity, aesthetics, farm forestry and biomass energy.

Pimentel et al (2008) found that each American consumes on average 3,747 calories of food per day. This is more than 1,000 over the recommended daily intake for a relatively active male. The average distance that food is transported before being consumed by an American is 2,400 km, using on average 1.4 times the energy in the food. The transport energy input for fruits and vegetables averages 4 calories for each calorie of food.[86]

According to the Pimentel et al (2008) analysis, the amount of fossil energy used in the American food system could be halved with changes in production, processing, packaging, transport, and consumption. Starting with consumption, they suggest that a 30% reduction in food consumption (including a 50% reduction in meat and dairy consumption, and an 80% reduction in junk food consumption), would deliver very large energy savings, environmental benefits and health benefits. They suggest that it is also possible to halve the energy consumed in food processing and packaging, and in food transport through more localised food production systems (and farmer's markets and Community Supported Agriculture programs) and greater use of rail and sea transport as opposed to road and air.

On farm, using corn as an example, they estimated that total energy in corn production could be more than halved by: using smaller machinery and less fuel; replacing commercial nitrogen applications with legume cover crops and livestock manure;[87] and reducing soil erosion in corn production through alternative tillage and conservation techniques. Halving energy use in the US food system also assumes considerably greater access to and use of renewable energy systems such as biomass, biogas, wind, hydroelectric and solar energy. Together, these systems could provide the USA with an estimated 46 of the 103 quads[88] of energy it currently uses per year, but that would require at least 17% of total land area, not counting cropland, in the USA (Pimentel et al 2002). Of course, sharply reducing food consumption — especially of meat, dairy and junk food — should free up some land.

Pimentel notes these figures without a trace of irony, in a matter of fact tone that fails to even hint at the tectonic shift in American land use, consumption patterns, human behaviour and core values that would be required to realise these efficiency improvements. President George Bush Snr stated famously at the Rio Earth Summit in 1990 that *"the American way of life is not negotiable"*. So yes, it is theoretically possible to halve the energy consumed and make a big dint in the greenhouse gas emissions of the American food system, with enormous ancillary health and environmental benefits. But it won't be easy.

Moving back to Victoria, Sophie Gaballa and Liam Cranley (2008) have followed up the earlier (Gabballa and Bee Abraham 2008) study on the food miles of a Melbourne food basket, with an analysis of the comparative emissions from road and rail transport of food in Victoria, for the same 21kg food basket used in the earlier study. They looked at four alternative scenarios:

A. solely using existing road networks;

B. all food items transported by a combination of primary road and rail freight, within the existing rail track and freight depot network, preferring rail wherever practical;

C. a combination of road and rail freight, within the existing rail track but with the addition of a much larger rail freight depot network, preferring rail wherever practical; and

D. a hypothetical complete rail network across Victoria.

They found that transport of the 21kg food basket in this study produced an estimated 940 grams of greenhouse gas emissions if transported in scenario A, 570g in scenario B (a 39% reduction), 451g in scenario C (52% reduction), and 438g in scenario D (53% reduction).

This is an interesting and potentially useful finding. Gaballa and Cranley (2008) concluded that transport planners aiming to reduce food-related emissions should focus on increasing the network of freight depots, rather than building new rail track. The potential transport emissions savings from doing so are considerable — potentially halving Victorian transport emissions from farm to supermarket without building any new rail lines.

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86 Of course some products are much higher. Air-freighting strawberries from California to New York uses 100 calories of energy for each calorie of food (Pimentel et al 2008).

87 Citing USDA figures, Pimentel et al (2008) estimate that intensively farmed livestock produce 1.6 million tonnes of Nitrogen per year in manure. But, as cow manure is 80% water, this manure can only be transported a distance of about eight miles before the energy return is negative (presumably further by rail). There are huge infrastructure implications and widespread return to mixed farming systems required in order to make widespread, large scale replacement of synthetic fertilizers with manure feasible.

88 One quad = 10^{15} BTU (British Thermal Unit). 1 BTU = 55.1 joules or 252 calories. 10^{15} BTU = 1,055,099 Terrajoules = 293 Gigawatt Hours

Of course the transport emissions from the consumer's residence to the supermarket and back are likely to be a greater proportion of the total carbon pollution generated, which underlines the importance of planning issues, public transport, shopping habits and localised food production systems.

6.3 Energy

> *"We see the beginning of the transition towards an emission-free era and non-petroleum-dependent drivetrains. Even if you take global warming out of the equation for a second, not much would change — nobody today challenges the idea that we will run out of oil some day. And before that, prices will explode. We feel well equipped to lead this transition, rather than suffering from it. We can heavily invest in new technologies and get out of this transformation a stronger player than we are today."*[89]

All sectors that are heavily dependent on oil, like agriculture and the food system, need to work out their strategy. Do you want to lead the transition, as the Chairman of Mercedes-Benz says they do through a range of solutions including hybrids, fuel cells, plug-ins and LPG, with many prototype cars already on the road. Or do you want to wait and see what happens, and then lose a technological edge, suffer from it and hope that government comes to the rescue?

There are two sides to the energy coin for the Victorian food and farming system. Firstly, as the cost of energy increases, both for scarcity reasons and as a carbon price is introduced, then input costs for fuel, fertilisers and many other nutrients will also rise. So there is a very strong incentive to find ways of reducing energy needs, of using energy more efficiently.

Secondly, there are opportunities for the farming system to be a producer of energy as well as a consumer, and potentially to meet some of its own energy needs and sell energy back into the grid. Some renewable energy options are mentioned below.

There is a third category of energy measures that would assist the food and farming system, in particular the through chain, and that is the transport system as a whole. Getting rail & other transport logistics sorted would have huge benefits for the Victorian food and farming system — with those benefits increasing commensurately as oil and carbon prices rise. This is dealt with further in the infrastructure discussion below.

Energy efficiency

Victorian broadacre farmers are already very energy-efficient by world standards. We are helped enormously by our mild winters and the fact that we don't have to house animals to get them through the winter. We have also come a long way in reducing tillage in cropping systems and in pasture establishment on grazing farms.

While the emphasis to date in 'low external input' farming systems such as organic and biodynamic approaches has been on avoiding the use of synthetic fertilisers and chemicals, it is now worth re-examining the range of approaches that might loosely be grouped under Jules Pretty's term regenerative agriculture. Farming systems that seek to minimise reliance on external inputs, to use microbial nitrogen-fixing processes, to exploit predator-prey dynamics to control pests, to use polycultures and mixed rotations to control disease, to build soil organic carbon and to increase the proportion of perennials in the system, should be re-examined from an energy, water and carbon perspective to measure their competitiveness with conventional systems under a range of oil price, carbon price and farm gate food price scenarios.

Renewable energy

The diagram at right[90] summarises the

	Current feedstocks	Future feedstocks
Examples	Canola, sugar cane	Algae, wood and crop waste
Food market interaction	Competes for feedstocks	Limited
Technical and economic viability	Now	5 - 10 years

[89] Dieter Zetsche, Chairman of Daimler, talking about how Mercedes-Benz is thinking about a world without oil. *The Australian*, 16-17 August 2008, p41

[90] From Future Fuels Forum 2008.

differences between so-called 'first generation' biofuels (current feedstocks) and second generation biofuels (future feedstocks). The discussion earlier suggested that first generation biofuels are problematic in that they generally consume more energy than they produce, they require significant subsidies, they compete with food production for land and water, and they often lead to additional deforestation (which further discounts any greenhouse gas saving). Second generation biofuels offer much more promise in the longer term in that they are energetically more efficient and they compete far less with food production, but they are less mature technologies and require further development. The remainder of this section discusses how second generation biofuels might fit into more sustainable Victorian food and farming systems over the next forty years.

Lignocellulosic (woody) biomass

If Victoria is to continue producing large quantities of high quality grass-fed, rain-fed beef and sheep meats in a carbon- and energy-constrained world (as I believe it should), then the integration of woody perennials into grazing operations for carbon sequestration and biomass energy production will be increasingly important. There will continue to be a market for beef and sheep meat. Health and pollution concerns are likely to see premium prices paid for meat from grass-fed, rain-fed open range sustainably managed grazing systems as opposed to feedlot production systems. But the methane emissions associated with grass fed ruminants are significant. In the absence of a radical technological breakthrough to reduce methane emissions from enteric fermentation, it will be desirable to offset those emissions, and from a marketing perspective, 'carbon neutral' or 'carbon plus' beef and sheep meat should have an advantage.

Of course well-designed revegetation carefully integrated into grazing systems offers ancillary benefits such as shade and shelter, wildlife habitat, erosion control, water quality improvement and landscape amenity.

91

From an economic perspective, and given the likely continued upward trend in energy prices, it is important to think through how Victorian farmers, on both cropping and grazing lands, could become

91 Integrated environmental revegetation, farm forestry and potential bioenergy plantings on Jigsaw Farms, Melville Forest, October 2005. Andrew Campbell photo.

significant energy producers in their own right. Farm forestry and biomass energy systems integrated into grazing and cropping lands have a potentially important role to play in off-setting methane, nitrous oxide and CO2 emissions from agriculture, and in giving farmers new economic options. Box 4.3 described how this is already happening in the Nordic countries.

Sustainability Victoria has recently commissioned a review, undertaken by Crucible Carbon (2008), of biomass energy processing technologies and their potential to contribute to Victoria's renewable energy targets. That review provides a first class introduction to the technologies and a comprehensive desk-top assessment of their potential in the Victorian context.

> *Each year in Victoria approximately 2,200 petajoules (PJ) of solar energy is captured by the leaves of plants and converted into biomass through photosynthesis. This is only 1.6 times the energy consumption of the state, which means that biomass as a significant scale energy resource is certainly not limitless, and must complement biomass use for food, material products (wood and paper), habitat conservation and ecosystem services.*[92]

This quote from Crucible Carbon (2008) illustrates that biomass energy is no magic bullet for aiming at Victoria's renewable energy targets — it can only ever be part of a bigger mix of renewable energy options. Nevertheless, their analysis concludes that lignocellulosic material (woody biomass) from mixed species plantings of native species integrated with grazing operations is the most prospective option, and that it is potentially very viable. Furthermore, with appropriate industrial processing, newly harvested biomass can be converted into homologs of current gas, liquid and solid fossil fuel resources. All other renewable or low carbon energy technologies (e.g. solar, wind, nuclear) can only produce heat and power. Whereas biomass is able to supply a range of carbon-based products with material qualities, such as liquid fuels, metallurgical reductants, lubricants and a wide range of petrochemical substitutes.

Crucible Carbon (2008) point out that the success of bioenergy projects depends fundamentally on sustainable biomass supply, technically and economically viable processing, and a social licence to operate.

Clearly there are significant regional land use planning issues associated with scaling up biomass energy plantings. Ideally, one would want biomass energy plantings integrated with food production at a farm and landscape scale, albeit clustered in higher densities around the processing mills. However this is far from inevitable. It will be crucial to learn the lessons from the rapid expansion of blue gum plantations in the Green Triangle region driven by Managed Incentive Schemes (MIS). If the mix of incentives is structured to favour biomass energy plantings and economies of scale, then the logic of the market is such that a corporate model will emerge quickly and there will be rapid conversion of land from food production to energy production, just as is occurring in the US today.

Let's assume for a moment that the modelling suggests that say 15% of grazing land should be planted to native trees for biomass energy production in defined regions within a defined radius (say 60km) of processing centres. There is a spectrum of ways of achieving this target, between two extremes:

1. Plant 15% of every farm within the defined area, in ways that maximise the complementarity with food production and environmental benefit — i.e. along creeks, in shelterbelts and alleys, retaining remnant vegetation, avoiding disturbance of native grassland — like the Jigsaw Farms photo above; or
2. Buy 15% of the land area, as close to the mill as possible, remove all the farm buildings and fences, and plant the most profitable species in a monoculture across the whole landscape.

Option 1 (the agrarian model), assuming good planning and execution, would not reduce food and fibre production at all, in fact it would probably increase it. Nor would it see any farmers leave the land, nor would it radically change the character of the landscape. Many landscapes in rural Victoria are over-cleared and would benefit greatly from an additional 15% of native tree cover in the right places. But from a commercial and economic perspective, Option 1 is problematic. From the perspective of someone trying to produce biomass energy efficiently, having lots of little plantings of odd shapes

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92 Crucible Carbon (2008)

spread across the whole district, and having to deal with all the farmers in an on-going way, is a pain in the backside and has high transaction costs.

Option 2 (the industrial model) however, is far more efficient in economic and carbon terms. It would be uglier, it would remove 15% of the farmers, reduce food and fibre production by around the same amount and it would do little for biodiversity, but it would be operationally much easier and energetically more efficient.

Left to its own devices, the market will default to Option 2.

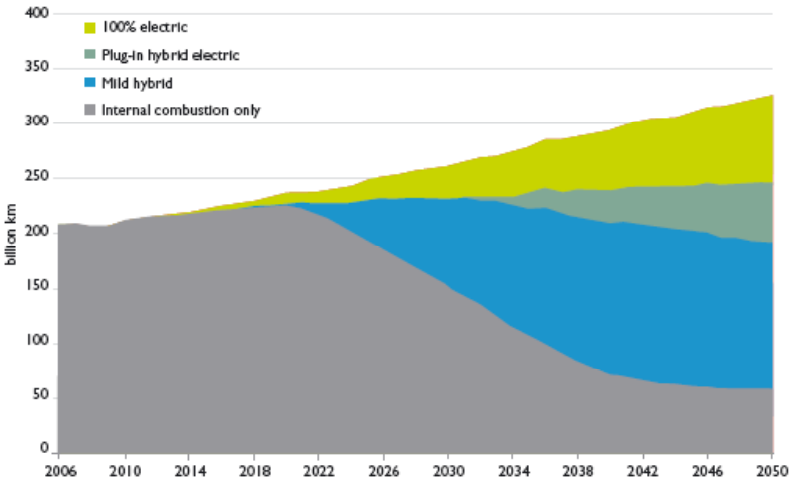
Biodiesel from algae

An emerging technology that also has the potential to be integrated with food production on farmlands, in particular in conjunction with more intensive livestock industries such as dairy and aquaculture, is the production of biodiesel from algae. The technology is relatively straightforward, at least in theory. Algae grown in waste water ponds draws down atmospheric CO_2 (or that emitted from a power plant) and can be converted to biodiesel. Residues can be refined into ethanol. Biomass production can be one to two orders of magnitude greater than those for a paddock of crops. In the United States, some companies have surpassed the 15,000 gallon per acre (168 Kl/ha) accepted benchmark, and one company claims to produce 180,000 gallons of biodiesel a year from each acre of algae (2Ml/ha/year), equalling 4,000 barrels at US$25 per barrel or US$.59 per gallon (A$0.15/litre as at 4.9.08). The benchmark 15,000 gallons/acre/year equates to A$1.80 per litre. The next leading feedstock (palm oil) yields 635 gallons per acre per year (7.1Kl/ha/year) (Epstein et al 2008).

If these claims are verified, then obviously 15 cents per litre for biodiesel from algae is very attractive. Even at the benchmark conversion ratio, reliable production of biodiesel for $1.80 per litre from algae grown in waste water lagoons would be a handy hedge against rising oil prices. The gap between these numbers is so large that it would seem very worthwhile to be undertaking trials to test and refine the methodology, hopefully improving productivity and reducing the net cost of the resultant renewable transport fuel.

Figure 6.3 Projected changes in the Australian transport fuel mix[93]

The graph at right is a CSIRO projection of the most likely change in transport fuel mix in Australia, if we are to meet the government's current target of a 60% reduction in greenhouse gas emissions (c.f. 1990) by 2050. It suggests that by 2020, hybrid and electric vehicles will need to achieve serious market penetration and that by 2040, the internal combustion engine will be only conveying about one sixth of the total transport load.



It is interesting to ponder where tractors fit in this equation. It seems strange that most of the attention to date about alternative fuels has focused on the car and transport fleets. But our current farming systems are fundamentally reliant on tractors. In the Cuban example discussed earlier, tractors proved to be one of the most difficult things to do without — and to a large degree they had to return to oxen (McKibben 2001). If we are to have a contingency plan to avoid a similar fate, then developing an alternative drivetrain for tractors would seem prudent. In some ways, tractors may be easier to retrofit than cars, as they don't need to be aerodynamic, they can handle much heavier batteries and so on. Solar electric hybrids or plug-in hybrid electric tractors or CNG options — the possibilities may be even greater than for cars.

93 Future Fuels Forum 2008, based on the scenario of reducing greenhouse gas emissions in Australia by 60% by 2050.

6.4 Soil and other resource constraints

Soil management

While perhaps not quite so immediately obvious, the implications of climate change for soil management are of the same dimensions as for water. They fall into two broad categories — the direct on-ground impacts and the policy responses, which will in turn have further on-ground impacts.

On-ground impacts

- the on-ground impacts of a drying, warming climate with more extreme weather events will generally make soil management more challenging in our main agricultural regions;
- regional shifts in climate patterns will increase demands to change farming systems or to move existing farming systems into new areas, potentially placing new pressures on soils;
- increasing energy prices, depletion of global phosphate reserves and likely pricing of carbon will lead to increasing costs of external farm inputs including diesel, nutrients and biocides. This should intensify efforts to develop soil management systems that minimise the need for external inputs of energy and nutrients — as well as increasing the risks of soils being used unsustainably (mined);

Both the on-ground impacts of climate change on soils and the probable policy responses to climate change listed below underline the need for a strategic national approach to investment in soils. Such an approach would need to consider how policy, research, extension, education, assessment and monitoring, data management and community engagement can work together to promote and assist more sustainable soil management in Australia.

Policy responses

The soil is a huge carbon store. Of the estimated 3,060 gigatonnes of carbon in the terrestrial biosphere, 82 per cent is in soils (Lal 2004). Poor soil management generates potentially large greenhouse gas emissions. There is a strong imperative for Australia to introduce a suite of policy instruments that encourage sequestration of soil carbon and that discourage practices that lead to large emissions of soil carbon. Such instruments could include (Campbell 2008b):

- developing robust, efficient, user-friendly methods for measuring the soil carbon store and tracking changes in it;
- using these tools to develop an accounting framework for soil carbon;
- the preceding two steps are prerequisites for any moves to include soil carbon in a national emissions trading scheme;
- measures to encourage abatement of greenhouse gas emissions from soils, which will inevitably lead to a greater focus on soil carbon, from a management as well as a measurement perspective; and
- greater attention within planning and development approval processes on the risks associated with developments on particular types of land (not just from a soils perspective, but also flooding, storm risks, bushfires and so on) leading to demands for improvements to natural resources information systems for a wide range of users.

On the latter point, soil management is just as critical as soil type, aspect, slope and so on. Better soil management, leading to improved soil health, makes soils less prone to erosion and waterlogging, as well as being able to better utilise more variable rainfall and to cope with extreme and unseasonal rainfall events.

As the earlier Box 3.4 containing the *Stock & Land* editorial illustrates, there is considerable optimism that soil carbon could become a big new income earner for Australian farmers. However, while we should take steps such as those above to investigate and prepare ourselves for this possibility, we should not become infatuated with the idea, for two key reasons:

- firstly, there are many other reasons for increasing soil carbon and improving soil management,

and we should not lose sight of those, irrespective of any carbon market potential; and

- secondly, there is a considerable risk of unrealistic expectations developing.

Consider for a moment the preconditions necessary for soil carbon to be counted in an emissions trading scheme. The complexities of tracking changes in soil carbon stocks through time are such that, if soil carbon is counted, then many other on-farm emissions and sinks are likely to also be counted. It is most unlikely that farmers will be able to sell their sequestration credits while not being forced to account for and pay for their emissions. While there are farming practices that build soil carbon through time, this is more difficult if you are selling significant quantities of either animals or crops.

> *"Not only is it difficult to increase the amount of C stored in cropped soils — even with no till and when large amounts of stubble are retained it may take decades to significantly influence soil C levels — it is also very difficult to quantify any change in the amount of C stored, a necessary requirement under the C-trading rules of the Kyoto Protocol."*[94]

Building up soil carbon also means locking up nutrients. Each tonne of humus (equating to 2.2 tonnes of CO2 equivalent) contains about $200 worth of Nitrogen, Phosphorous and Sulphur. So even if carbon sells for $40 per tonne of CO2e, that equates to less than half the value of nutrients locked up.[75] Leaving aside the measurement complexities for a moment, it will come down to the relative price of carbon compared with meat, milk, grain and nutrient prices. Yes you can build carbon stocks, but if that is at the expense of food or fibre production, then the carbon price received has to be greater than the food or fibre earnings foregone and the nutrients applied. If the carbon price is high enough, then in the medium-high rainfall areas, various forms of forestry may generate faster carbon returns.

That said, we should still be encouraging the development and promotion of farming systems that are 'carbon-smart' — that build soil carbon, that close carbon and nutrient cycles as far as possible, that minimise net emissions and that look for sequestration opportunities on-farm. In the rangelands or on very degraded sheep-wheat country, the opportunity cost of increasing ground cover and soil carbon is relatively low, and the broader environmental benefits sufficient to justify policy settings that encourage more resilient, carbon-smart farming systems.

Nutrients

Rising fertiliser costs are another big driver for farming systems that build organic matter and fix their own nitrogen. There has been a spike in interest in industry programs on better nutrient management in the dairy industry (Cathy Phelps *pers. comm*). 'Closed loop' systems for nutrients deliver cost savings on fertilisers, but also reduce air and water pollution, especially in the more intensive industries like dairy, pork and poultry.

We can also do better in looking harder at nutrients from the perspective of the food system as a whole. A whole system analysis of nutrient stocks and flows of the Victorian food system would reveal that Melbourne — like all big cities (Hawken 1993) — is in effect a huge sink for nutrients and water. Melbourne imports and concentrates nutrients, water and energy from the rest of the state — much of which turns up in waste streams.

There is considerable potential scope to undertake a forensic analysis of waste streams and stocks, then comprehensively mapping their embedded nutrients, water and energy. These could then be targeted as sources for recycling nutrients and water, and for renewable energy.

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[94] Dr Mark Peoples, CSIRO Plant Industry, in BCG News (p4), August 2008.

6.5 Farming systems

The earlier discussion on drought policy concluded that *'the more fundamental, long term challenge is to develop farming systems that are more intrinsically Australian: that are resilient in the face of extreme weather and extreme variability; that are miserly with water and conserving of energy; that maintain groundcover and are kind to the soil; that sit lightly on the landscape and don't displace native wildlife or habitat; that are highly profitable in good seasons and don't lose money in bad seasons; that preserve and build their natural, human and financial capital; that recover quickly from shocks and stress; that attract and retain young, talented people on the land; that generate jobs and income in regional communities; and that produce things in high demand for good prices.'*

This section explores this further, thinking about how these design criteria might be realised in different ways on the ground.

New broadacre farming systems

The level of current expenditure on drought subsidies, especially in the cropping and grazing country of southern Australia, underlines the need to develop and promote more resilient broadacre farming systems that can make money in the sorts of conditions we are currently experiencing, while better looking after the resource base.

The Future Farm Industries Cooperative Research Centre[95] (FFICRC) is working on a range of new farm technologies and farming systems aiming to do just that. These include:

- ***EverGraze***™, a high performance grazing system based on perennial pasture plants.
- *Enrich*, an initiative based on screening Australian native and introduced fodder shrubs for their production and persistence. Potentially they could be the basis of new grazing enterprises in areas where profitable cropping is in decline due to a drying climate.
- ***EverCrop***™, the use of perennial plants in the non-crop phase of cereal production systems, aimed at improving soil health, water management and drought resilience, lower cost organic nitrogen delivery, and weed and disease control.

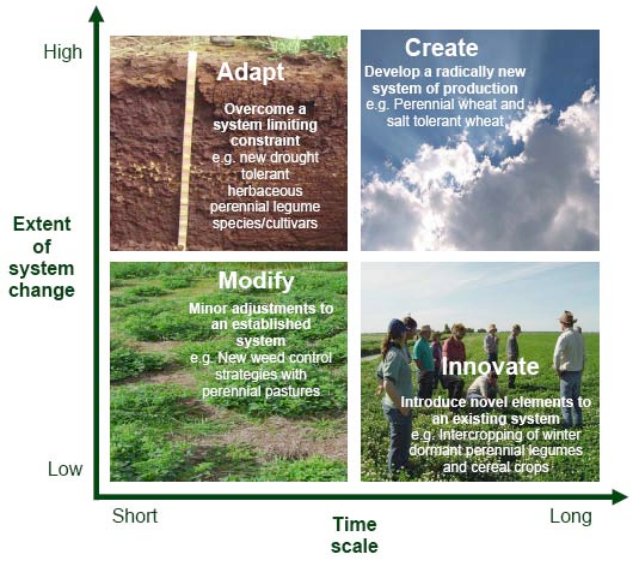
EverGraze is developing and testing new farming systems in different environments across the high rainfall zone of southern Australia. The target is to increase profits of sheep and cattle enterprises by 50% while improving water management, use of perennials, biodiversity and soil health. Six research teams at proof sites in three states are testing these new farming systems, measuring soil, water, pasture and livestock inputs and outputs, enabling accurate modelling of the impact catchment outcomes and farm profits. Three sites focus on sown exotic perennial species and three sites are working with existing native perennial pastures. A network of Supporting Sites is associated with each Proof Site allowing groups of producers to try new grazing practices and perennial systems.

In Victoria the EverGraze proof sites are at Hamilton (exotic perennials) and Rutherglen (native perennials). The Hamilton site is further advanced, and it has done remarkably well under very severe seasonal conditions in 2006-8. Both the lucerne/fescue and kikuyu/chicory rotationally grazed pasture systems increased profitability by well over 50% compared with conventional rye grass pastures. The conventional rye grass system, despite lower stocking rates, cost $20 per head more in supplementary feeding than the two EverGraze systems, and eventually the conventionally-farmed paddock was so bare in severe drought conditions that it had to be destocked. The EverGraze systems incorporate perennial legumes and thus fix their own nitrogen, they include summer active perennials that can respond to summer rainfall, and they maintain adequate ground cover all year round, minimising erosion risk, improving soil health and soil carbon levels compared with the conventional rye grass-based system. David Robertson, Chairman of the Hamilton EverGraze regional group, estimates that on his farm over the 2007-8 season he saved $6 per head on supplementary feeding costs, and made an extra $10/head on his store lambs from the EverGraze lucerne-fescue system.

Figure 6.4 The *EverCrop*™ integrated research strategy[96]

[95] Declaration: the author is a Director on the Board of this CRC.

This graph gives a good depiction of the strategic options in seeking to develop more resilient and sustainable cropping systems. In the short term, the most viable option is to modify or adapt existing systems, whereas in the longer term, new systems or novel additions to existing systems may generate greater system improvements. In this case, the example is from the FFICRC EverCrop program, which is exploring new cropping systems that make greater use of perennials, either in the cropping rotation or, as in the top right quadrant, as crop species in their own right.



Given the sorts of climatic conditions we are in, and moving into in southern Australia, it is important to look for ways to improve the resilience of the system, to make changes that increase the likelihood of getting a return in very poor years, and to try to maintain groundcover over as much of the country as much of the time as possible. So intercropping and pasture cropping systems that may produce lower crop yields, but do so reliably while producing excellent feed for animals and returning nitrogen and organic matter to the soil profile, are being tried on an increasing scale.

The CRC FFI is working in all four of the above quadrants, which is entirely appropriate for a well-funded research collaboration. However many individual farmers are also applied researchers, and there is much we can learn from their responses to the current very challenging conditions, which tend to cluster in the adapt, modify and innovate quadrants of the graph above. For example, in the Wimmera and Mallee, good farmers are retaining soil moisture through trash retention, feedlotting sheep to minimise erosion risk, and getting crops in quickly at minimal expense *"we don't need to produce much grain to cover variable costs. If we were to achieve average long term yields, our profit would be substantial."*[97]

In northern Victoria, dairy farmers buffeted by three years of very poor seasons, declining security of irrigation water and increasing water prices have also responded in innovative ways. Stephen Mills[98] (*pers.comm.*) describes how top dairy farmers managed to do very well in 2007-8, selling water early n the season when water prices were high, buying feed for cows and fully feeding them from purchased feed (meeting their total nutritional requirements), then buying water again in the autumn when prices were lower: *"on our place, milk production increased from 6,000 litres to 8,000 litres per cow, and we did not irrigate at all in the winter, spring or summer — our first irrigation was on the first of April. I doubt if we will ever see wall to wall pastures again in dairy around here."*

Steve points out that a key factor was that milk prices were high enough that dairy farmers could afford to fully feed their cows, that having had experience in the water market was important, and that attitude is also critical: *"a 'glass half empty' approach doesn't work. If you just try to survive, that's all you'll do."*

New intensive farming systems

The challenges for intensive agriculture, horticulture and aquaculture systems mirror those for the broadacre systems. However by their very nature, there may be opportunities for more intensive food production systems to turn waste streams into revenue streams, to increase recycling of water and nutrients, and to generate bioenergy from their waste streams (for example through methane

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96 From http://www.futurefarmcrc.com.au/documents/P2FutureCroppingSystems.pdf

97 Ian McLelland, Chairman's Message, *BCG News* August 2008.

98 Stephen Mills, dairy farmer, recently retired Chairman of Irrigation Australia Ltd, former Chair of the Goulburn-Broken Catchment Management Authority, director of Murray Goulburn Cooperative Limited and now Chairman of Goulburn-Murray Water.

digestors). Co-location of complementary industries, where one industry can benefit from the waste of its neighbour, is also an option that should be explored more at a whole system level.

Organic farming

Towards the end of Chapter 5, the notion of a 'new agricultural paradigm' under Jules Pretty's umbrella term of 'regenerative agriculture' was introduced, with reference to farming systems that minimise external inputs, fix their own nitrogen, recycle wastes, exploit predator-prey relationships for natural pest control, use diverse species and rotations, seek more direct relationships with customers and so on.

Advocates of organic farming could be forgiven for feeling disgruntled at these weasel words — why not just go with 'organic farming'? After all, the organic sector has been developing robust standards and pushing such farming practices (mostly uphill) for decades. And now, just when organic food sales are growing faster than almost any other sector of the market in the UK, US and in Australia, there is an apparent move to establish alternate 'clean and green' brands.

The relationship between organic and conventional agriculture is complex.

It is about far more than just alternative land management practices — it is also about clashing philosophies and worldviews. This has led to an unfortunate but understandable tendency for debate to become polarised and for people to take sides — with each 'side' seeing the very existence of the other as a direct personal criticism. Simplistic caricatures painting organic farming as unprofitable ideological mysticism bordering on witchcraft, and conventional farming as saturating the landscape with poisons peddled by greedy multinational corporations, have tended to hamper meaningful dialogue. So we have seen decades of claim and counter claim and deepening misunderstandings, with very few examples of synergistic joint effort.

Because the organic sector has always been tiny in comparison with the conventional sector[99], and because it is seen by the establishment as 'alternative' in the fullest sense of the word, until relatively recently it has been starved of public research funding[100] and has not been taken seriously by the big agricultural research institutes, including CSIRO. There may be a handful of tenured academics in Australian tertiary institutions capable of teaching a thorough course on organic agriculture, and relatively few credible mainstream agricultural researchers working on improving organic agriculture.

Most state departments of agriculture and primary industries have added small sections on organic farming to their websites, technical notes and research portfolios in recent years, but again it tends to be at the margins, less than 1% of total research and extension effort, and driven more by market demands than by any underlying curiosity about the performance of the farming system. The

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99 Despite strong recent growth (80% growth in farm gate value in the four years since 2004) the organic sector at $684 million is still less than 1% of total retail market value in Australia, with 2750 certified operators (growing at around 5% per year) still representing only about 2% of farm businesses (Kristianson and Smithson 2008).

100 The Rural Industries R&D Corporation (RIRDC) has a dedicated organic agriculture R&D program worth $418,000 in 2007-08, out of total investment across the rural industry RDCs exceeding half a billion dollars – equating to less than one tenth of 1%. The photo above is of a DPI trial site at Rutherglen, which is good to see, but organic farming remains a small part of the DPI research portfolio.

allocation of $1m to the organic sector in Victoria's $205m Future Farming Strategy is a very positive move that could potentially assist in getting the organic sector on to a more professional footing. For the sector this is a very significant investment, but in the overall scheme of things it remains at the periphery.

So, while it is the fastest growing sector of the food market, organic farming is still working from a very small base of about 2% of farmers (younger on average than their conventional counterparts) and 1% of retail value, and even lower in terms of the proportion of public investment in research, extension and education. The Organic Market Report 2008 (Kristiansen and Smithson 2008) published by Biological Farmers of Australia is a worthy attempt to pull together existing data, but it found that major information gaps impede a comprehensive response to even basic questions like the size of the sector — they estimate that the actual farm gate value of organic production may be 25-40% higher than the available data indicates.

While still a fringe dweller from the perspective of the agricultural establishment, organic farming is far more established in the minds of consumers, with 40% of consumers (mainly women) reporting that they buy organic food on occasions. You know you are becoming mainstream when you get a gig on reality television, as Box 6.2 illustrates.

BOX 6.2

Farmer Wants a Wife goes Organic

Industry growth and niche market opportunities are not the only benefits of being organic. Now it appears it could also increase your chances of meeting your future spouse – in an unconventional manner, of course.

The hit reality TV show – Farmer Wants a Wife – is putting a chemical-free spin on Series Three.

Eligible organic farmers looking for love are officially invited to audition for castings. Farmers must meet the following criteria: Single, in their mid 20's to mid 40's, and certified!

The show has been the reason behind several marriages between isolated bush bachelors and women from around the nation, with event organisers stating it is a real opportunity for 'true love', or, at the very least, some serious socialising! Having had more than their share of conventional producers, being organic this time around increases a bachelor's chance of natural selection.

"Farmer wants a wife is a feel-good story. This is not a competition. There's no prize money and the only winner in the end... is LOVE. We simply follow the story of Australian farmers meeting new women, exploring new relationships and trying to find their soul mate" says show organiser Wendy Hanna.

"We are searching nationally for real farmers aged between 25 and 45 who are looking to meet their one true love. Bachelors must be working farmers, be it grazier, dairy, citrus, oyster, etc."

Interested men should drop an email with an introduction to: eliza@mcgregorcasting.com or call (02) 9557 2844 to register your interest. To download an application form or apply online visit **http://www.farmerwantsawife.com.au/**.

It is time to jettison the baggage of tired old arguments and to start a completely new dialogue between the organic farming sector and the so-called conventional farming sector.

Climate change, the policy responses to climate change, rising energy and nutrient costs and increasing water scarcity and hence prices, will all put pressure on the Victorian farming system to use inputs more frugally and efficiently, to make greater use of organic as opposed to synthetic nitrogen, to apply the principles of integrated pest and weed management, and to manage water very carefully. Health and broader environmental concerns will also put pressure on the food system to deliver fresher, healthier foods that meet consumer needs, that are not so replete with sugars, salts, saturated fats and food additives, and that minimise net greenhouse gas emissions along the value chain.

From both of these perspectives, organic agriculture as it has been practised for centuries around the world has many lessons to offer. In general, pollution and food contamination risks are much lower. There is solid evidence from well-controlled comparisons that the global warming potential of organic farming systems is lower than comparable conventional farming systems (Niggli et al 2008), and that food produced organically has appreciably higher levels of anti-oxidants, flavonoids, vitamins, Omega 3

fatty acids and other nutrients than food produced conventionally.[101] Of course organic farming is not a panacea that can deliver immunity from all the pressures discussed in Chapter 3. Moreover, just as in conventional agriculture, management expertise makes a huge difference. The gaps between best practice and the average, and between the average and the tail, can be more significant than those between farming systems. But it does have valuable lessons to offer, both at the farm end and the consumer end of the food value chain.

BOX 6.3

The Skopilianos family — Keilor Valley Gardens

The Skopilianos family came to Victoria from North Greece in 1946 three generations ago. They farm 250 acres across several farms of alluvial flats for baby leaf salad production (and value adding) in the Keilor Valley, fifteen minutes from Melbourne Airport. In recent years they have converted to full organic production. Steve Skopilianos explains that one of the final straws for him was realising his wife didn't want him to bring home salads from the farm for their kids even though they were 'legally safe' within the withholding periods. A key reason for conversion to organic was also to develop a unique point of sale (UPS) and to attract premium prices: *"We were getting lost in the marketplace. We thought that we would go the whole hog so that we could charge the extra dollar. We felt like our business was a dog chasing its tail — the more fertilisers and chemicals we applied, the further backwards we were going."*

Keilor Valley Gardens went more biological in soil management about ten years ago, progressively moving from standard synthetic fertilisers to use of manures, to now using composted organic manures and green manure crops and investigating soil biology at a more profound level. They also moved more into IPM (Integrated Pest management) about 7-8 years ago — halving their pesticide bill one year.

Andrew Monk has known the Skopilianos family for many years: *"for over two decades since I was lugging produce from their farms while purchasing and contracts manager for a Melbourne based company - supplementing my university undergrad days. They exemplify the new type of producer entering the organic sector - professional, backed by science and well resourced, not philosophical so much as focused on the realities of things. Obviously declining returns and competition from the "low road" end of the market would have also helped. Lastly it has been their work in proving the farming systems can work - an ongoing task of course. ...I would put these guys at about 70% through the organic farming systems roadmap - ie they still have plans, and need to plant more shelterbelts, predator harbouring crops, etc. They are well ahead of many others however, in technique and the science they use."*[102]

Keilor Valley Gardens now has a significant business turnover, supplying to the major supermarkets, selling produce off farm in Keilor Valley as well as gearing up for export. Steve Skopilianos (pers.comm.) says that the jury is still out on the commercial returns from conversion to organic: *"conversion has definitely worked for us environmentally, but commercially…. ask me again in 12 months time. Our cost of production is definitely higher producing baby leaf salads organically, but there is light at the end of the tunnel. We've virtually created the organic baby leaf salad market and have grown the market fourfold, going from 100 to 250 acres of production. The consumer response is excellent, with a feel good element for people purchasing our product. We get a lot of praise reports and emails from people saying how they love the products."*

"Water is a huge issue for us — a huge stumbling block and one of the reasons we haven't turned a profit earlier." Traditionally the market gardens of the Keilor Valley have always drawn water from the Maribyrnong River, but dry years have seen that source closed to them for most of the last five years, forcing them to use town water supplies at retail prices ($1040/Ml). Paradoxically, yields drop by at least 30% using this much more expensive water (because it is effectively sterilised and has much less nitrates and phosphates than river water) so more water needs to be applied and weed problems increase.

This is a classic case where better urban planning (incorporating both food-sensitive and water-sensitive urban design principles) could deliver environmental and commercial win-wins. Less than 2km away from the Keilor Valley growers are sewer pits en route to Werribee with an average flow 3 times greater than the total water use of all the Keilor Valley growers. It is technically feasible to mine this sewer and treat the water to a suitable standard for growing vegetables, but was assessed by Council as being uneconomic. Strategically, having great alluvial soils less than 22km from the Melbourne GPO used to produce quality healthy foods, using recycled water and nutrients, would be a much smarter use of resources than having growers use tap water at great cost, with lower yields and more weed problems.

Developing farming systems that can meet the design criteria spelled out at the start of this section will inevitably draw on some of the same principles that organic farming has been based on for decades, and may well arrive at some of the same practices. Or not. It may be that organic farming

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101 Cordis 2007, Benbrook et al 2008 and Ellis et al 2006, cited in Larsen et al 2008; Asami et al 2003, Brandt and Mølgaard 2001, Carbomaro and Mattera 2001, Davis et al 2004, Fox et al 2007, Mitchell et al 2007 and Ryan et al 2004, cited in Pollan 2008)

102 Andrew Monk *pers comm.*, September 2008. Andrew Monk is a Director of Biological Farmers of Australia and Chairman of their Organic Standards Advisory Group.

also has to change and adapt as the price of diesel and other inputs soars, and as our knowledge of, for example, soil biology in the Australian context, develops. Some co-learning would be mutually beneficial, and boundaries between farming systems that we may have thought were poles apart could start to blur.

Another key aspect of organic farming is that it is not just about farming practices — *"it is a total package defined by **clear standards**, long history and arguably driven in large measure by consumers (for example in relation to concerns about chemicals and GMOs). It is an exemplar of industry self regulation, reactivity to consumer expectations at the "high end" of the market, and well nuanced and real and meaningful standards - love or hate them."*[103]

BOX 6.4

Organic food processors and distributors

The organic sector has always had to think about the whole food value chain. There are many innovative and interesting Victorian based processors of certified organic produce and other foods marketed as being free from, for example, food additives and GMOs. Here is a quick sample:

Pureharvest is based at Drouin in South Gippsland. Pureharvest was established in 1979 in Prahran, distributing bulk whole beans and grains to health food stores in Victoria, quickly becoming one of the largest suppliers of organic seeds and grains to the bakery trade in Victoria. It has been a leader in importing and distributing soy milk, bio-dynamic rice rice cakes and rice milk in Australia, and was largely responsible for creating markets for these products. In 1987, Pureharvest was the first Australian company to sell locally made whole bean soy milk, marketed under the 'Aussie Soy' brand. Today, Pureharvest is one of Australia's largest importers, manufacturers and distributors of natural and organic food with a national distribution network, supplying major supermarkets and health food retailers with a large range of organic and natural products. It is also a leading exporter of organic and natural products.

Whole Kids grew out of a concern about the health and food safety qualities of children's snacks. Since launching the first Australian range of certified organic snacks for children over three years ago, Whole Kids (a brand name of Nourish Foods based in South Melbourne) has become the country's leading provider of organic snacks for children.

Organic by Nature is one of many brands distributed by Australian Organic Wholesalers, based in Cheltenham.

Original Foods is an innovative caterer providing very fine foods for the top end of town. *"Our passion is **visionary food**."* Original Foods was founded by a refugee executive from the corporate sector. It uses organic, free-range and chemical free inputs, avoiding GM and refined ingredients where possible, in catering for a wide range of functions and clients. Original Foods makes a point that the whole business is oriented around sustainability, including the design of its Collingwood premises, its vehicle fleet, using green power, water and energy efficient appliances, encouraging staff to ride to work, recycling waste and contributing to **Second Bite** where possible.

This photo illustrates the fruit juices from **Emma and Tom**'s[104] of Prahran. Organic processors and distributors have trouble sourcing Victorian — let alone local — and constantly risk running out of product. Importing product is a crucial risk management strategy for these firms. Demand for organic food in Victoria frequently exceeds supply.

Victoria has considerable potential in this sector of the market, both domestically and for export as part of a broader premium food offering. But at present our record as an exporter of organic foods lags well behind other countries such as New Zealand. Realising this potential will require a more integrated strategy that goes well beyond on-farm issues to include regulatory standards for certain pesticide and herbicide use in the environment, and a raft of food colourings and additives that

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103 Andrew Monk, pers comm. September 2008.

104 Purchased in Brisbane, August 2008. In addition to the standard nutrition & ingredients panel on the back, it says: *"Gently pasteurised, no added sugar, artificial additives, preservatives, colours or flavours. Made in Australia from the best ingredients we can find in Australia and around the world."* Even products emphasising their health benefits cannot necessarily rely on sourcing local ingredients all year round, which has obvious consequences in terms of freshness. For the record, they were delicious.

arguably should not be in children's foods, through to training in biological systems farming for people interested in entering the organic sector or building their skills. Andrew Monk again:

> *"...it is silly to treat the opportunities in organic foods for export as a flippant fad — there is great opportunity to value add at the high end of the market (the world still has not enough organic dairy - and doesn't look like it will anytime soon in the value added end of that market). Ergo - organic is at the already proven (just add water!) end of the value added "high road" market - but this state has struggled to see significant production and marketing growth, beyond what is now being pulled through by the supermarkets (and much on the non fresh side is being imported due to non availability)."*

The point about the need for the organic sector and the conventional sector to work more closely together is not about getting more farmers to become certified organic, although some may choose to do so. Rather, it is about the broader need to reduce reliance on external inputs, lower pesticide and herbicide runoff, build soil carbon and improve soil health, make greater use of organic nitrogen and recycled nutrients, improve sustainability performance along the whole food value chain and so on. There are many insights from the experience of organic farmers around the world that can be brought to bear on these challenges, which are now mainstream.

6.6 The food value chain

While the bulk of the environmental footprint of the food system is on-farm, there is still much that can be done to improve the sustainability and resilience along the food value chain. Again, this issue is connected with virtually everything else in this section. Systemic improvements to the food value chain will involve changes to infrastructure such as renewable energy supplies and improved transport logistics, more sustainable packaging options, and better access to water and waste recycling schemes.

Kirsten Larsen and colleagues (2008) provide an excellent overview of alternative food production and distribution strategies and their potential benefits, including:

- Localisation: aiming to shorten supply chains by producing food close to where it is consumed;
- Farmers' Markets: predominantly fresh food markets where farmers sell their produce direct to consumers (there are about 40 in Victoria);
- Community Supported Agriculture: where people in urban areas pay a local farmer a bulk amount at the start of the year and in return receive a supply of fresh seasonal produce from that farm (only 1 in Victoria);
- Slow Food: a movement that started in Italy in 1989 in opposition to the fast food culture, which emphasises that food should taste good, be savoured in the company of friends and family, and be good for producers and the environment (significant activity in Victoria); and
- Urban Agriculture: recognising that for the first time in human history, the number of people living in cities worldwide outnumber those living in the country, and that large amounts of food have been and can be produced in cities (CERES and Cultivating Community in Melbourne).

These strategies aim to achieve various combinations of several objectives: to shorten food chains; to reduce the transport and energy costs associated with food distribution; to support local producers; to keep people in touch with where their food comes from and how it is grown; and to increase consumption of fresh, whole foods. All of them have grown very quickly around the world over the last twenty years, as a response to concerns about climate change, food security, food quality and regional development. However this growth has been from a small base, and these alternative food chain strategies have a tiny share of the food market in comparison with supermarkets.

While they may still be marginal, these alternative strategies are worth further analysis. It is not axiomatic that they have a lower carbon footprint than conventional food chains that shift high volumes of products through complex distribution and processing channels and out through supermarkets. This is because the volumes of product tend to be small, and consumer car miles may be significant per unit of product. Nor is it necessarily sensible in a highly variable climate to rely totally on locally-grown food.

Nevertheless, these are valid strategies and should be treated as such as part of a resilient, healthy food system. With good planning and design (for example locating farmers' markets at public transport

hubs) these strategies generally do reduce the environmental footprint of the food chain. They do engage consumers more directly with their food production, they do promote fresh whole foods, and they do return a greater share of the consumer dollar to the producers.

Urban agriculture in particular offers an important element that should not be forgotten in considering how to double food production over the next 40 years, using probably less land and water in aggregate, and much less per capita. Fifteen percent of world food production already occurs in cities, and in the US during the Second World War, urban food production reached 40% (Larsen et al 2008). Kirsten Larsen has coined the term 'food sensitive urban design'. This is a potentially very useful analogue of 'water sensitive urban design' (WSUD), a well-established planning concept that integrates the water cycle into the design of urban areas that minimise their use of diverted freshwater (from storages) and maximise their use of rainwater, stormwater and recycled water. Food Sensitive Urban Design would seek to optimise opportunities to produce food within cities and reduce the length of food chains; it would inform the design of water, transport, energy and waste management infastructure to improve the sustainability of food production and distribution; and it would seek to minimise 'food deserts' within the urban footprint.[105]

BOX 6.5

Innovators in the food system

(from Austin et al 2007)

Food, like air and water, is essential to human existence. But the way in which we make decisions about what we eat is far removed from simply sustaining ourselves. Consumer research shows that people also buy food to feel good about themselves and the world around them. Food, then, enters the realm of emotions and ethics rather than just being a fuel for survival.

Four mega-trends have emerged in food purchasing – convenience, health, taste and ethics. These trends were first identified in mature markets such as the United Kingdom, but are now also seen in developing countries like India. Within these trends there are specific categories:

- **Convenience** – eating on the go, dinner time convenience, smaller purchases more often, and snacks and grazing foods;
- **Healthy foods** – more nutrient value, 'free-from' foods, low-allergen, chronic condition-related foods, high energy, relaxing, and personalized health foods;
- **Taste and indulgence** – great flavour and taste, premium foods, authentic regional tastes, and bespoke foods; and
- **Ethical** – organic, sustainable, and fair trade foods.

These trends are at the forefront of decision-making for our innovators. They are developing new products and services to target the specific needs of consumers.

Chocolate maker **Farm by Nature** and health food producer **Roma Food Products** are two companies which have developed new products specifically to meet the complex - and sometimes conflicting - needs of consumers. Farm by Nature is transforming a traditionally 'sinful' confectionary into a tasty health food. Its chocolates are made using VinLife™ – a fine grape seed powder, which contains health-giving antioxidants that are believed to help combat degenerative conditions such as heart disease, cancer and diabetes. The company has also developed Australia's first commercial cocoa operation in North Queensland to ensure the integrity of its key ingredient. Melbourne-based Roma Food Products is producing a range of low allergen health foods. The company's R&D has develop products that are free of gluten, wheat, dairy, eggs, yeast and any GMOs; yet are still tasty.

Two of our innovators are making food shopping a great experience for consumers. Vertically integrated beef producer and retailer, **Polkinghornes**, and **Macro Wholefoods Market**, Australia's largest organic and natural foods retailer, have listened to their customers and are reaping the rewards. Polkinghornes believes its key success is in understanding and adapting to the modern lifestyles of its customers. The company sells tenderness-guaranteed fresh meat cuts as well as a range of high-quality, pre-cooked convenience meals through its café-style outlet, which has extended trading hours. Macro Wholefoods has tapped into the modern-day 'conscious consumer', who is concerned with their health and wellbeing, the impact of food production on the environment, and fair trade. As a result their stores in Sydney and Melbourne only sell products that are ethically and environmentally sustainable, with a story to tell.

[105] A VicHealth study mapped food deserts in the City of Maribyrnong and found that two thirds of residents do not have easy access to fresh fruit and vegetables and that for most people it is easier to walk to a poker machine than a fruit shop.

Ensuring adequate returns to producers

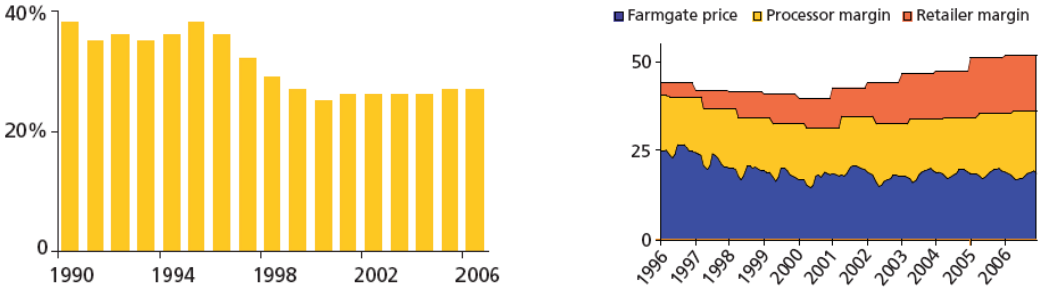
From the first half of this report it should be clear that farming is becoming a more difficult business and will become even more so in future. Significant changes in farming systems will be required, and the skills demanded of successful farmers will continue to increase. One of the key factors that may influence whether or not the farming sector can meet its share of the challenges facing the whole food system is the extent to which prices paid by consumers reflect the full cost of food production, and the share of the retail price that is received by the farmer.

There is a widespread perception among farmers that their share of the price paid by consumers has been shrinking for a long time, and that they are not receiving their fair share of recent food price increases. Julian Cribb (*pers. comm.*) summarises the concern:

> *"The integration of world markets and the dominance of a handful of big supermarket chains has sent a price signal to farmers to get out of food production, and not to invest in new systems. They are actually sowing the seeds of their own shortages."*

The graphs below present some recent UK data. The chart on the left shows the farmers' share of the average retail food basket, which has declined since the 1990s, but now appears to have stabilised. For some products, such as liquid milk (right hand chart), there does appear to have been a shift in the distribution of margins away from farmers towards processors and retailers (UK Cabinet Office 2008).

Figure 6.5 UK Farmers' share of retail food basket, 1990-2006; and liquid milk prices in the supply chain, price per litre (pence) 1996-2006 (UK Cabinet Office 2008).



It would be somewhat surprising if similar trends were not occurring in Australia.

So what can farmers do about this?

> *"As Australian agriculture evolves from being a low-cost supplier of bulk commodities to global markets into a supplier of both bulk commodities and more specialised and differentiated products to higher value markets, the interaction between farmers and the value chain post the farmgate will become an increasingly important element of farm business profitability."*[106]

One obvious strategy is for farmers to try to move further down the value chain, and to capture more of the value accordingly, by differentiating their product and getting involved in its further processing, distribution and marketing.

Michael O'Keefe (2008), in a terrific study commissioned by the Australian Farm Institute and the former National Food Industry Strategy Ltd, has done an excellent job exploring the key ingredients if farmers are to extract greater value from value chains. Using case studies from Britain, Canada and New Zealand, he explores how successful businesses have penetrated the food value chain and identifies some of the critical success factors.

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106 Mick Keogh, Executive Director, Australian Farm Institute in his foreword to O'Keefe (2008) *Value in Value Chains: Collaborative Business Models and Farm Accreditation Systems Examined.*

> *"We now define ourselves as suppliers to our supermarket customers. We used to be sellers of commodities but now we are suppliers. Our aim is to service supermarket customers with a differentiated product/service mix – and not just produce anonymous commodities."*[107]

This is how one of O'Keefe's case study businesses, 3Ms, sees their evolution. 3Ms is a group of three vegetable growers from Suffolk (the '3 Musketeers') and two marketers who joined together seven years ago to improve the marketing of farm produce. They operate a dual business structure that separates marketing activities from R&D and capital investment. They farm approximately 20,000 acres of irrigable light sand, producing about 45,000 tonnes per annum of new and early maincrop potatoes, 30,000 tonnes of onions and 10,000 tonnes of carrots. Evolving from commodity producers to supermarket suppliers has involved the development of a number of new capabilities such as: (1) production capability to guarantee supply; (2) on-farm grading to support direct to supermarket distribution centre supply; and (3) utilising farm waste for electricity generation, and biofuel and fertiliser production. The aim is for the farm to be carbon neutral and to incorporate this into another point of differentiation in the market.

O'Keefe identifies three levels of competition in food marketing. The product/service mix in the market is the first level of competition. It is visible to competitors and relatively easy to copy. *"There are no secrets in food retailing."*[108] The next level of competition is the capabilities that deliver the product and associated services, which are less visible to competitors and more difficult to copy. The third, deeper and most important level of competition is what O'Keefe calls the 'business design'. According to O'Keefe (2008) *"business design innovation encourages capability development which in turn leads to a superior product for consumers."*

O'Keefe (2008) identifies five consistent messages that emerged across all the case studies:

1. The importance of being part of a **competitive system** that creates value for the end consumer. Branding — either retailer or supplier brands — is an integral component of developing systems that are aligned to the end consumer. The brand captures the promise to the consumer. Consumer-aligned systems also provide primary producers with consumer-relevant performance goals.
2. The reward for developing **new capabilities** that are difficult for competitors to copy. Producers cannot expect to be rewarded for simply participating in consumer-aligned systems. They need to develop new skills in production, supply forecasting, recording systems and so on. Furthermore, capabilities evolve over time and the relationship between producer, supplier and retailer needs to change in response.
3. The importance of **partnering** as a specific capability. Most case study producers participated in systems in which they did not interface directly with their supermarket customers. They viewed this as a specific skill that was not in their domain. Leading (category manager) suppliers who work with the supermarkets to grow sales and profits were in a better position to manage the sometimes difficult daily interaction with the supermarket.
4. **Payment systems** matter. There were invariably increased costs of farm production (up to 7-10% in many cases) arising from participation in retailer-aligned fresh food systems. Producers need to monitor their costs of production and ensure that the payment system covers the whole crop or farm production. Product specifications need to balance the needs of the consumer with the realities of agricultural production systems.
5. Producers saw significant **risk management benefits** from being closely aligned to retailer driven supply chains. For example, rather than complain about UK supermarket farm accreditation systems such as Tesco's *Field to Fork* program, producers in the O'Keefe (2008) study tended to see this as a consumer risk management tool. Retailers globally have sensitive antennae to changing consumer concerns over the food they eat and how it is produced. The retailer production and supply chain protocols incorporate these consumer concerns and the grower is unlikely to be caught unawares.

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[107] 3M's Marketing Manager Graham Thorne, quoted in O'Keefe (2008)

[108] O'Keefe (2008 p5)

A number of the producers in O'Keefe's (2008) study emphasised that participating in consumer-aligned food systems gave them very clear performance targets — there is a quality as well as quantity dimension to production. Commodity producers — for example Victorian dairy farmers — are different to most small businesses in that they typically do not compete directly for a customer or consumer. They do not compete for market share *per se* nor do they 'gain or lose' specific customers, a process that has very clear performance implications. It is hard for individual producers to differentiate their product when it is a bulk commodity. Most Australian dairy product is exported as dry milk powder, and there is no reward yet in environmental branding of dairy product in the supermarket. It is easy for commodity producers in this environment to simply focus on quantity performance measures such as kilograms of butterfat.

[109]

Branding, labelling and farm accreditation systems

> *"While there are moves to brand products as clean and/or green, and to expend significant industry association efforts and monies on programs that promote new logos and standards in the marketplace as a means of encouraging greater environmental practices being linked with market rewards, (similar to the established standards and logos in the marketplace denoting organic products in a range of key trading partner markets), there are questions as to the ongoing viability and consumer acceptability of such brands in the marketplace, and their "green credential" claims, along with premiums that may be maintained by such programs."*[110]

The quote at right[111] neatly encapsulates some of the concerns about 'greenwashing'. False claims about the environmental credentials is now a priority for the Australian Competition and Consumer Commission (ACCC).

> ***"Cotton On admits lambskin boots with no lambskin may have misled customers"***

As Michael O'Keefe (2008) notes, branding is crucial in 'capturing the promise to the consumer'. Being able to secure a bigger slice of the customer dollar depends to a large degree on being able to differentiate your product from the rest of the market. But when it comes to sustainability claims,

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109 Woolworths' distribution centre at the Logic Hub just off the Hume Freeway near Wodonga, June 2008.

110 Andrew Monk, *pers comm.*, September 2008.

111 http://www.smartcompany.com.au/Free-Articles/The-Briefing/20080909-Cotton-On-admits-lambskin-boots-with-no-lambskin-may-have-misled-customers.html?source=cmailer

how can the consumer be confident about firstly, whether the claim on the label is true, and secondly, what that means in terms of environmental benefits?

There has been strong interest in Australia in recent years in the development of Environmental Management Systems (EMS), with support from government and industry, in response to this question. For example, the DAFF-funded program **Pathways to Industry Environmental Management Systems** (2004-2007) assisted 19 industry bodies to develop and implement EMS and other environmental assurance approaches that would position them to achieve:

- the adoption of profitable and sustainable farming practices;
- improved natural resource management and environmental outcomes; and
- an ability to demonstrate environmental stewardship to domestic and international markets.

Industry- or commodity-based EMS schemes can play a valuable role in establishing acceptable standards of practice and performance within an industry, and in developing more professional and rigorous quality assurance systems at an enterprise level. They lift the bar for the average producer, underpinning food safety and quality, and setting baselines for minimising environmental damage. However to the extent that they only comprise process measures, and do not measure actual environmental impact, EMS schemes do not of themselves certify environmental outcomes.

BOX 6.6

"THE PRICE WE PAY"

From the promo for ABC TV *4 CORNERS* MONDAY 1 SEPTEMBER 2008

Next on Four Corners: Big and dangerous? Or cheap and friendly? Stephen Long investigates how the astonishing market dominance of Woolworth's and Coles affects consumers, suppliers and the nation's food bowl.

Supermarkets have bulked up. These days they´re retail superpowers who make money not just when we eat or drink but increasingly when we fill the petrol tank, play pokies or buy a hammer from the local hardware - and they´re quietly stalking pharmacies, newsagents and florists.

But food is their staple. Coles and Woolworth´s sell 70 per cent of the dry groceries and half the fresh food that Australians consume - among the highest concentrations of market power in the developed world. Last month the competition watchdog the ACCC officially ticked this arrangement, insisting the market is working.

But the growth in supermarket muscle has come at a cost to many suppliers and small retailers. "Crippling" is how one industry analyst terms Coles´ and Woolies´ power over food producers; the regulator calls it "simply tough dealing". *"It´s just eating my farm away, we´re just finished,"* says a despairing pumpkin grower whose produce retails for as much as 10 times the price he gets for it. He scoffs at the ACCC´s view that the gap between farm gate prices and the checkout isn´t growing.

Don´t like pumpkin? How about an ice-cream story to illustrate supermarkets´ throat-hold? Four Corners meets an ice-cream maker who buys a lot of milk - and bizarrely he gets it cheaper from his local supermarket than from the wholesale processor. Why? Because the wholesaler has to accept ultra low prices from the supermarket - and compensates by inflating his price to smaller buyers, says the ice-cream man.

Or try sausage. One sausage-maker explains the choice he made when the supermarket told him he had to cut his supply price or get kicked off the shelf: *"The only way we would do that was by using lesser quality meat product... and adding soy proteins and what some people might call 'fillings' to extend the product."* He then volunteers to Four Corners that he wouldn´t even eat the product himself.

Suppliers can reel off a list of punishing "rebates" that they must pay supermarkets for product promotions, to get paid on time, or just for the privilege and opportunity of supplying goods. But few are bold enough to do so publicly. Like suppliers to the big supermarkets, minnow retailers are fed up - but more outspoken.

Small liquor merchants can get some beer and wine cheaper from supermarket-owned retail grog barns than they can from wholesalers. Some refuse to see this as competition: *"In the 36 years I´ve been in our two shops I´ve had 12 armed hold-ups, 11 with a gun and one with a machete, and the biggest predator we face is this company here."*

While Coles´ and Woolies´ market clout can translate into cheap prices for consumers, there are fears it may threaten the survival of Australia´s food industry. As reporter Stephen Long reveals, these concerns are held by eminent people at the very top of the food chain. Ultimately it´s up to consumers to decide "The Price We Pay".

Moreover according to O'Keefe (2008), farm accreditation schemes like EMS are a necessary but not sufficient element in differentiating food products in the market place and securing a greater slice of the consumer dollar for producers:

> *"From a producer perspective, however, there is limited value in farm accreditation schemes per se providing the mechanism for producers to capture the benefits from increased consumer value on non-functional fresh food attributes. The brand, not the farm accreditation scheme, provides the point of differentiation and the promise to consumers. Farm accreditation schemes, however, do play a risk management role for the supermarket, supplier and producers by establishing the benchmark food safety and quality protocols."*

Michael O'Keefe underlines the importance of the brand, and makes some very interesting points about the attributes of a successful brand. He distinguishes between functional attributes of a brand, such as colour, flavour, taste and price; and non-functional or credence attributes such as region of origin, production system or feeding regime. Functional attributes of a food can be easily evaluated either before (search attributes) or after consumption (experience attributes), whereas non-functional attributes are difficult to assess even after consumption. O'Keefe (2008) cites studies suggesting that, particularly in more affluent markets, the component of the brand that relates to non-functional characteristics can be more dominant than the functional product attribute factors. Moreover, it is more important to promote the brand as a whole package, than to highlight specific functional attributes, which can be more easily copied by competitors.

From a brand marketing perspective, having an industry EMS is a useful underpinning quality assurance measure, but it does not help much in brand development or differentiation.

Regional distinctiveness, provided it is underpinned by quality production systems, can be a better point of brand differentiation and by definition it is difficult for competitors to copy. For example, returning to the dairy industry, it is easier for the small regional factories like **Bega Cheese**, **Warrnambool Cheese and Butter** and obviously **King Island Dairy** to distinguish their product on the basis of regional branding and sustainability issues than for a big player like Murray Goulburn with 30% of the total dairy market.

6.7 Knowledge

> *"I have always felt that knowledge was better than ignorance,*
> *and we should try knowledge in this country because ignorance hasn't got us very far."*[112]

The Victorian Eco-Innovation Lab (VEIL), through its Sustainable and Secure Food Systems for Victoria project (Larsen et al 2008), has done a very comprehensive job analysing the areas where we suffer from a lack of evidence or knowledge in either seeking to understand the sustainability challenge, or to develop solutions. Those information needs are summarised in Table D1 in Appendix D.

The analysis undertaken during this project underlines the importance of these identified needs. There are very few with which I disagree, and in those instances we differ mainly about the relative priority or preferred approach.

Some key priorities for urgent work to fill information gaps include detailed life cycle analyses (LCAs) to explore and map the stocks and flows of carbon, water and energy across the food system, in particular the through chain. This is needed in order to understand the full environmental footprint and then to identify those areas where gains in efficiency can be made most easily and quickly. It also highlights the areas where the biggest consumption and pollution is taking place, and hence where the need for new technologies is most urgent.

Another obvious area for work is to get a handle on just how big a contribution low-input, 'regenerative' farming systems could make. How big (if at all) is the net reduction in energy and water consumption or carbon pollution per unit of product (or value) compared with conventional approaches, how big is the drop in production (if any), and how high would carbon, water, energy and premium food prices need to go for such systems to be demonstrably more productive in a value sense? Looked at in another way, are these systems ever going to move beyond a niche for a small proportion of consumers demanding particular types of products, into the dominant mainstream approach?

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[112] The late Peter Cullen, quoted in an obituary by Asa Wahlquist, rural writer for *The Australian* http://asawahlquist.com/content/view/26/2/

Finally, in areas close to main population centres at least, we need to be looking much more creatively at waste. Firstly how to minimise it, and secondly how to turn waste streams into nutrient, energy and income streams through smart recycling and re-use systems.

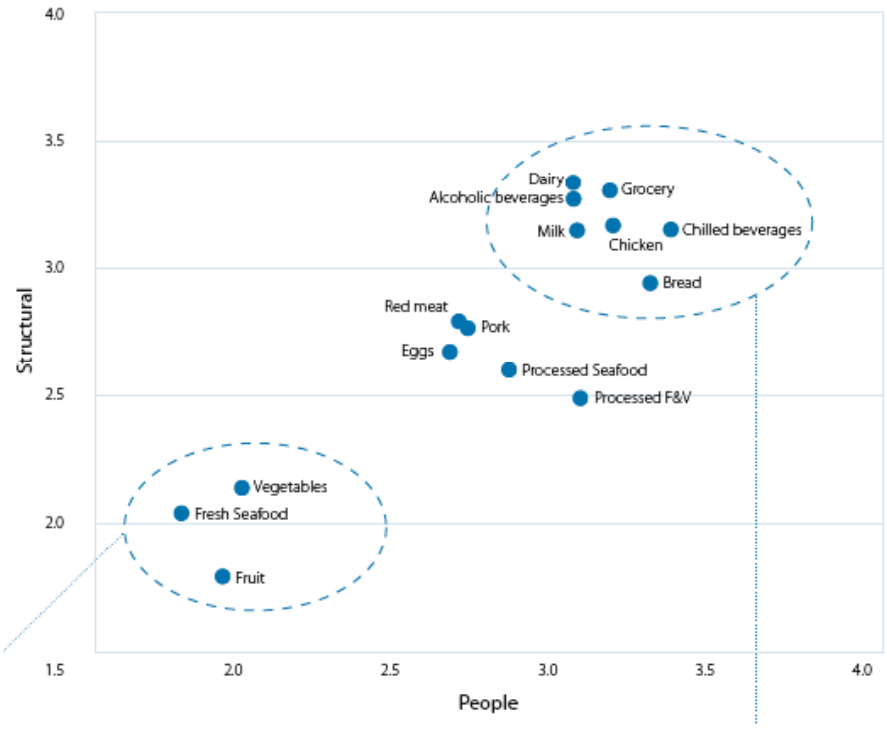
Improving food chain knowledge systems

One of the main difficulties encountered during this project has been finding comprehensive, current information about the 'middle' of the food value chain. The information base about farming systems is voluminous, and the information base at the retail and consumption end of the food chain is reasonable. But the information base in between the two ends of the value chain — around wholesaling, distribution, processing and manufacturing — is much harder to find, fragmented, partial and not always current. This is a significant constraint to the development of a more strategic, forward-looking approach to improving the sustainability and resilience of the Victorian food system in a carbon-, water-, energy-, and nutrient-constrained world.

The best mapping and analysis of Australian food value chains encountered during this project, has been undertaken for DAFF by Freshlogic. The Freshlogic (2007) report presents reasonably comprehensive descriptions of the main food value chains in Australia (those mapped in Figure 6.3 below), with some data cobbled together from disparate data sources. It is a very worthy attempt at a whole system analysis, but was constrained by the coverage, currency and comparability of available datasets.

The graph below compares different Australian food value chains against a range of criteria developed by Freshlogic (2007). The x axis (people) refers to a number of assessment criteria around the human capacity and 'software' within the value chain including information flows and the apparent rate of adoption of innovations. The y axis (structural) refers to the state of structure and process issues (or 'hardware') such as the diversity of products and services in the respective value chain, their yield and logistical efficiency.

Figure 6.3 Summary of the comparative assessments of food value chains (from Freshlogic 2007)



The cluster of value chains circled in the upper right of the graph are assessed by Freshlogic (2007) as performing better. They tend to be characterised by lower numbers of participants, informed markets, greater diversity and stronger brands. These conditions have led to higher levels of innovation, a higher primary product yield and as a direct consequence, greater value capture (Freshlogic 2007).

The poorer-performing cluster in the lower left of the graph is characterised by higher number of participants, existence of a wholesale market clearance function in the chain and low levels of market information. These conditions flow on to challenge the capacities to innovate, limit the diversity of offers, and consequently result in limited success in capturing value (Freshlogic 2007). Vermeulen et al (2008) have produced guidelines on how to improve levels of cross-sector learning within food value chains with these characteristics, dominated by lots of small producers.

Measuring food chain sustainability

As the box below notes, if you can't measure something, it is difficult to manage it.

There are significant information and data gaps along the food value chain that need to be filled in order to make it easier to undertake lifecycle analysis (LCA) of key food products (especially on carbon pollution and water). While LCAs are hard to do comprehensively, they are the best means yet for identifying where systemic improvements can be made, and for supporting modelling that can predict the impacts of interventions to improve the food system (Larsen et al 2008).

Building an information capability that can support system-level analysis along the value chain is a key priority for the Victorian food system.

6.8 Skills and talent

As brands, "agriculture" and "farming" are tired and shop-worn.

We have to re-think, re-tool, re-wire, re-skill and re-brand agriculture if it is to be competitive in attracting and retaining the sorts of people we need.

We need to be thinking about agriculture as a key part of the food system and consequently the health system, and we also need to start seeing it as part of the energy system. Agriculture needs a totally new discourse around human health, nutrition, carbon, water, energy, biodiversity and survival, linked to the big demographic challenges that already have policy attention in Australia.

Such a change of tone might start to see agriculture (producing food, fibre, bioenergy and environmental services in clever ways, working with the landscape rather than against it) become sexy again. The entry scores for university courses would start going up again as the best and brightest students want to engage in one of the world's biggest challenges.

In tackling climate change at a global level, the 'big three' in terms of reducing emissions, are stationary energy (power stations), transport and agriculture. The latter is also meeting the most basic human need — for food. Food has been too cheap for too long, sending messages that agriculture is not where you go if you want to make money and get ahead in life. But with prices rising, that is starting to change. It will change even faster as more people come to realise the strategic significance of having a resilient and innovative food system that makes best use of scarce water, is not extravagant with carbon, delivers delicious healthy foods, and maintains vibrant rural landscapes.

This is a huge agenda.

Strategically, it is at least as important as infrastructure. You can't exploit advantages in natural capital, financial capital or built capital without good human capital.

Leadership

> *"One doesn't discover new lands without consenting to lose sight of the shore for a very long time."*[113]

In thinking about where to start, I would always start with leadership.

Leaders are crucial, not just in changing perceptions about what is possible, in being prepared to 'lose sight of the shore' and in setting directions. Crucially, leaders inspire followers. We tend to make judgments about professions, sectors, industries, sporting teams, political parties and indeed nations — at least in part — on their leadership. Everyone likes to work with good people — people you can look up to.

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[113] André Gide, 1925 *Les Faux-Monnayeurs* (The Counterfeiters), cited in Pretty (1995).

It will be very difficult to attract the sorts of people and skills needed in the Victorian food and farming system in a tightening labour market if the sector is not, and is not seen to be, well led.

This means starting with existing leaders within the sector, and building their skills, networks, confidence and profile. There are already excellent leadership programs in place, including the Australian Rural Leadership Program funded by the Australian Rural Leadership Foundation, the Williamson Community Leadership Program funded by the Hugh Williamson Foundation and managed by Leadership Victoria, and the Vincent Fairfax Fellowship Ethics in Leadership Program run by the St James Ethics Centre and funded by the Vincent Fairfax Ethics in Leadership Foundation. Graduates of these programs, which typically involve several one to two week residential courses per year for one or two years, sometimes including overseas travel, invariably describe such courses as a life-changing experience involving an enormous amount of self-learning, not all of it comfortable. They tend to form close, lasting networks with their fellow course participants, which they continue to draw upon throughout their career.

It would be well worth investigating the potential to run such a leadership program targeted specifically at the Victorian food and farming system, along the full value chain. Such a program would aim to:

1. identify existing and emerging leaders within the sector;
2. build their capacity and confidence to lead within their own businesses and industries; and
3. develop networks along the value chain, improving the cohesion of the whole food system.

A strategic partnership with an existing leadership program, involving several courses over say five years in the first instance, would deliver several cohorts of industry leaders with a powerful network grounded in shared experience and mutual understanding.

This would be one of the fastest and most effective ways to build cohesion across the sector, in addition to the obvious benefit of developing people who are indeed able to discover new lands.

Skills and training

Leadership is a crucial condition, but not a sufficient condition, for attracting talent, and leadership skills are not the only skills required.

It is now well recognised that a large, inexorable demographic momentum will see an annual decline in the number of school leavers over coming decades, with an estimated shortage in the agriculture sector of 123,000 people over the next six years. Declining entry scores for agriculture at tertiary levels indicates that it is not attracting bright young people in the necessary numbers. We need to turn this around. This in part is about re-positioning and re-branding agriculture and food as being a life-sustaining, environmentally sound, high-tech, value-added sector with huge growth potential and lots of rewarding career and lifestyle opportunities in Australia and internationally. It is also about offering great education and training choices, and marketing them well.

New skills are going to be required across the whole sector in order to meet the challenges of producing more and healthier food in a carbon, water, energy and nutrient constrained world. That will mean both attracting and retaining people with the requisite capabilities, aptitude and commitment, and ensuring that appropriate training resources are available to meet their needs and the needs of the sector as a whole.

A crucial early step is to get a handle on the size and diversity of the sector and to research and map its requirements in terms of people and capabilities. This is not a trivial task given the fragmented nature of the sector and the number of SMEs (small and medium enterprises) involved, but it is crucial if investments in education and training are to be targeted to real industry needs.

For example, returning to the challenge of improving engagement of food producers further along the value chain, Michael O'Keefe (2008) makes the point that *"both value creation and protection against imitation rely on a complex bundle of capabilities that are deeply embedded within the firm or within the chain and not simply a single capability."* He identifies the capabilities to develop consumer-aligned fresh food chains as including:

- new product and packaging development;
- consumer insights from market research and shopper insights based on scanning data analysis;
- brand management and development;
- demand and supply forecasting, including ordering and inventory management;
- category planning and non-price based promotional demand management;
- lean supply chain management and supply risk management;
- traceability and production protocols and systems; and
- strategic relationship management and partnering.

It would be interesting to see how easy it is to gain these capabilities within the Victorian food system. Of course this is but one aspect of the broader challenge of improving the performance and resilience of the system in a rapidly changing world. Clearly a mix of approaches will be required, including formal tertiary education,[114] apprenticeships, TAFE and adult education. A comprehensive, integrated education and training package is required.

Ultimately however, we need to improve the environmental literacy of the whole population if we are to deal with climate change. Improving the sustainability of food and farming systems is obviously a key part of this challenge. Box 6.7 overleaf, prepared as part of a **submission** to the 2020 summit is an attempt to map out what a national initiative to improve environmental literacy might entail. It would be a relatively minor tweak to integrate the linkages between food systems, farming systems, and the natural resources on which they depend, into such an initiative. Rather than waiting for national leadership, and given its tradition of innovation in areas like Landcare, Waterwatch, salinity and market-based approaches, Victoria could take the initiative and develop an approach like this at the state level in the first instance, while communicating the broader need and ideas at a national level.

We need to accept that our education systems and the skills base of the food and farming sector are a key element of the situation we are in today.

The majority of broadacre farmers in southern Australia do not make a farm business profit in most years, let alone in drought years.

The aggregate impacts of farm level decisions at the landscape scale illustrate our practical ecological ineptitude and illiteracy in the Australian context. We have spent about ten generations trying to refine European farming systems, based on annual species of crops and pastures, cloven hoofed animals, soil cultivation, flood irrigation and so on, in a colonial context of producing large volumes of undifferentiated, unprocessed products for export markets. We have barely shifted from the species that arrived with the first fleet. Conversely, we have barely scratched the surface in developing farming systems based on native species that are already adapted to this dry, old, leached continent.

By now, ecological concepts and processes such as nutrient, carbon and water cycling, trophic levels, energy transfer, herbivory, competition, predation, parasitism, symbiosis, connectivity, growth, decay, disturbance, pollination and so on — deeply rooted in the Australian context — should be second nature to natural resource managers and those who advise them. This is rarely the case. Our universities barely touch on this stuff, let alone the agricultural colleges. Few mainstream farm management advisers are capable of helping people to modify farm layout and management to enhance ecological integrity at a landscape scale, to 'close the loop' in carbon, water and nutrient cycles, or to re-tune their production system around what we know of climate variability using even the existing forecasting and risk management tools.

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[114] About twenty years ago, Professor **Jim Shute** gave a fascinating lecture at the then School of Agriculture and Forestry at the University of Melbourne, about an overhaul of tertiary agricultural education at the **University of Guelph** in the early 1980s. In response to declining enrolments and entry scores, Guelph completely restructured its large school of agriculture. First it went out and looked at where its graduates were going and interviewed both graduates and their employers. It got a cold shower about how useful the course was in preparing students for the world of employment. It restructured the whole of first year around the hamburger – the food system, cropping, beef, consumer preferences, human diet, marketing etc all taught through the lens of the hamburger. Second year was redesigned around the farming landscape – environmental, water, energy, climate, rural sociology etc. For both the first and second year generalist units they encouraged students from law, medicine, architecture, arts etc to come and do units in the agriculture school. They abolished Ag Economics, Ag Engineering, Ag Biochemistry, Ag Microbiology etc, and encouraged agriculture students interested in those disciplines to do units in the relevant faculties elsewhere in the university. They incorporated a major industry placement for a large part of third year, and in fourth year they started to indulge some specialisation again as students got a better idea of their preferences. According to Jim Shute, the decline in their enrolments and entry scores turned around, as did the feedback from graduates and employers. There are echoes of these themes in the restructured **Melbourne School of Land & Environment** — it will be interesting to track the influence of the **Melbourne Model** on agri-environment-food teaching. **Postscript September 2008**: From its website it appears that Guelph may have reverted slightly to a more traditional Ag Science curriculum, although industry placements are still prominent, as is the food industry dimension. It is noteworthy that they now offer a major in **Organic Agriculture** and have just opened a **Centre for Urban Organic Farming** on their main campus.

BOX 6.7

Building Environmental and Food Literacy among Australians

A big risk with climate change is that individuals feel impotent in the face of something that seems overwhelming. We need to find ways of helping people to come to grips with the changes happening around them in their immediate environment, and to take positive steps to tackle them.

The old mantra about "measurement becomes management" is true. We accept the need for good economic data without question, but seem to think we can respond sensibly to complex environmental challenges in the absence of good data. We need to make more visible, what is currently invisible to most people, and we need to make it measurable and transparent. Further, we need to engage as many citizens as possible in doing so, in ways that are scientifically rigorous. This is doable, in Australia much more than in most countries.

Households with obvious, user-friendly energy meters or water consumption meters in the kitchen where everyone can see them, are more likely to change their behaviour. We need to think creatively about how to hard-wire such mechanisms throughout society, starting from pre-school and extending through basic and applied sciences right to the old folks' homes. Done well, it would engage lots of innovative Australian small businesses working in the sustainability sector (which still does not rate a mention in ABS statistical categories so tends to be invisible as an economic sector, yet it is significant and growing very fast) across climate, water, food, energy, green building, farming systems and so on. It would help to re-position Australia internationally in the climate debate and lead to lots of export opportunities for those SMEs. It would develop a younger generation much better equipped to understand the world around them — hopefully getting them on the front foot, feeling less helpless.

Australia is renowned internationally for innovation and excellence in environmental education and community engagement through initiatives like **Landcare**, **Waterwatch**, **Coastcare** and so on. These programs remain valid and still involve thousands of people, but they are tired and have had no strategic attention over the last decade. They were never well connected to science, and links now are patchy and threadbare. Individual teachers and some schools are doing a great job in environmental education, almost despite the system. The most recent **State of the Environment** Report concluded that it could not report authoritatively on trends in Australia's environment for lack of good quality time-series data. The overall monitoring and evaluation system is in terrible disrepair.

An **Australian Environmental Literacy initiative**, could be easily delivered by 2020 using resources already committed, with seven interdependent and closely linked core elements:

- A schools-based environmental and food education initiative, drawing on the recently completed (but un-launched) national strategy, consistent with the rollout of new technology into schools.
- A national land literacy initiative, drawing together, expanding upon, and providing national support and coordination for all the community-based voluntary 'watch' programs.
- A national innovation centre for analytical tools, technologies and metrics — including tools such as carbon footprinting, lifecycle analyses (LCAs), energy efficiency measures etc (especially those that can assist in integrating consideration of carbon, water and energy), and technologies such as sensing, metering and telemetry systems, linked to mapping systems such as GIS and GPS and user-friendly front ends like Google Earth — that would help schools, community groups, industries and governments at all levels to develop their own 'sustainability dashboards', including the sustainability of their food production & distribution systems.
- A complete federal overhaul to create a single national system to monitor the status of and trends in the condition of natural resources like biodiversity, soil, land and water (complementing and to a degree unifying work already underway in the Bureau of Meteorology on water and in the National Carbon Accounting System).
- An Australian Ecosystem Observation Network that would establish core scientific infrastructure based on a network of sentinel sites for monitoring environmental change at a continental scale and supporting research. This could be complemented by a Farming Systems Research Network, pulling in long term data sets from research farms to establish for each agroecological zone an equivalent of the environmental sentinel sites, but with a greater emphasis on adaptation, rather than just tracking key parameters of change.
- A data and knowledge centre (distributed network across existing super computers) that would work with States, Territories, R&D organisations and other data providers to consolidate both existing and new data into much more accessible and tractable forms (again with front ends like Google Earth).
- An Australian Centre for Ecological Analysis and Synthesis that would analyse data generated through all of the above mechanisms to provide big-picture syntheses of trends and options for policy and other audiences.

For each of these elements, a great deal of preparatory thinking has been done, there are keen and knowledgeable stakeholders ready to go, and the States and Territories are largely already on side. There is enough money already in the system to do most of it. What is needed is national leadership, an overarching vision based on a coherent narrative, and a COAG level agreement to get the federal machinery working cohesively rather than in the current state of fragmentation, amnesia, adhocery and confusion.

Much of this is not sexy, but it could be marketed against a compelling, coherent background narrative.

We need to start with a clean sheet of paper and think about what Australian farming and food systems for Australian climates might look like in a carbon, water, energy and nutrient constrained world — and

consequently what sorts of know-how and people we might need to develop those systems. Land tenure systems, land management regulations, R&D infrastructure and funding, the education system, incentives, the tax system, trade policies — all conspire to prop up the status quo. When a drought coincides with an election year, the prospects of an ecologically informed, long-term policy response become even more remote than good rains.

6.9 Innovation

The earlier section 6.7 touched on knowledge gaps, but less so on how best to re-organise the system to fill those gaps. You can't improve the performance or cohesion of a knowledge system without first understanding it. Vermeulen et al (2008) have developed a guide on how to improve learning along food chains through multi-stakeholder participatory processes, and Campbell (2006) presents an analysis of the Australian Natural Resource Management Knowledge System. Campbell and Schofield (2007) provide a guide on the design and management of knowledge systems for three key purposes:

- to help us make better decisions;
- to underpin innovation; and
- so that we learn as we go along, so that, in the words of Peter Cullen, *"at least we should be making new mistakes."*

A combination of the insights and techniques from these three studies, coupled with the comprehensive analysis of information gaps and innovation opportunities already completed by Larsen et al (2008) would provide a solid platform for designing a project to improve the learning and innovation capacity of the Victorian food and farming system as a whole.

The Freshlogic (2007) analysis raises some interesting questions about the 'premium' versus 'generic' dichotomy discussed earlier, as it suggests that tightly integrated value chains, with a small number of large players and very good market intelligence about their customers, are best able to innovate and capture value. The more decentralised and atomistic fresh fruit, vegetables and seafood markets are not seen as having these characteristics and are seen as less able to innovate and capture value, notwithstanding the health, sustainability or other virtues of their product. The methods and tools outlined in Vermeulen et al (2008) were designed for just such contexts — to help sectors with thousands of small scale producers to capture greater value along the food chain.

A major challenge for the notion of directly reconnecting consumers with the growers of their food, and better rewarding the production of high quality foods grown in sustainable ways, is how to ensure that at a higher system level, the system is learning, innovation is happening and lessons are being shared and learned quickly across a large number of small, scattered players. This highlights the importance, not just of research and innovation, but of the data and knowledge management systems and advisory services that are crucial if we are to make best use of our collective brains in tackling the big challenge of feeding ourselves and others from a declining resource base in a warming climate.

Just as they have done in identifying knowledge needs, the VEIL team (Larsen et al 2008) mapped out what they saw as the key opportunities for innovation in the Victorian food system. These are summarised in Table D2 of Appendix D. Again, this project has reached very similar conclusions about areas where the status quo is patently not good enough, and where new technologies and/or approaches need to be found.

New technologies

If we are to have a third agricultural revolution, then, just as with previous such transformations, it is inevitable that new technologies will play a central driving and enabling role. This will of course be occurring in parallel with and as a part of, a much bigger transformation to decouple the human economy and economic growth from fossil fuel-derived energy, and a shift to renewable energy.

Two of the obvious technologies are with us already, in the form of biotechnology and the information and communication technologies (ICT). Others are still emerging, such as nanotechnology, robotics and photonics. Nanotechnology is the science and technology around manipulation of atoms and molecules to create devices and materials such as electronic circuits, drug delivery systems, new

materials, new structural characteristics and new products constructed on extremely small scales, as small as individual atoms and molecules.

Internationally, research funding for nanotechnologies is increasing rapidly, and nanotechnologies have potential to change many technologies and systems profoundly. For example, a German research team has demonstrated a nanotechnology that could cut residual food waste by half. A nanoparticle-based coating stops food sticking to the sides of the container. In the photo at left (from UK Cabinet Office 2008b), the nano-particle coated bottle is on the right, the standard bottle is on the left.

Nanotechology has the potential to reduce food-borne disease, pesticide use on crops, antibiotics use in livestock and to improve supply-chain efficiency. Nanoproducts in food could improve health, through facilitating the uptake of nutrients for example, but they could be controversial. Inedible nanoproducts, such as food packaging, are likely to be less contentious and are forecast to grow rapidly. For example, researchers at Yale have found that carbon nanotubes have a powerful antimicrobial activity, pointing the way to anti-microbial packaging that improves food safety and extends product life (UK Cabinet Office 2008b).

While each of these technologies is exciting in its own right, the possibilities of using them in combination, called 'convergence' is potentially even more powerful. The convergence of ICT, biotechnology, and nanotechnology could revolutionise science and technology. It has been claimed that *"over the next two decades, the impacts of this convergence on farmers will exceed that of farm mechanisation or of the Green Revolution."*[115] The seeds of Julian Cribb's third agricultural revolution may lie here.

Funding and support models for innovation in the Victorian food system

Because the Victorian food and farming system is not seen as a distinct and coherent entity, there are no mature frameworks to either develop policies or support research and innovation across the sector as a whole from paddock to plate. There are well-established research funding models for agriculture, although the fact that most funds are allocated along commodity lines is proving to be a constraint to amassing sufficient investment in the big cross-cutting issues like water, energy and carbon. And, as Federal Minister for Agriculture Tony Burke[116] has noted, the fact that research levies for R&D Corporations are gathered from farmers but not from wholesalers, distributors, processors or retailers, means that a big proportion of the research dollar is on-farm, not further along the value chain.

In terms of the carbon, water and energy footprint of the food system, where around 80% of the total impact is on-farm, that distribution of research funding is defensible, on paper at least. But it does not help the food and farming system to develop any sense of cohesion along the through chain, nor across commodities.

In reviewing the Cooperative Research Centres (CRC) Program as part of the **National Innovation Review**, Professor Mary O'Kane made an intriguing recommendation:

> *"That a new program be established to assist industry and other end-user groups to undertake strategic analysis or innovation mapping projects and to establish collaborative ventures between end-users and researchers, including publicly funded research institutions. The priority is to support new collaborations in areas with little history of collaborative activity or a low research and development base, particularly service industries and those sectors populated by SMEs."*

Should the Australian Government take up this recommendation, such a new program would seem perfectly suited to the current situation of the Victorian food and farming system: lots of SMEs, both on-farm and along the through chain, little history of collaborative activity across the whole system, and yet a pressing need for innovation and knowledge at the level of the system as a whole. Such a new program could be used to build cross-sector networks and fund scoping activities that would take

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115 ETC Group (2004) cited in Larsen et al (2008)

116 In his speech to the 2008 ABARE Outlook Conference

the higher level analyses in this report and the VEIL Report (Larsen et al 2008), and develop much more detailed and grounded proposals to fill critical evidence gaps and to support much needed innovation across the system.

It would be a good idea to start designing a funding submission for this yet-to-be-announced new program. Having an archetypal project may influence the design of the program, and could well be an attractive pilot.

6.10 Infrastructure

From the discussion above, it should be clear that there are some key areas where new or upgraded infrastructure would make a big difference in facilitating reforms within the Victorian food and farming system that would lead to substantial improvements in its performance and sustainability.

Transport

A good place to start is to add a more comprehensive network of rail freight depots within the existing network, and to develop an integrated food transport strategy that looks at how road, rail, sea and air can best fit together to maximise efficiency while minimising greenhouse gas emissions and energy consumption. Innovative packaging has a role to play here, both to reduce waste, and to keep food fresh for longer, allowing the replacement of some air freight with more energy efficient modes.

As discussed earlier in Box 3.1 describing the greening of the Murray Goulburn milk tanker fleet, there are major capacity constraints in extending the use of Compressed Natural Gas (CNG) in Victoria. Removing these constraints by increasing the natural gas supply and extending the distribution network would enable not just Murray Goulburn, but large components of the truck, bus, tractor and vehicle fleet to be converted either fully to CNG, or as dual fuel with diesel.

While biofuels are clearly not a magic bullet, it is clear that within our lifetimes, or certainly those of our kids, in a big sparsely populated country like Australia we are going to need alternative transport fuels on a significant scale. Whether CNG, lignocellulosic biofuels or fuel cells, there are major technological and infrastructure issues on which we need to get cracking.

Water

The need to improve irrigation and urban water infrastructure to minimise leakage, optimise system level efficiency and facilitate greater re-use and recycling of water is well documented and is being looked at rigorously by the Victorian Water Trust Advisory Council. However it is critical to keep in mind that the more you eliminate leakage from any irrigation system, the more you have to make specific allocations of water to the environment — preferably by reducing extractions in the first place, or by strategic releases of water from storages for environmental purposes. The default outcome from improving water use efficiency is increased production, not more water for the environment. So policy reform must be joined at the hip with infrastructure renewal in order to ensure that improvements in infrastructure do actually deliver more water for the environment and improved sustainability outcomes.

Energy

Renewable energy, in particular biomass energy from woody perennials, has significant infrastructure implications, both to ensure adequate feedstock supply and to provide viable processing options. Identifying a suitable region and developing a business plan for a pilot biomass energy plant would be a good first step. The trial bioenergy plant owned by Verve Energy at Narrogin in Western Australia provides an interesting example from which to learn.

An analysis of energy use along the food value chain, of the kind undertaken by Pimentel et al (2008) for the US, may also reveal opportunities for greater use of renewable energy in food distribution, processing and retailing. The targets set by Tesco as outlined in Box 4.1, suggest that significant energy savings are possible, some of which may require changes to existing infrastructure.

Appendix G from the Harvard Medical School (Epstein et al 2008), outlines the main options to substantially reduce global greenhouse gas emissions. All of these have substantial infrastructure implications. From a Victorian food and farming system perspective, it is important to know which of the broad renewable energy options are likely to play the biggest role in the state meeting its own emissions reduction targets. For example, what role could on-farm biomass energy play in delivering 'smart, cleanly powered grids'? Could Victorian farmers get a feed-in tariff for biomass energy they export to the grid, just as households in South Australia and the ACT are getting for the outputs of their grid-connected solar panels?

6.11 Policy

> *The scale of the challenge of raising output to feed a larger, wealthier human population, adapting to climate change and mitigating food-related emissions, all at once, is not to be understated.*[117]

With characteristic British understatement, this line captures the policy dilemma well.

Improving the sustainability of the Victorian food and farming system exhibits all the attributes of sustainability policy problems described by Stephen Dovers (2005):

- broadened, deepened and highly variable spatial and temporal scales;
- the possibility of absolute ecological limits to human activity;
- irreversible impacts and related policy urgency;
- complexity within and connectivity between problems, both within and across the three arenas of environment, society and economy;
- pervasive risk and uncertainty;
- often cumulative rather than discrete impacts;
- important assets not traded in formal markets, and thus rarely assigned economic value, such as ecosystem services;
- new moral dimensions (e.g. other species, future generations, the world's poor);
- systemic problem causes, embedded in patterns of production, consumption, settlement and governance;
- difficulty in separating public and private costs and benefits;
- lack of available uncontested research methods, policy instruments and management approaches;
- lack of defined policy, management and property rights, roles and responsibilities;
- sheer novelty as a policy field; and
- intense demands (and justification) for increased stakeholder/citizen participation in both policy formulation and actual management.

Little wonder that such policy problems have been described as 'wicked dilemmas'. Dovers argues that they are different both in kind and degree from 'traditional' policy fields for which policy and institutional responses have become well established.

Putting it all together — 'joined up' government

> *Sustainable development provides a new lens through which to view and tackle complex policy issues. Responsibilities within government that used to be viewed separately, such as 'agriculture', 'health', 'energy', 'planning' and 'transport' are now being recognised as elements of a bigger sustainable development picture. Complex issues such as climate change and obesity are posing new challenges for coherent, cross-government policy making and delivery.*[118]

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117 UK Cabinet Office (2008)

118 Sustainable Development Commission, UK (SDC 2008)

Different bits of the food system have always been connected at various levels with a wide cross section of policy areas, but the food and farming system as a whole does not have a mature, coherent policy framework, institutional apparatus or information-gathering capacity. This is a major barrier that constrains it from comprehending something as big and multifaceted as climate change, resource constraints or responding to increasing demand for food in a carbon-constrained economy.

It does not necessarily follow however, that to overcome this barrier we need to invent a new institution, at least not something with an air of permanence. As Dovers (2005) counsels:

> *"One characteristic of persistent, influential institutions is 'goodness of fit' with the operating environment. However, innovative institutional reforms for sustainability, need, at least to some extent, to 'not fit': this defines a core tension in sustainability reform that is 'radical' enough to drive sustainability, but 'mild' enough to be tolerated by the wider system. …Given the depth and complexity of institutional systems and the systemic nature of the causes of sustainability problems, rapid institutional change is unlikely."*

Notwithstanding Steve Dovers' cautions about the potential for rapid institutional change, there are real questions as to whether conventional, compartmentalised approaches to policy development and program delivery are up to the task of improving the sustainability of the Victorian food and farming system.

BOX 6.8

How not to do an integrated agri-food-health policy (a Scottish case)[119]

Scotland has a history of poor diet, and diet-related health problems. It has one of Europe's highest mortality rates from heart disease, and obesity is at the forefront of current health concerns. In Scotland, a 10-year integrated strategy — the Scottish Diet Action Plan (SDAP) — was launched in 1996, calling for a systematic approach to food and health policy. Increasing the consumption of fruit and vegetables became the main goal. The strategy emphasized that changing Scotland's diet and food culture would require a coordinated, partnership approach between government public services, consumers, farmers, and others in the food supply chain.

In 2004 a review found that the SDAP had not met most of its goals. For example, no increase occurred in the per-person daily intake of fruit and vegetables or in the consumption of oil-rich fish or breakfast cereals. Sugar intake actually increased, while no reduction occurred in the intake of complex carbohydrates. A major cause of these shortcomings was the plan's failure to engage the food supply chain. The plan adopted a wholly consensual, partnership approach to 'working with' the food industry and thus underplayed the powerful role of the food supply chain in shaping food content, access, availability and consumer demand over the 10-year period. The plan did not account for the way the powerful marketing and advertising of the food and drink industry could undermine health messages. Institutions and leadership across the supply chain were not aligned effectively. At the producers' end, no reduction occurred in the production of dairy fat, and no alternative, non-food markets were found for butterfat. Nor was the sugar and fat content in processed foods and drinks reduced. No basic training occurred in nutrition for people working in the food industry and the hospitality management curriculum. The plan fell short in increasing consumer demand for fruits and vegetables, whether through primary producers or the catering service.

The review found that the plan failed to influence the agricultural sector. The area devoted to growing soft and orchard fruits and vegetables actually declined, even though Scotland has favorable conditions for growing a wide variety of fruits and vegetables. The plan made a number of recommendations to stimulate consumer demand for fruits and vegetables, but these recommendations did not find their way into policies on agriculture and farming. No actions to prioritise fruits and vegetables were included in the Scottish Executive 2001 report, nor were they included in Scotland's 2003 Organic Action Plan. The review recommended that, given the complexity of modern food systems, action must be coordinated across all levels of food governance.

The challenge for Victorian policy makers is to develop a coherent view about the future development of the food and farming system and the challenges it faces, across traditional departmental boundaries. In doing so, it will be critical to strike the right balance between two extremes:

- a monolithic, central agency-driven, whole of government approach that necessarily stays at a high level and misses out on the richness of insight and detail that specialist expertise and networks within line agencies can provide; or

[119] From Tyrchniewicz and McDonald (December 2007)

- a loose confederation of line agencies pushing their own agendas and squabbling for resources with insufficient attention to cross-cutting issues like skills, infrastructure or the knowledge base, and limited cohesion in delivering an overall strategy.

Getting synergies across departments is just a start. It is equally important to develop productive collaborative approaches that extend beyond government to include industry (along the entire food chain), NGOs (in the environment, agriculture, health and community sectors) and consumers. In developing such collaborations, it is very important to establish from the outset the value proposition for the collaboration — why should people and organisations invest their time and potentially bury their own brand in a big, complex, multifaceted effort involving lots of players? The answer has to be around getting a better outcome, and that being in everyone's best interests.

The risk with large, multi-partner collaborations is that, in the interests of 'keeping everyone in the tent' they can easily become risk averse, defaulting to lowest common denominator approaches that don't offend anyone, but don't actually get very far. Such collaborations quickly become 'small c' coordination and information sharing exercises and often fizzle out. Big collaborations that make a difference take the time to get their value proposition right, and to be very clear about the ultimate objective — with commitment to that objective being the entry card to the partnership. The successful ones invariably have good leaders, able to focus on the big picture while ensuring that all partners get heard and get a fair go — which does not necessarily equate to getting their own way.

It is worth thinking about what such a collaboration across the Victorian food and farming system might look like — involving *inter alia* industry from all components of the value chain, NGOs, the community sector, education and training, and government.

BOX 6.9

Reflections on the DNRE split into DPI and DSE

The discussion towards the end of Section 3 about the Victorian Future Farming Strategy and the Green Paper on Land & Biodiversity in a time of Climate Change highlights one of the key issues for a sector as multifaceted as the food system facing a broad suite of challenges as outlined here.

There is a natural and understandable tendency for government agencies and most Ministers to focus more on those issues and areas that are central to their responsibilities, and to tread more warily as they get towards the edges of their mandates, lest they be seen to be encroaching on the territory of other agencies. Going across the boundaries set out in the administrative orders from the Premier to each Minister necessitates collaborative activities across two or more sets of hierarchies and decision making processes that inevitably slows things down and makes things more complicated and expensive. So there is a centripetal force sucking focus inwards towards 'core business', rather than outwards towards more holistic analyses and collaboration, or (heaven forbid) the inevitably cumbersome and slow moving 'whole of government' approaches coordinated by central agencies.

From the outside, the Land and Biodiversity Green Paper appears to pay insufficient attention to farming systems and farming practices, and the Future Farming Strategy pays insufficient attention to landscape ecology and biodiversity, although it does cross-reference the Green Paper. Neither of them explore linkages to the health system or the relationship between human health and environmental health. It is interesting to reflect on whether this would have been the case had the former Department of Natural Resources and Environment (DNRE) not been split into the Department of Primary Industries (DPI) and the Department of Sustainability and Environment (DSE). From my perspective, having been in national roles dealing with all state and territory primary industries, environment and natural resources agencies over the last 20 years, the DNRE was the best administrative model that had yet evolved in Australia for dealing with the complexities of sustainable agriculture and natural resource management across private and public lands.

The challenges represented by climate change — across food, water, energy, carbon and biodiversity — demand a highly integrated approach to policy development, to knowledge management including R&D and monitoring, and to program implementation including extension and advisory services. To my mind, the former DNRE, coupled with Victoria's CMA framework (with catchment levies reintroduced) and the community landcare network, would have been by far the best institutional framework in Australia for working through such a complex and compelling set of interconnected issues, and for the critical task of bringing the community along at the necessary pace.

The likely continuing divergence between DPI and DSE, as time goes on, agency boundaries solidify and the proportion of staff who worked together in DNRE declines, could impede Victoria in achieving its potential to lead in ensuring the sustainability and productivity of a food and farming system in the face of climate change.

All the earlier points about leadership are particularly potent in the policy domain.

There is enormous inertia vested in the status quo. The interests that are favoured by the current

situation are usually better resourced and more influential than those wishing to challenge it, especially in the direction of making it more sustainable.

Policy leadership can be challenging in a pluralistic democratic society, because (particularly with short electoral cycles) it is difficult to get too far in front of key stakeholders. The trick is getting those stakeholders to show sufficient leadership themselves — through appeals to enlightened self interest, awards and strategic appointments etc — to push the boundaries of public debate and industry commitment, to create political space in which policy can move and innovate.

In the content of the Victorian food system, an option worth considering would be to take the institutional food sector (schools, hospitals, nursing homes etc), which is highly dependent upon and influenced by government, and use it as a pilot for exploring and demonstrating new approaches to improving its environmental and health performance. This would set a great example (the best form of leadership) and would deliver significant public health and environmental benefits in its own right. Conversely, if government is incapable of lifting its own game with the parts of the food system it controls, then its credibility in leading reform of the wider food and farming system is compromised.

Finally, in any section discussing policy options, it is important to keep in mind the full repertoire of policy instruments that can potentially be brought to bear. We tend to default to regulation vs incentives vs planning vs education or research, when in fact there is a much richer menu of possibilities, as Steve Dovers has articulated in Table 6.1 below.

Table 6.1 Policy instruments for supporting change (from SELN 2006 after Dovers 1995)

1. Regulation, Enforcement and Compliance	Statutes, laws and regulations provide institutional guidelines and specify agency responsibilities for enforcing minimum standards, prohibiting certain practices and regulating resource use in policy areas such as landuse planning, water allocation, pollution and food standards. Enforcement and compliance of regulatory frameworks facilitate changed practices. A major risk is that 'command and control' approaches limit effectiveness in achieving more than minimum standards. Regulation *per se* is rarely effective without sufficient effort on enforcement and compliance.
2. Direct Investment	Sometimes when specific on-ground outcomes are desired, the most effective mechanism is direct investment – to contract to deliver a specified outcome.
3. Covenants and MoUs	Voluntary but official agreements and contracts for performance of a particular activity can support change processes. Examples include conservation agreements tied to property title.
4. Common Law, Duty of Care, Stewardship	Common Law refers to a system of law based on custom and general social principles that are embodied in centuries of legal case history judgments. Common Law recognises social norms, community values and rights as key enablers of effective and sustainable practice. Within Common Law there are notions of a Duty of Care that persons have to ensure that they do not create harm to others. Potentially this Duty of Care extends to the environment.
5. Formal Agreements	There are a variety of formal mechanisms that can be used between governments and other entities to facilitate action. Governments can commission industry bodies or other organisations to deliver certain services or outcomes.
6. Research and Development	R&D increases the stock of knowledge through basic and applied research. The implementation and adoption of research outputs contributes to practice change and the achievement of sustainable and productive outcomes.
7. Monitoring and Evaluation	Monitoring and evaluation enables progress towards policy or program goals to be measured. Evaluation of methods used to create change is necessary to enable fine-tuning of the instruments through adaptive management.
8. Assessment Procedures	Procedures such as environmental impact assessment (EIA), social impact assessment (SIA), health impact assessment (HIA), strategic environmental assessment (SEA), lifecycle assessment (LCA), triple bottom line accounting (TBL) and sustainability assessment all have goals of improving environmental and social outcomes. By providing information about sources of harm, and opportunities for improvement, these assessment tools can facilitate change.
9. Self-Regulation	Codes of practice, codes of ethics and professional standards are approaches that encourage stakeholders to change their own practices in order to meet commonly accepted standards of practice. The process of developing these codes, and awareness of them, leads to practice change.
10. Quality Assurance processes, EMS and Ecolabling	Encouragement of the implementation of Quality Assurance processes (such as Environmental Management Systems and Farm Management Systems) can encourage continuous improvement, monitoring and benchmarking against best practice. Ecolabeling is a market-based mechanism where the establishment of an ecolabel potentially provides competitive advantage to products produced under this label. Ecolabeling is in effect a code of conduct that ensures the quality assurance of environmentally sound practices.
11. PR, Marketing and Advertising	The achievement of change can sometimes be facilitated by a public relations, advertising or marketing campaign. Awareness of an issue or of practical solutions is sometimes all that is required for change to occur.
12. Formal Education and Training	Public, targeted formal education and training programs can improve knowledge and develop skills in a specific area as a means to enabling practice change and on-ground improvements.
13. Suasion	Appeals to the right thing to do — campaigns that promote what is socially desirable.
14. Extension	Extension is the process of enabling change in individuals, communities and industries involved in the primary industry sector and with natural resource management. While extension seeks to improve communication and information flow between industry, agency and community stakeholders, it is primarily concerned with building capacity for change.
15. Participatory Approaches	Solving complex, unstructured problems requires inclusive institutions and participatory processes of mediation, negotiation, dispute resolution and other deliberative mechanisms with community and industry stakeholders. Participatory approaches may contribute to collective ownership of an issue and a willingness to take action.
16. Market-based Mechanisms	Market-based mechanisms usually involve the assignment of property rights to goods that are not normally traded through a market, and setting up competitive processes for the provision of those goods.
17. Economic Incentives	Economic incentives refer to a range of financial inducements that attempt to change behaviour through monetary reward or penalty including: taxes on bad practices, use charges, tax deductions and/or rebates/credits, rate relief, subsidies and co-funding arrangements, direct grants, and penalties for poor practice.
18. Conditionalities or cross-compliance	Conditionalities refers to the conditions that can be imposed on a business in conjunction with the granting of, for example, a licence to operate or an economic incentive. This may include stipulations on emission levels, offset compensation (such as revegetation in one area to compensate for clearing in another), and/or performance bonds.
19. Institutional Arrangements	Responsive institutional environments are necessary for enabling other instruments, policies and management. The capacity of institutions to change is essential for improving inter-organisational outcomes.
20. Change other policies	Actions to influence and/or distort policies or statutory objects can induce change processes. Examples include: ineffective subsidies; conflicting policies and misplaced or outdated statutory objects.
21. Reasoned Inaction	*Doing nothing* is valid where justified by due consideration, eg. allowing market forces to prevail.

Chapter 7. Flying some kites

This chapter is not written as the first draft of the propositions document that will follow this one. Rather, it should be read as a series of thought balloons, intended to open up thinking about possibilities for 'where to next'. Some of these may be workable, some not, but all are of value to the extent to which they draw out and stimulate ideas that could contribute to a better performing and more resilient Victorian food and farming sector.

7.1 Higher level strategy

In developing strategy, it is always important to have a good answer for the 'why?' questions before diving into 'what' you are going to do.

Setting some ambitious goals for the Victorian food and farming system is an important first step. Some of these could include:

- Positioning the Victorian food system as a whole, and Melbourne as a city, as world-leading exemplars of how to produce and market healthy, sustainable foods in a highly variable, warming and drying climate (linking this to tourism & business development marketing);
- Use the food and farming system to pilot a new approach to integrated planning across government (portfolios including transport, energy, health, water, agriculture, environment, education etc) to deal with cross-cutting issues like infrastructure, skills and innovation;
- Ensuring that all Victorians have access to safe, healthy, affordable fresh foods;
- Working with other sectors including health, education and sport to halve the overall rate of obesity in the Victorian population and reduce it by a factor of four among children, by 2020;
- 50/50 by 2020 for energy use in the Victorian food and farming system: 50% reduction in energy consumption and 50% of energy from renewable sources, by 2020 across the Victorian food and farming system;
- 'factor 4' for water consumption by 2020 — halving water consumption and doubling total production, equating to a fourfold increase in productivity from the water used;
- 'factor 4' for water recycling — doubling the proportion of water that is recycled, and doubling the use of recycled water, especially in urban food production and in the processing sector;
- halving Victorian food waste (and waste along the food chain) and doubling the amount of food waste that is recycled or used for bioenergy production by 2020;
- ensuring that all new residential developments in Victorian cities incorporate Food Sensitive Urban Design principles as well as Water Sensitive Urban Design principles — securing the best soils for food production, providing community gardens (in areas of maximum population density and integrated with stormwater recycling etc), maximising recycling options for water, nutrients and energy, aligning public transport and fresh food outlets and so on;

As a key element, not just of its climate change response but as a strategic direction for the state as a whole, Victoria needs a comprehensive, integrated food strategy. It should have ambitious goals, it should be long term in its focus, but within reasonable planning horizons — say to 2020 — its development should involve many players across the sector, and it should be bipartisan, at least at a strategic level. This would sit well with the government's innovation and regional development priorities, it is very consistent with Victoria's proud history of innovation in natural resource management, and it bridges the health and sustainability agendas.

A very early step in developing any more strategic, integrated approach across the food and farming system is to get the sector working together and thinking about the system as a whole. This means developing new collaborative platform(s) across the sector, involving representatives from industry (along the entire food chain), the community sector including consumers, NGOs (farming, environment, health) and government. As outlined previously and below, a crucial element in fomenting synergy across the sector is leadership — not just high profile figureheads, but several cohorts of talented, committed, well-networked people interested in the long term development of the sector as a whole, and determined to achieve excellence within their part of it.

Piloting innovation in sustainable food and farming systems

Some of the more innovative elements of a new food strategy for Victoria will be necessarily experimental. They should be designed as such, with systematic measurement and monitoring built-in, so that lessons can be learned quickly and shared easily. One way of doing this is to establish some high profile pilot projects to test and demonstrate key aspects of a new approach. Such pilot projects lend themselves to attracting co-funding from external sources, including the Commonwealth, the corporate sector and the philanthropic sector. Here are some potential examples.

Landscape reconfiguration.
It is clear that some irrigation areas — for example along the Murray in northern Victoria — that have enjoyed high levels of water security in the past, will have to survive in the future with much less water, and much less reliable water. Radical re-configuration of irrigation infrastructure may be required, and it is likely that fewer farms will remain viable. With good planning, it is possible to reconfigure property boundaries and irrigation infrastructure to restore floodplain connectivity and floodplain-river connectivity, to return some land to environmental services, and to finish up with a fewer number of larger, more viable and more sustainable farms in the most favourable parts of the landscape for agriculture. Those people wishing to leave the irrigation industry can do so receiving a good price for their properties, and those determined to stay have opportunities to secure a better designed, better located, better serviced property. There are potential investors like VicSuper for such landscape reconstruction projects. It would be interesting to call for expressions of interest from irrigation districts and from investors, willing to investigate the potential for a **pilot large-scale landscape reconfiguration project**. Such a project would deliver significant water savings, big improvements in water security, restoration of environmental assets and ecological function, and opportunities for people to leave the irrigation industry with dignity and reasonable financial equity.

Reuniting rail and food
A recent study (Gaballa & Cranley 2008) found that it would be possible to almost halve the transport emissions from the Victorian food system by adding a comprehensive network of rail freight depots to the existing rail network, and then using rail wherever possible. Noting that, especially in spread-out cities like Melbourne, the biggest component of 'food miles' in many instances is the travel done by consumers, it is important to think about how food purchasing could also be better aligned with the rail network. It would be instructive to design and set up a pilot project to locate one or more fresh food markets and food retailers with the rail network so that both producers and consumers could use trains to get to the market, coupled with a research project to measure savings achieved and evaluate the overall benefit-cost for producers, consumers and the environment.

Urban food production
The Victorian government estimates that it will need 600,000 new houses to meet projected demand from current population trajectories. Presumably this means more suburban development. This should not mean further expansion of the ugly, resource consuming, energy guzzling, poorly serviced "McMansion" estates dominated by hard surfaces and lacking even street trees, that have been allowed to blot and consume the landscapes around Melbourne over recent decades. A **pilot urban development project** could look at urban food production, water, energy, waste, residential design and public transport in an integrated way, with ambitious targets for urban food production and to eliminate food deserts. Community gardens, market gardens and fresh food markets could be co-located with public transport, with areas of high population density and with for example aged care facilities — and designed to utilise and recycle organic wastes, storm water and renewable energy. Such a project could start with an international design competition to attract the best and brightest urban planners, environmental consultants and sustainability architects from around the world, to work on a challenge that will be confronting all big cities over coming decades. A complementary project could look at retrofitting an existing older suburb to increase urban food production.

Woody biomass energy
Western Australia already has a pilot integrated wood processing plant at Narrogin owned by Verve Energy producing biomass energy, activated charcoal and eucalyptus oil from alley crops of oil mallees planted by wheatbelt farmers. It would be instructive to investigate the establishment of a **pilot biomass energy plant** in Victoria capable of utilising both forestry by-products, woody biomass crops and agricultural wastes, in order to develop a key piece of the jigsaw if we are to reduce energy use, increase use of renewable energy and offset greenhouse gas emissions in the food and farming system.

7.2 Project level ideas

The following are some project-level suggestions. This list does not purport to be comprehensive, nor organised. Much more detailed and better integrated implementation ideas would emerge from a systematic strategy development approach as foreshadowed above. But these ideas hint at the breadth and scope of the activities that will be needed if Victoria is to equip its food and farming system to produce more healthy foods, more sustainably, in a much more difficult climate, while consuming less water, nutrients and energy.

A world centre of excellence in premium sustainable food systems
Developing and implementing the sort of strategy envisaged above will require some seriously talented people, with specialist expertise in areas like agro-ecology, supply chain management, smart water management, renewable energy, urban design, biotechnology, transport, human ecology and so on. But having brilliant specialists will not be sufficient — it could even be counter-productive — in the absence of equally good thinking about how such elements interact and fit together at the level of the food system as a whole. Such thinking is more likely to develop and be promulgated where people are working together and interacting on a daily basis. A Centre of Excellence in Sustainable Food Systems (preferably located with and partnering an existing institution), appropriately resourced and mandated, would attract talent from around the world, build a critical mass of expertise, and start to develop a new praxis around food system design and management in a carbon-constrained economy. A high profile project for such a centre could be *"The Foodies"* — a biannual awards night celebrating excellence across the whole food and farming system and along the value chain from paddock to plate.

A premium sustainable food systems research alliance
A sustainable food and farming systems research alliance would undertake further research scoping work and fill key information gaps, building on the work done in this project and the VEIL project (Larsen et al 2008).

Leaders in sustainable food systems
Call for expressions of interest from existing leadership programs like the ARLP, Williamson and Fairfax leadership programs, to undertake several leadership programs targeted at participants from across the food and farming sector over the next five years. Courses would be explicitly designed to build networks and social capital across the sector, across commodities and along the food value chain including key consumer groups and the community and health sectors. They would target people already in leadership roles and people with leadership potential, and they would be informed by a deep understanding of career opportunities in the sector and international trends.

Farming without oil
Victoria has a significant auto manufacturing and components sector that is already receiving significant government funding to help improve fuel efficiency. Why not challenge the sector to mobilise some of its engineering and design expertise to retrofit tractors to use renewable fuels, or further, to develop a tractor drivetrain that is 'beyond oil' — e.g. a solar-electric tractor?

Bridging Bass Strait
Victoria is already a significant food importer. Building resilience in the Victorian food system may mean identifying areas of supply vulnerability and alternative sources of supply, then to look around for allies and trade partners with complementary strengths in terms of access to water, good soils, nutrients, renewable energy and so on (Tasmania? New Zealand? Queensland? parts of China?), and look to form strategic alliances and durable trade relationships that would improve resilience and provide export opportunities. For example, the Victorian government could offer Tasmania assistance in gaining an AFL team, in return for greater integration of the food systems, access to good soils, fresh water, clean energy and carbon offsets, and a combined R&D effort.

Reinventing public sector food.
The government provides millions of meals every day in hospitals, aged care facilities, prisons, defence establishments and so on. Government is a very significant direct player in the food system and a very large customer. There is a glaring opportunity to use public sector foods to drive innovation in the system by setting mandatory sustainability and health standards for these foods, shortening food chains and rewarding Victorian food producers that are meeting high sustainability and health standards.

Chapter 8. Conclusion and next steps

Healthy environments, healthy farming systems, healthy foods and healthy people are intricately intertwined.

From a human health, environmental health and economic health perspective, there are very strong imperatives to improve the performance of the Victorian food and farming system right now. Business as usual is not a viable option, especially when the challenges of the decade ahead are considered.

World demand for food will double by about 2050. Food prices are likely to continue to increase, although the shape of the supply and price curves is less predictable than that of the demand curve. There are immense opportunities for the industries, sectors and regions able to meet these demands.

However food production is becoming more difficult in many parts of the world, not least in Victoria.

Climate change is here already. In Victoria it is driving radical reductions in run off and water resource availability, hotter, drier conditions, less reliable seasonality, shorter growing seasons and a likely increase in the risk of losses due to bushfires, pests, weeds and diseases. In order to thrive in this more difficult environment, Victorian farming systems will need to manage climate risk extremely well. Doing so will open up further significant export opportunities, not just for the products of the farming systems, but for the expertise and technologies behind them.

Supply constraints on oil and phosphate, coupled with increasing demand, have led to rises in their price that are likely to continue. The era of abundant cheap fossil fuels is over. The fact that oil is a component of so many farm inputs including nitrogenous fertilisers has driven consequent price rises for those inputs. Prices received by farmers have generally not risen as quickly as food retail prices.

Looking beyond the farm gate, there are opportunities to improve the carbon, water and energy efficiencies of the Victorian food system. However these are generally more modest than the on-farm opportunities and involve more systemic changes to infrastructure and policies. More could be done to improve the linkages between the food system and the health system, to make healthier, fresh local produce more accessible and to reduce the carbon pollution associated with its consumption.

The commencement of the Carbon Pollution Reduction Scheme, and in particular the entry of agriculture into the scheme sometime after 2013, represents a critical juncture for the Victorian food and farming system. An enormous amount of work needs to be done between now and then to help farmers and other food system players to capture opportunities arising from the carbon market while minimising the risks of being squeezed by the price on carbon.

At a strategic level, the Victorian food and farming sector needs to make a conscious decision about the balance of its portfolio across two key trajectories in the global food market:

- The ‘premium road’ servicing affluent, discerning markets demanding highly differentiated foods with known and trusted characteristics about environmental impacts, animal welfare and food safety; or
- The ‘generic road’ producing large volumes of undifferentiated base commodities at least cost on lower margins, meeting the minimum regulatory food safety and environmental standards.

If it is to target the former end of the market, then serious attention needs to be given to the measurement systems, standards and systems of accreditation and labelling that are necessary to provide consumers with the information and confidence they need to be comfortable with the premium prices paid for these products. In order to develop such systems, considerable work needs to be done at a base line level with Life Cycle Analyses of different products, production systems and value chains to generate robust data and to identify areas for improvement.

Positioning the Victorian food system at the premium end of the market will also entail significant attention to infrastructure such as renewable energy, water and transport to improve the systemic efficiency and reduce the environmental footprint of the system as a whole.

In order to deliver all of the above, a very significant investment in human capacity will be required, to develop the necessary leadership and skills among food system participants, and also to improve the environmental literacy of the wider community. Knowledge is already one of the major export products of the Australian mining industry. Hard won Victorian know how in the production of premium foods in a variable climate will be a significant export opportunity as other countries start to grapple with similar challenges, but from a much lower base of climate risk management. Victoria can lead the world in designing sustainable food and farming systems for a warming, drying climate, generating significant know how, innovation, regional development and export income along the way.

The fundamental challenge that emerges from this study is to develop farming systems that are more intrinsically Australian: that are resilient in the face of extreme weather and extreme seasonal variability; that are miserly with water and conserving of energy; that maintain groundcover and are kind to the soil; that sit lightly on the landscape and don't displace native wildlife or habitat; that are highly profitable in good seasons and don't lose money in bad seasons; that preserve and build their natural, human and financial capital; that recover quickly from shocks and stress; that attract and retain young, talented people on the land; that generate jobs and income in regional communities; and that produce things in high demand for good prices.

One of the big policy challenges for industries, communities and governments is to find ways to return a bigger slice of the food price cake back to the producer — and to ensure that higher returns are reinvested in measures that improve the sustainability of the system. Just as climate change writ large represents a colossal market failure, the fact that the price paid for food by consumers does not reflect the full costs of production in terms of agriculture's environmental footprint, is also a market failure that fundamentally constrains the ability of farmers to produce food and fibre more sustainably. Correcting the market failures within the food system so that consumers pay a more realistic price for food (mindful of equity issues), and so that farmers receive their due portion of that price, would be one of the most effective ways of enabling food producers to retool their businesses for much more demanding conditions.

The performance and quality of the food system is a core indicator of the health of any society. The food system has a huge environmental footprint, and is fundamentally dependent on natural resources and environmental services. Food is Victoria's largest manufacturing sector and a very large component of export revenue. The food and farming system is a very significant employer of Victorians throughout the state, especially in the regions. Victoria has a very strong science base underpinning its food and farming system and a great platform for innovation and adding value.

Improving the improving the performance, sustainability and resilience of the food and farming system, to thrive and to meet community expectations in a more demanding world, is a very good fit with the government's priorities in innovation, regional development and sustainability.

The sustainability question for Australians is a simple one. Do we continue to manage this country as if we are just passing through, here to extract what we can and live off the profits elsewhere, or do we start to think and act as if we are here to stay, for good?

The major challenge of our time is how to develop a vibrant, self-reliant, carbon-constrained economy and sustain a reasonable quality of life, equitably shared, without depleting or degrading the resources upon which we and future generations depend. This challenge is universal. Grappling with it is a certain growth industry of this century.

Victoria is uniquely placed to make an important contribution.

8.1 Next Steps

If you have received a copy of this draft and wish to comment on it,
please send your feedback and suggestions to andrew@triplehelix.com.au

A stakeholder workshop on 3 October will build on the analysis presented here to develop suggestions and ideas that could improve the sustainability, resilience and profitability of the Victorian food and farming system.

After the workshop, this document will become the background document to a much smaller, crisper document, that will attempt to draw together some of the themes from this paper with the hopefully brilliant insights generated by the workshop. It will develop more detailed propositions to better prepare and position the Victorian food and farming system to be successful in a carbon, energy and water constrained world, against a background of on-going climate change.

The propositions document will be completed by 17 October, and considered by the 3FP Project Reference Panel at its 27 October meeting. The revised and approved final document is scheduled to be printed and ready for a public launch by late November 2008.

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APPENDIX A: Reference Group

A reference group of progressive practitioners and opinion leaders in the fields of agriculture, food and the environment has been established to:

- Assist in selecting the consultant and providing strategic advice;
- Review and refine the proposed outputs, terms of reference and methods;
- Review the draft documents;
- Add intellectual value, real-world experience and integrity to the project; and
- Champion project aims and, *where possible*, recommendations through their networks.

The reference group is selected primarily on the basis of skill, experience and integrity, and secondarily in an effort to secure key stakeholder representation from across the supply chain. It includes senior policy makers, leading researchers, producers, environmentalists, businesspeople, and corporate managers from around Victoria, Australia and the United Kingdom

The membership of the reference group is:

- Prof. Snow Barlow, Professor of Horticulture & Viticulture, Institute for Land & Food Resources, Melbourne University, Victoria.
- Mr Michael Batycki, Senior Business Manager, Fresh Food, Woolworths Ltd., NSW.
- Ms Dure Dara OAM, Restaurateur & Chair, Victorian Women's Trust
- Ms Kimberley Dripps*, Executive Director, Biodiversity & Ecosystem Services, Department of Sustainability & Environment, Victoria.
- Mr Liam Egerton, Climate Change Adaptation Group, Department of Sustainability & Environment, Victoria.
- Dr Christine Forster*, Farmer, Victoria.
- Mr Cullen Gunn, Natural Resource Management Consultant, Bendigo, Victoria.
- Ms Clare Hughes, Food Policy Officer, Choice, Sydney, NSW.
- Ms Kirsten Larsen, Researcher, Victorian Eco-Innovation Laboratory, Melbourne University, Victoria.
- Mr Andrew Monk, Organic Agriculture Consultant, Victoria.
- Mr John Pettigrew, Farmer, Victoria.
- Ms Catherine Phelps, Environmental Officer, Dairy Australia Ltd., Victoria
- Prof. Jules Pretty* OBE, Professor of Environment & Society, University of Essex, UK.
- Ms Gioia Small, Manager, Sustainable Viticulture, Foster's Group Ltd, Adelaide, SA.

* Corresponding member

APPENDIX B: Project Terms of Reference

The 3FP project involves three stages: an initial report, a stakeholder workshop and a final proposal. In this way it is hoped that the project's impact and reach can be maximised. The methodology will be qualitative, involving a desktop literature review, strategic foresight work, issues and power mapping, and consultation with the reference group, the workshop delegates and other stakeholders.

The following terms of reference were agreed by the reference group at its first meeting. The group acknowledges however that the project's scope may be refined following discussion between it, the consultant and ACF.

Stage 1: A scoping paper - prepared by the consultant - including:

a. Taking note of current policy directions, and relevant national and global trends (including market research), an overview of the key (private and public sector) players in Victoria's agri-food sector, and the degree to which they are taking up key sustainability challenges and opportunities, particularly:
    - Reducing greenhouse pollution to sustainable levels, and building resilience in a changing climate and a carbon-constrained economy; and
    - Protecting and enhancing biodiversity, ecosystem health, natural resources and critical life-support services (inc. soil fertility, water quality, etc.);
    - Promoting sustainable livelihoods and prosperity, healthy communities, and social justice.

b. Identification of key information gaps and other obstacles to progress;

c. A broad review of overseas experience with sustainability policy and strategy in the agricultural and food industry arena; paying particular attention to key themes, issues and directions. .

Stage 2: A workshop — organised by ACF and attended by the consultant — involving key stakeholders and opinion leaders in Victoria's food, farming and sustainability communities to:

a. Draw out and discuss emerging themes, issues and directions from the Stage 1 report;

b. Raise public awareness of the project, themes, issues and directions;

c. Bring together diverse individuals and groups to focus on the challenges & opportunities for sustainable food and farming in Victoria;

d. *Begin* to craft a shared vision (inc. key objectives, outcomes and actions) for a sustainable future for food & farming in Victoria; and

e. Inform the development of the next stage of the project.

The consultant will present the Stage 1 report to the workshop, participate in discussions as appropriate and take note of proceedings to inform Stage 3. Submissions may also be invited from those delegates unable to attend. The consultant is expected to consult widely, to build on the scoping paper and to draw on the workshop in the process of drafting Stage 3.

Stage 3: A detailed strategy — prepared by the consultant — for a step-change towards sustainable food & farming in Victoria that would:

a. Enable Victoria's agri-food sector to more clearly demonstrate its commitment to ESD, maintain or enhance competitiveness and efficiency, develop new environmental industries, and access emerging markets for "clean & green" produce;

b. Make substantial additional improvements in the use of natural resources, and enable the sector to better protect and enhance biodiversity and ecosystem services;

c. Progressively reduce the sector's reliance on non-renewable resources & energy supplies (including increasingly scare and expensive oil), and enable cuts in waste and environmental pollution - especially greenhouse gases - to sustainable levels;

d. Substantially increase the uptake by agri-food businesses of eco-design principles, tools and technologies, and improve environmental management to best-practice and beyond;

e. Reverse drivers of unsustainable activities, including by phasing out environmentally perverse subsidies and policies;

f. Educate and empower consumers to make better choices, appreciate problems and potential solutions, and play a positive role in the progress towards sustainable food systems;

g. Help build resilience to significant global risks, such as rapid climate change, trade shocks, and oil depletion;

h. Enable the sector to better contribute to the health and sustainability of communities around Victoria, Australia and worldwide;

i. Stimulate research, development and innovation in clean, green food & farming systems; and

j. Help rural & regional Victorians access more sustainable development opportunities using innovative policy and institutional mixes that mobilise private capital for the public good as well as private return.

In drafting the strategy the consultant should:

1. Put forward bold, imaginative and practical ideas to drive markets, develop opportunities, overcome obstacles, empower communities and enable progress over the next (say) 5, 10 and 25 years;

2. Venture ambitious but achievable milestones for progress, and include monitoring and adaptive mechanisms;

3. Highlight market failures and risks to the public, and spell out the roles and responsibilities of different agencies and levels of government;

4. Focus on win-win outcomes where possible, and attend to conflict and trade-offs fairly where these are unavoidable;

5. Illustrate proposals with examples and case studies from around Victoria, Australia and the world; and

6. Identify projects and partnerships that can be undertaken in the near term in an effort to address key outstanding questions.

APPENDIX C: Useful web resources

The following newsletters and websites have provided useful, relevant and interesting material during the course of this project.

Newsletters

Food Climate Research Network, Centre for Environmental Strategy, University of Surrey

To join the FCRN mailing list, email taragarnett@blueyonder.co.uk For archived FCRN mailings, go to http://www.jiscmail.ac.uk and click on 'register password' under quick links. Then go to **http://www.jiscmail.ac.uk/FCRN** to view the archives.

Cleanfood

Food & Agriculture e-news compiled by Future Climate Australia http://www.futureclimate.com.au

eCarbon News

Everything you ever wanted to know about climate change and emissions trading, sponsored by Land & Water Australia and TreeSmart. http://www.australianclimateforum.com/ecarbon/enews_aug08.php

Websites

Australian

http://www.ecoinnovationlab.com/pages/library.php The Victorian Eco-Innovation Lab (VEIL) at the University of Melbourne has undertaken a comprehensive analysis of the Victorian food system, with many valuable Victorian sources and ideas accessible through this site and the VEIL Research Report No 1 (Larsen et al 2008).

http://www.business.vic.gov.au/BUSVIC/STANDARD.HTML//pc=PC_60024.html The food portal on the Business Victoria website has useful links to a range of aspects of the Victorian food industry.

http://cultivatingcommunity.org.au/cc/ Cultivating Community is a not-for-profit organisation that has grown out of support for community garden projects in inner-Melbourne public housing estates. Since 1990 it has evolved into an organisation that is currently supporting more than 20 community gardens in Melbourne. This web site has an excellent resources page that links to a wide range of sites and organisations dealing with urban food production, community gardens, school gardens and food security.

International

http://www.fcrn.org.uk The Food Climate Research Network is a UK Research Council-funded initiative based in the University of Surrey. It works to research & promote ways of achieving absolute reductions in greenhouse gas (GHG) emissions from the whole UK food chain. There is a wealth of material on this site and in the FCRN archives.

http://www.cabinetoffice.gov.uk/strategy/work_areas/food_policy.aspx The UK Cabinet Office has done a major project looking at the British food system, and its analytical work is very comprehensive.

http://jimhightower.com/node/6577 Jim Hightower was elected Agriculture Commissioner for Texas for two terms from 1983-1991, and he has been writing and speaking on agriculture and food issues in the USA, with keen insight and dry wit, for more than 30 years. His daily commentaries are carried on more than 150 commercial and public radio stations, and on the web. His monthly newsletter *"The Hightower Lowdown"* has more than 135,000 subscribers and has received both the Alternative Press Award and the Independent Press Association Award for best national newsletter.

http://www.wiserearth.org/aof/745 The Wiser Earth website has dozens of portals leading to various aspects of sustainability and food systems globally and in North America, and many links to grassroots US organisations promoting all sorts of dimensions of healthy food and farming systems.

[to be updated with key Australian and Victorian sites]

APPENDIX D. A Knowledge and Innovation Agenda for the Victorian Food System

(as identified in the VEIL Report by Larsen et al 2008)

Table D1. Knowledge gaps and information needs identified by Larsen et al (2008)

Focus	Knowledge gap or information need
Climate change	The IPCC has identified a number of research gaps regarding climate change impacts in Australia. These include: ➢ Impacts on agricultural pests, disease and weeds in Australia ➢ Interrelations of increased temperatures, carbon dioxide AND changing rainfall patterns on disease, weed and pest ranges (have mainly been studied separately – little is known about combined impacts)
	The IPCC has also noted that global modelling of projected food security under climate change has tended to rely on assumptions about economics, trade and technology that are poorly tested against observed data. Further work is needed in this area
	Expanded analysis of climate change adaptation in the food system beyond agricultural production
Responses to Climate Change	Update analysis of the energy and emissions of the full food chain (most recent Australian analysis is from 1982)
	Conduct full lifecycle analysis (particularly on greenhouse emissions) on a range of essential foods in Victoria, to better understand how they will be affected by policy changes, and how emissions can most effectively be reduced. Victorian information on direct agricultural emissions (from conventional systems) is good. However, beyond the direct on-farm emissions very little information exists.
	Measure and investigate the potential greenhouse benefits of non-conventional production and distribution systems (including techniques that reduce reliance on inputs).
Resource Constraints	Analysis of social and economic vulnerabilities to food price changes (linked to resource constraints).
	Explore the relationship between water pricing and nutritional value per litre - how can nutritional value from water and other scarce resources be maximised? Potential for analysis of L/$ to be extended to L/kj or other nutritional measure.
	Improve understanding of the affects of water scarcity on food production, prices and security. Investigate the changing volumes of Victorian production, how much of this is exported and how this is impacting on changes in local prices.
	Develop consumer information around embodied water in food choices through detailed lifecycle analysis of key food products (correct market failure and reduce reliance on cruder measures).
	Investigate the water efficiency potential of active soil management in Victorian soils, in conjunction with soil carbon sequestration and other productivity benefits.
	Use of alternative water sources for food production – recycled water, greywater (research also required to ensure human and environmental safety). Increase production where these resources are most accessible.
	Assessment of the Victorian food system's vulnerability to oil and input scarcity – how reliant is it? Where is substitution viable and where is it unlikely? Could significant production decreases or supply disruptions occur? Need to model possible price / adaptation scenarios
	Improved land and soil management can have benefits for water use (greater retention in soils) and greenhouse emissions (carbon sequestration). Research specific to the Victorian context would help to fully capture emerging opportunities.
	There is a lack of statewide data on the actual state of soil health – little is known about the extent and spatial distribution of soil problems.
	Long-term monitoring of soil health, including impacts of physical, chemical and biological management in specific types of Victorian condition, network of sites to enable controlled comparison of management practices.
Biodiversity	Improve information about soil biodiversity – what's there, what's disappearing, what impact does that have on productivity and environmental services?
Waste	Analysis of waste throughout the food system in Victoria: ➢ Where does it occur (pre-harvest due to pests, through gluts, retailer logistics, spoilage, household, etc) ➢ Where can it be avoided, reused (as inputs to another process or redistributed), or recycled (potential resource?)
	Analysis of the balance between the environmental impacts of food processing, storage & packaging, and the saved impacts of wasted food
	Analysis of the productive potential of Melbourne / Victoria's food waste – including consideration of travel distances and available processing technologies
Health and Nutrition	Analysis of recommended 'healthy eating' in Victoria / Australia and the environmental implications of recommended changes to dietary composition (such as reduced sugar, increased fruit and vegetables, level of processing); are there areas where these conflict?
	Analysis of the impacts of carbon pricing on access to healthy and nutritious foods (which foods will become more expensive and how will this affect food access?)
	Analysis of potential improvement to nutritional densities of Victorian fruit and vegetable products through changed production methods – do methods that improve health outcomes have positive or negative environmental impacts? Which methods make a difference and for which foods?

	Analysis of the potential for health and nutritional aspects of food to be improved through changes in processing, distribution and supply chains
	Analysis of the potential to meet food needs through local, seasonal production in Melbourne / Victoria – what would diet include? Would it be nutritionally adequate?
Emerging Technologies	Governance of emerging technologies – particularly how to manage entry into the food system
	Environmental impacts of genetically modified crops, including on soils and surrounding biodiversity
	Potential environmental impacts of nanotechnology
New Production Strategies	Evaluate benefits of specific methods [farming systems] in Victorian conditions – which ones work best where and why? Measurement and evaluation through controlled trials
	How important are diverse farms to Victorian food production / security? Key questions include: ➢ What types of products? How is it being distributed? How viable are these businesses? ➢ What production systems / methods are they using? ➢ What are their relative efficiencies and environmental impacts? ➢ What is the potential contribution to food security?
	Analysis of the contribution of smaller farms and more farmers in the landscape to health and social objectives, and adaptation to climate change
	Long-term field trials of organic, biological and conventional methods, including: ➢ yield comparisons for different products ➢ overall efficiencies of inputs and yields
	Further investigation of the environmental benefits of low/no-input farming methods in a Victorian / Australian context, with particular attention to: ➢ The most significant changes – which techniques / processes make the most difference to environmental impact (including soil, water and emissions) and what is the potential for their adaptation more broadly; and ➢ For which food types or production systems are the benefits greatest – focus attention on development of methods and systems with most potential impact
	Investigate whether low-input production in Victoria is resulting in higher nutrient levels in fruit and vegetables – pursue opportunities for health **and** environmental gains
New Distribution Strategies	Analysis of benefits of local food consumption in Victoria, with consideration given to: ➢ How much environmental impact is related to transport & storage vs production; ➢ Different production conditions for different foods; and ➢ Relative environmental impacts of production / processing in Victoria vs elsewhere
	Analysis of the potential to meet food needs through local, seasonal production in Melbourne / Victoria – what would it include? Would it be nutritionally adequate?
	An understanding of the full transport patterns of Victorian farmers' markets, and comparison with full transport cycles of conventional distribution systems
	Explore the economic and social implications of increased urban agriculture – how much could it affect access to and affordability of food (particularly fruit and vegetables)
	Investigate how much food is currently, and could potentially be, produced within Melbourne - how much land could be available, and what technologies / systems could contribute?
	Analyse the resource / environmental costs and benefits of urban food production (specific to Melbourne and regional urban centres) ➢ Relative contributions of transport, energy, water use (including potential use of wastewater) ➢ Comparison of water / emissions / inputs of home vegetable garden & fruit trees to food from other sources
Consumer Choices	Are Victorian producers receiving 'fair' prices for their produce?
	How much food is wasted, and where in the system could it be reduced, salvaged, redistributed or recycled?
	Explore seasonality in Victoria (and/or different regions in Victoria) – is it changing?
	Analysis of the potential to meet food needs through local, seasonal production in Melbourne / Victoria – what would diet include? Would it be nutritionally adequate?
	Analysis of recommended 'healthy eating' in Victoria / Australia and the environmental implications of recommended changes to dietary composition (such as reduced sugar, increased fruit and vegetables, level of processing); are there areas where these conflict?
	Analysis of the most effective ways to reduce the environmental impact of diets through food substitution in a Victorian context – which foods to reduce, avoid, replace etc
	Adaptation of knowledge about behaviour change in other fields (health, water, drinkdriving etc) – how can food programs be developed, or integrated into existing programs?

Table D2. Opportunities for Innovation identified by Larsen et al (2008)

Focus	Innovation Opportunity
Climate Change	Increase diversity of food production to increase the likelihood of harvest even in unpredictable conditions
	Changes to planting dates and varieties, more resilient crops and systems
	Opportunities for low-input agricultural techniques (including organic systems)
	Redundancy and flexibility in processing, logistics and distribution systems
	Reduce the vulnerability of food distribution systems
	Shift to food production, processing and distribution systems that minimise greenhouse emissions will have competitive advantage under carbon pricing
	Market advantages where Victorian agricultural production is less emissions-intensive than international competitors
	Track and label emissions profiles to strengthen this advantage eg. inclusion of emissions data in new commodity tracking systems
	Drive development and extension (many are already known) of locally appropriate techniques for soil carbon sequestration
Resource Constraints	Increase efficiency of input use
	Transition to less water intensive foods or production systems – focus on making use of water where it is available (including storage where it falls and water in and around cities)
	Accounting systems that can record water information for supply chain and consumer decision making – through global supply chains
	Production methods and systems that are less reliant on oil, oil-based products (eg. chemical fertilisers and pesticides), and contested agricultural inputs
	Alternative biofuel production that is not reliant on conventional inputs or large amounts of productive land (possibility of genetically modified crops or algae systems)
	Developing markets / making use of potential biofuel feedstocks that are currently going to waste (eg. lignocellulosic (wood))
	Renewable / sustainable substitutes for petroleum-based agricultural inputs, including organic wastes
	Supply chains and distribution systems within cities – increasing production closer to consumption and/or innovations in food distribution and access
	Active soil management techniques designed to reduce input costs and increase productivity while improving land and soil quality
	Create supportive conditions for diverse innovation and experimentation across many landscapes eg. different farming systems, crops, scales of production
	Design of residential developments that make use of productive capability of the land on which they are being built (urban agriculture built in from the start)
	Integration of aquaculture with horiculture (aquaponics) makes use of the nutrients fish excrete to grow food and can be a very efficient mixed production system
Biodiversity	Use of native species for food – may encourage preservation and improved knowledge while reducing impact on the environment
	Identifying and applying (in new contexts) techniques and systems that improve biodiversity and productivity (win-wins)
	Food products that incorporate and value native biodiversity eg. 'premium' for saltbush lamb
	Soil carbon sequestration potential of some native species or ecosystems may facilitate habitat preservation
	Diversification of species, products, mixed-farming systems etc
Waste	Food preservation technologies and systems eg. reduced reliance on refrigeration
	Nutrients in food 'waste' as alternative fertiliser sources – organic waste recycling providing inputs to food production ➢ urban ➢ rural – innovation potential in logistics / distribution?
	Effective, self-managing home composting systems or services
	Biodegradable and recyclable food packaging
	Adaptive food processing systems – able to adjust products and systems in response to scarcity and seasonal gluts
Health & Nutrition	Identification of input / production factors that affect nutrition in food holds marketing / export potential
	Involvement in food production can increase knowledge of and access to healthy food, physical activity and/or community interaction
	Supply and distribution systems that minimise nutritional loss
Emerging technologies	New applications and reconfiguration of existing technologies
New Production Strategies	Further development and application of existing methods above, underpinned by research
	Certifications / branding that can take new issues into account – improved soil health, water use, emissions generation, potentially carbon sequestration
	Extension services for entrepreneurial small farmers to develop new products and reach new markets
	Production and distribution systems more suited to smaller land areas and farming enterprises

	Adaptation of agricultural knowledge and services to smaller-scale, diverse production systems
	Improving low/no-input systems and techniques – significant domestic and export potential for knowledge and innovation in this area
	Improvements to sustainability and resilience across all agricultural systems using knowledge / techniques developed in low/no input production systems
	Product quality improvements through organic / biodynamic / biological methods eg. Viticulture
	Build consumer awareness of biological / low-input farming systems other than organic – possibly branding / labels – enabling purchase of products from low-impact farming methods
	Integration of other technology development eg. use of ICT for precision farming, soil testing, GIS/GPS for low-input methods
New Distribution Strategies	Reducing environmental impacts and vulnerability of supply chains – logistics, packaging innovations, storage systems
	Collaboration with transport / retailer / health sectors to encourage change in how people access food ie. increase walking / cycling and ensure that increased local food purchase does not require extra car trips
	Increased efficiencies and accessibility of food distribution – reducing reliance on separate car / small truck trips
	Cheap, simple and safe household greywater systems enabling use for food
	Small scale green / organic waste composting systems (and larger scale energy from waste facilities)
	Integrated urban water treatment / food production systems
	Improved production practices in urban systems – applying useful agricultural knowledge to small-scale (household and community) systems
	Knowledge and systems for urban food production have very significant export potential
Consumer Choices	Reducing, reusing and recycling food that is currently wasted at the consumer end of the system (ie. retailer and household)
	Potential for processing innovations to reduce waste from seasonal 'gluts'
	Alternative sources of meat protein and other foods – native species?
	Systems and information enabling informed consumer choices

APPENDIX E. An Eater's Manifesto and a Fructivist's Lament

Michael Pollan's manifesto is very simple: eat food; not too much; mostly plants.

In *In Defense of Food: An Eater's Manifesto* (2008), Pollan unpacks this prescription with some further rules of thumb. The first point 'eat food', is perhaps the most puzzling — what else is there to eat but food? But Pollan argues that much of what passes for food on American supermarket shelves is not real food, but 'edible food-like substances', of which there are 17,000 new products every year, promoted by a US$32 billion per annum food marketing effort (Pollan 2008). So Pollan's rules of thumb are:

- Don't eat anything your great-grandmother would not recognise as food;
- Don't eat anything incapable of rotting;
- Avoid food products containing ingredients that are a) unfamiliar, b) unpronounceable, c) more than five in number, or that include d) high fructose corn syrup (HFCS);
- Avoid food products that make health claims;
- Shop the peripheries of the supermarket and stay out of the middle;
- Get out of the supermarket whenever possible — "shake the hand that feeds you" at a farmer's market;
- Eat mostly plants, especially leaves;
- You are what you eat eats too (a steak qualifies as a 'whole food', but it could be from a feedlot steer fed a grain-based feed mix, feed supplements, hormones and antibiotics, generating significant carbon and nutrient pollution in the process);
- If you have the space, buy a freezer (for fresh local seasonal produce from the farmer's market);
- Eat like an omnivore;
- Eat well-grown food from healthy soils;
- Eat wild foods when you can (but not endangered species, and not with cruelty);
- Be the *kind* of person who takes supplements (and then don't bother, apart from maybe a multivitamin if you are over 50 and perhaps a fish oil capsule);
- Eat more like the French, or the Italians, or the Japanese, or the Indians, or the Greeks;
- Regard nontraditional foods with scepticism;
- Don't look for the magic bullet in the traditional diet (the whole of a dietary pattern is greater than the sum of its parts);
- Have a glass of wine with dinner;
- Pay more, eat less (smaller portions of higher quality);
- Eat meals;
- Do all your eating at a table;
- Don't get your fuel from the same place your car does (American petrol stations now make more money selling food (and cigarettes) than gasoline);
- Try not to eat alone;
- Eat slowly (deliberately and knowledgeably, *a la* the Slow Food movement started in Italy);
- Consult your gut (stop eating when you feel full – this only works if you eat slowly);
- Cook and, if you can, plant a garden (then you'll enjoy the shortest of food chains).

Fruit

George Monbiot's lament. Extracts from an article published in *The Guardian,* 2nd September 2008

A hard commercial logic dictates that the only way to get good fruit today is to grow your own.

…Though we still subsist largely on junk, even bilious old gits like me are forced to admit that the quality and variety of most types of food sold in Britain has improved. But one kind has deteriorated. You can buy mangoes, papayas, custard apples, persimmons, pomegranates, mangosteens, lychees, rambutans and god knows what else. But almost all the fruit sold here now seems to taste the same: either rock hard and dry or wet and bland. A mango may be ambrosia in India; it tastes like soggy toilet paper in the UK. And the variety of native fruits on sale is smaller than it has been for 200 years.

Why? Most people believe it's because the supermarkets select for appearance not taste. This might be true for vegetables, but for fruit it's evidently wrong. Green mangoes, Conference pears, unripe Bramley, Granny Smith or Golden Delicious apples look about as appealing as a shrink-wrapped stool. Appearance has nothing to do with it. What counts to the retailer is how well the variety travels.

Take the Egremont Russet, for example. It's a small apple that looks like a conker wrapped in sandpaper. But it has one inestimable quality. It can be dropped from the top of Canary Wharf, smash a kerbstone and come to no harm. This means it can be trucked from an orchard at Land's End to a packing plant in John O'Groats, via Sydney, Washington and Vladivostock, then back to a superstore in Penzance (this is the preferred route for most of the fruit sold in the UK) and remain fit for sale. The supermarkets must have had some trouble shifting it because of its strange appearance, so they promoted it as a connoisseur's apple. Such is our suggestibility that almost everyone believes this, though a dispassionate tasting would show you that it's as sweet and juicy as a box of Kleenex.

For the same reason, we are assaulted with Conference pears, most of which resemble some kind of heavy ordnance, rather than any one of a hundred exquisite varieties such as the Durondeau, Belle Julie, Urbaniste, Glou Morceau, Ambrosia, Professeur du Breuil or Althorp Crasanne. It is because these pears are so delicious that they cannot be marketed. They melt in the mouth, which means they would also melt in the truck before it left the farm gate. As the best pears, plums, peaches and cherries are those which go soft and juicy when ripe, the grocers ensure that we never eat them.

To compound the problem, the supermarkets demand that fruit is picked long before it ripens: it doesn't soften until it rots. This makes great commercial sense. It also ensures that no one in his right mind would want to eat it. But, happily for the retailers, we have forgotten what fruit should taste like. The only way to find out is either to travel abroad or (the low-carbon option) to grow your own. I find myself becoming a fruit evangelist, a fructivist, whose mission is to show people what they are missing.

When I lived in Oxford, at a time when allotments were underused, I spent a week in the Bodleian library reading Hogg and Bull's Herefordshire Pomona, a massive book of apples and pears, written in the 1870s (you can now buy it on CD from the Marcher Apple Network). Then I cleared two and a half plots and planted the best varieties I could find. I left just as the trees were ready to fruit. But land here in mid-Wales is cheap. I bought half an acre and have started planting a second orchard.

When I first tried to place an order, I caused great excitement among the nurseries I phoned. Where had I seen these apples? Who recommended them? Two of them, I discovered, had been extinct for at least 50 years. So I have had to settle for second best, by which I mean breeds which still exist. I began by planting a Ribston Pippin and an Ashmead's Kernel… To spread the fruit as far through the year as possible, I have ordered an apple called the Irish Peach, which ripens in early August; a St Edmund's Pippin (September) and a Wyken Pippin (December to April). If I'd had more space, I would also have planted a Catshead, a Boston Russet, a Sturmer Pippin and a Reinette Grise.

I have bought two pears - a Seckle and a Beurre Rance - a green plum (the Cambridge Gage), a fig, a medlar, a peach, currants, gooseberries, raspberries, loganberries and blueberries. …I've decided to buy an Arnold Thorn (Crataegus arnoldiana), which belongs to the same genus as the hawthorn, but grows sweet juicy fruits the size of cherries, and to replace my hedge with Eleagnus x ebbingei, which produces sweet red berries with edible seeds, in (uniquely) April and May. This means, if it works out, that I can eat fresh fruit all the year round….

Most people have less space than I do, but even a tiny garden can support half a dozen apple trees, if you grow them as cordons (single stems with short spurs) 80cm apart against a wall….

It's not just the produce I love. When you start growing fruit, you enter a world of recondite knowledge, accumulated over centuries of amateur experiments. You must choose the right rootstocks and pollinators and learn about bees, birds and caterpillars. But above all you must learn patience. Growing fruit forces you to think ahead, to imagine a sweeter future and then to wait. Perhaps it is this, as much as the forgotten flavours, that I have been missing.

www.monbiot.com

APPENDIX F. Agriculture-Environment-Health links in the US and UK

The box below is from *CULTIVATING COMMON GROUND: Linking Health and Sustainable Agriculture*, produced by the **Prevention Institute**, California in 2004.

Over-Production of a Range of Unhealthy Food Products

- US subsidies (direct- and in-direct) create incentives to over-produce crops that are integral ingredients in cheap, high-fat, high-sugar, processed foods. A high-fat diet and excessive calorie consumption are linked to chronic diseases such as obesity, high blood pressure, diabetes, coronary heart disease, cancer, and stroke.
- At least one-fourth of all energy intake comes from food groups that provide large quantities of refined sugar and fat and few micronutrients.
- On an annual basis, US corn is consumed as follows: 1.2% as a vegetable, 8.0% as a sweetener, 50.1% as animal feed, 2.6% as starch, 5% as alcohol (ethanol), 22.6% as exports, 10.3% as reserve stocks, 0.2% as the seed.

Use of and Exposure to Toxins

- Pesticides used in conventional agriculture accumulate in the human body and can cause cancer, birth defects, decreased fertility, neurological damage and other health problems.
- Every day, 9 out of 10 US children between the ages of 6 months and 5 years are exposed to combinations of 13 different neuro-toxic insecticides in the foods they eat. More than 8 million Californians drink water from systems where some or all of the water is contaminated with nitrate levels above government health standards.
- Hormones found in food may be associated with breast cancer and the increasingly early onset of human female puberty.
- The use of agricultural chemicals known to cause cancer in California increased 127% from 1991 to 1998.

Dangers to Farmer & Worker Health and Safety

- Farmers and agricultural workers develop occupation-induced health problems from chemical exposures. Occupational exposures to pesticides have been associated with health problems including miscarriages, birth defects, and decreased sperm counts.
- One health survey of California agricultural workers revealed that the predominantly young male work force is at high risk for chronic disease, due in part to difficulty accessing a healthy diet.
- US family farmers typically lose money each year. Their average income declined by over 60% in 2001 alone. Suicide is a leading cause of death for farmers.
- Analyses of farm communities in Nebraska and Wisconsin show that the loss of 1 family farm results in the loss of 8 "white collar" jobs and the loss of 7 farms results in the loss of 1 business in town.

Antibiotic Resistance

- The use of antibiotics in animals is linked to antibiotic resistant strains of food poisoning bacteria and may cause reduced effectiveness of related antibiotics used to treat humans.
- 70% of US-produced antibiotics are fed to animals to promote growth.
- The American Medical Association adopted a formal resolution opposing the nontherapeutic use of antibiotics. The Center for Disease Control and Prevention considers animal use of antibiotics to be the major cause of foodborne illnesses that resist treatment with antibiotics. The World Health Organization has called for an end to animal antibiotics important to human medicine.

Foodborne Illness

- 76 million Americans get sick every year: more than 300,000 are hospitalized, and 5,000 die from foodborne illnesses, according to estimates from the Center for Disease Control and Prevention.
- The crowded conditions of factory farms and the high-speed, automated methods of slaughtering and processing the animals, increase bacterial contamination.
- Salmonella cases in the US have doubled in the last 2 decades. Similar increases are reported for other foodborne bacteria.
- As much as 8% of the weight of supermarket chicken is not meat, but a "fecal soup" from water used in processing chickens into meat.

Respiratory Illness and Poor Air Quality

- Non-sustainable methods of agricultural production contribute to poor air quality through pesticide drift, field dust, waste burning, gases from manure lagoons, and diesel exhaust from transporting food long distances. Associated health problems include asthma, cardiovascular disease, lung cancer, and respiratory illness. Poor air quality also limits physical activity, increasing risks for chronic disease.
- Secondhand pesticides from pesticide drift, just like secondhand cigarette smoke, can cause serious adverse health effects.
- 2.2 million Californians suffer from asthma, the number 1 cause of hospitalization for children. In Fresno, California's leading agricultural county, childhood asthma is 3 times the national average.

The box below is from ***Green, Healthy and Fair***: *A review of government's role in supporting sustainable supermarket food*, published by the UK Sustainable Development Commission (SDC 2008).

Environmental limits

- EU food consumption accounts for 31% of all consumption-related emissions, in the UK the figure is estimated at 19%
- Globally, livestock accounts for 18% of greenhouse gas emissions.
- In the UK, meat and dairy production accounts for 8% of total UK GHG emissions.
- 5.2 million tonnes of food-related packaging waste and 6.7 million tonnes of food waste are generated from UK homes each year.
- The external cost of food transport has been estimated at between £1.9 billion and £4 billion.
- Agriculture globally consumes 70% of all freshwater extracted for human use.
- In the UK, agriculture uses 742 Gigalitres of water, and the food and drink industry uses 155 Gl
- It takes 13 litres of water to produce a 70g tomato, 200 litres of water for a 200ml glass of milk, and 2400 litres of water to produce a 150g hamburger.
- The food system is also a major source of land, forestry, fisheries and water degradation. 15 out of 24 of the world's ecosystem services are being degraded or used unsustainably according to the Millennium Ecosystem Assessment.
- Three-quarters of the world's fish stocks are fully or over-exploited.
- Conversion of land to palm oil production for use in food processing (and cosmetics and other household products) has accounted for 87% of deforestation in Malaysia between 1985 and 2000.

Strong, healthy and just society

- Between 1993 and 2005, the proportion of men classified as obese increased from 13% to 22%, whilst among women the proportion rose from 16% to 24%.
- Diet related ill health is responsible for about 10% of deaths in the UK.
- 30,000 deaths a year in the UK are related to obesity.
- 67% of suppliers report relationships between retailers and suppliers to be a problem, compared to only 35% of retailers.
- For every £1 spent on cashew nuts in British supermarkets, 77 pence goes to importers and retailers, 22 pence to traders and processors, and just one pence to farmers.
- 1 million people in rural Africa are supported by the fresh fruit and vegetable trade with the UK, injecting an estimated £200 million into rural economies in Africa.

Sustainable economy

- The UK has 6,691 food and drink manufacturing enterprises, with an economic value of £21.1 billion (GVA). It is the single largest manufacturing sector in the UK.
- In December 2005, over 1.2 million people were employed in UK food and drink retailing, almost 5% of UK employees. Over 60% of these employees were part-time or female (45% were both part-time and female).
- Consumer expenditure on food accounts for approximately £160bn annually in the UK.
- Farmers' share of a basket of food staples has fallen by 23% between 1988 and 2006.
- The number of migrants working in the countryside tripled between 2004 and 2007, many seeking employment in agriculture.
- Supermarkets account for around three-quarters of the burgeoning £1.9 billion organic market.
- Current economic costs of obesity to the UK economy are estimated at £10 billion a year.

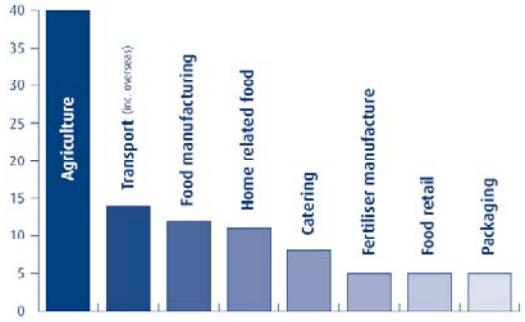
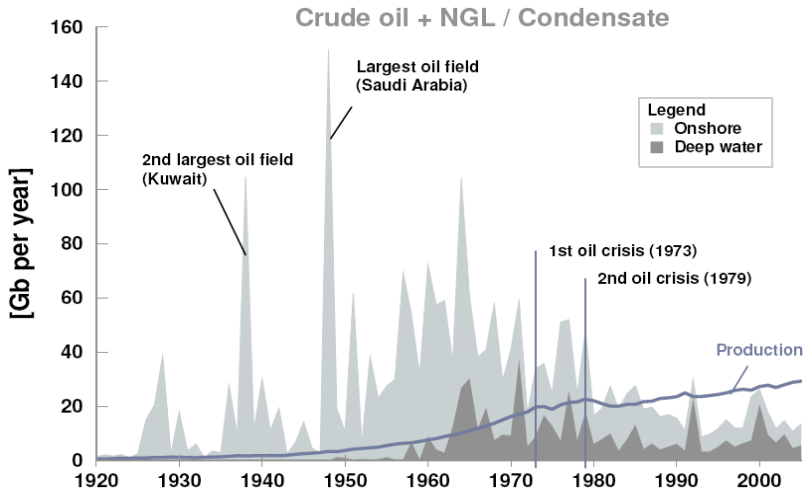


Figure F1 Food related UK greenhouse gas emissions

The graph in Figure F1 at left (from SDC 2008) illustrates the break-down of food consumption-related greenhouse gas emissions in the UK. Food, through the way it is produced, distributed and consumed, is the UK households' single largest contributor to climate change impacts. Agriculture makes up the biggest portion of this, mainly from emissions of nitrous oxide (largely from fertiliser use on food and feed crops) and methane emissions from ruminant animals, rather than carbon dioxide emissions from fossil fuels.

APPENDIX G. The Outlook for Oil

Figure D1 History of oil discoveries (proved+probable) and production (EWG 2007)



The growing discrepancy between oil discoveries and production is shown in Figure D1. In the period 1960 to 1970 the average size of new discoveries was 527Mb per New Field Wildcat. This size has declined to 20Mb per New Field Wildcat over the period 2000 to 2005. Table D1 below compares oil industry estimates (IHS) with independent estimates (EWG) of remaining crude oil reserves, and 2005 production and consumption figures for the main oil producing and consuming countries and regions. EWG point out that the industry has consistently over-estimated the size of reserves, and present comprehensive data to support their projections. The bottom line from this table is that the oil industry estimates we have about 40 years of oil left at 2005 consumption levels, and independent estimates are a more conservative 30 years. Of course consumption patterns will change (at the moment oil consumption is still rising), exploration efforts will accelerate, and alternatives will become more viable as oil becomes more expensive.

Table D1 Oil reserves and annual oil production in different regions and key countries (EWG 2007)

Region	Remaining reserves		Production 2005		Consumption 2005 [Gb/yr]
	EWG [Gb]	IHS [Gb]	onshore [Gb/yr]	offshore [Gb/yr]	
OECD North America	84	67.6	3.20	1.71	9.13
Canada	17	15.3	0.89	0.12	0.82
USA	41	31.9	1.93	0.59	7.59
Mexico	26	20.4	0.36	1.00	0.72
OECD Europe	25.5	23.5	0.1	1.94	5.72
Norway	11	11.6	0	1.13	0.08
UK	8	7.8	0.01	0.70	0.65
OECD Pacific	2.5	5.1	0.025	0.18	3.18
Australia	2.4	4.8	0.02	0.17	0.31
Transition Economies	154	190.6	4.1	0.18	2.02
Russian Federation	105	128	3.4	0.13	1.00
Azerbaijan	9.2	14	0.01	0.15	0.04
Kazakhstan	33	39	0.47	0	0.08
China	27	25.5	1.1	0.22	2.55
South Asia	5.5	5.9	0.11	0.16	0.96
East Asia	16.5	24.1	0.3	0.65	1.75
Indonesia	6.8	8.6	0.27	0.11	0.43
Latin America	52.5	129	2.0	0.61	1.74
Brazil	13.2	24	0.075	0.55	0.75
Venezuela	21.9	89	1.17	0	0.20
Middle East	362	678.5	6.97	1.97	2.09
Kuwait	35	51	0.96	0	0.11
Iran	43.5	134	1.19	0.24	0.59
Iraq	41	99	0.67	0	
Saudi Arabia	181	286	2.85	0.86	0.69
UAE	39	57	0.46	0.45	0.14
Africa	125	104.9	2,03	1,53	1.01
Algeria	14	13.5	0.72	0	0.09
Angola	19	14.5	0.01	0.45	
Libya	33	27	0.61	0.02	
Nigeria	42	36	0.39	0.52	
World	**854**	**1,255**	**19.94**	**9.15**	**30.3**

APPENDIX H. Alternative Energy Options

By now it should be clear that achieving more sustainable and resilient food systems capable of meeting growing needs in more difficult conditions can only be done through a well-organised combination of multifaceted, complementary measures. There is no silver bullet. That is equally the case for component parts of the picture — in this case energy. Responding to the situation described on the previous page in Appendix D with respect to oil will require multiple elements. A set of energy solutions, called the "stabilization wedges," was developed by Steve Pacala and Robert Socolow of Princeton University (*Science* 2004; **305**:968-971), with a view to stabilising global greenhouse gas emissions at about double the pre-industrial levels. It provides a template for developing comprehensive energy plans. Fifteen energy choices were depicted and several others have since been proposed. Each wedge would avoid 1 billion tons (a gigaton or Gt) of carbon emissions annually by mid-century, by reducing CO2 and CO2-equivalent (CO2-e) emissions. The seven wedges first proposed by Pacala and Socolow are reproduced below (from Epstein et al 2008).

Efficiency
1. Double fuel economy for 2 billion cars from 30 to 60 mpg
2. Halve vehicular miles traveled for 2 billion cars: urban design, mass transit, telecommuting
3. Cut carbon emissions by one-fourth from buildings and appliances
4. Double coal-power output with advanced high-temperature materials

Fuel shift
5. Replace 1400 GW of coal-fired power with natural gas plants

CO_2 capture and storage (CCS)
6. CCS for 800 GW worth of coal or 1600 GW natural gas: average plant = 1 GW
7. Capture CO_2 at plants producing H_2 from coal or natural gas
8. CCS at synfuels plants producing 30 million barrels a day from coal

Nuclear fission
9. Add 700 GW: twice the current capacity

Renewable electricity and fuels
10. Add 2 million 1MW-peak windmills: 50 times current capacity
11. Wind-derived H_2 for fuel-cells in hybrid cars: add 4 million 1 MW-peak windmills to make H_2 or 100 times current capacity
12. Add 2000 GW-peak photovoltaics (PV): 700 times current capacity
13. Add 100 times the current ethanol: one-sixth of world cropland

Forests and agricultural soils
14. Eliminate deforestation; reforestation and afforestation: 300 Mha of new trees or twice current rate
15. Conservation tillage for all cropland: 10 times the current usage

These targets are challenging (and #13 is unwise from a food perspective), but they are all feasible — and eminently fundable. If it is possible to find US$700 billion within a week or so to bail out the barons of Wall St, then it should be within the wit of the political and financial system to underwrite the decarbonisation of the world economy to secure the liveability of the planet.

The Australian Conservation Foundation (ACF) is committed to inspiring people to achieve a healthy environment for all Australians. For over 40 years we have been a strong voice for the environment, promoting solutions through research, consultation, education and partnerships. We work with the community, business and government to protect, restore and sustain our environment.

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