GOAL **TWO** SUSTAINABLE NATURAL RESOURCES

DETAILED CHAPTER GOAL **TWO**

GOAL TWO SUSTAINABLE NATURAL RESOURCES

2.1 Sustainable Food Systems

Proposition

The UN Environment Programme tells us that:

'... [in relation to food security] the current agricultural knowledge, science and technology model requires revision. Business-as-usual is no longer an option.'[1]

Interdisciplinary approaches, including the application of social sciences is necessary.

> **[Such inclusion] recognises the need for systems thinking at multiple levels and over multiple decades. It requires a shift from a narrow focus on production systems to an examination of complete food and fibre systems. It calls for the inclusion of issues of justice, intergenerational equity and inter-species balance.**[2]

Agriculture and food security are critical issues in discussions about environmental sustainability. Natural resources are not unlimited, and in conceiving of food as a whole-system issue we need to understand agriculture as multifunctional.[3] Statistics only tell part of the story.[4]

Context

An inflexible agri-industrial model lacks resilience in the face of climate change (to which Australia will be particularly vulnerable)[5] and projected population increases. We will need to adjust by planning adaptation, become more deliberate in our design of solutions, build on synergies, remain focused on equity and find new ways of ensuring environmental sustainability.[6]

No till farming stubble

2.1.1 Agricultural economy

Food and its production is a touchstone of the Australian economy.

Food and clothing are fundamental requirements of life and our farmers produce most of the food that Australians put on their tables as well as wool and cotton – raw materials for the clothes we wear.[7]

The gross value of agricultural production in 2009–2012 was just under $40 billion.[7] Australia remains a net exporter of food, including wheat, sugar and barley,[8] even as imports of other food stuffs, including fruit and vegetables continue to rise.[9]

Food retailing industries employed 434,000 people and food manufacturing employed 210,000 people across Australia in 2009–2010.[7] In Victoria, over 50% of land (and the vast majority of all private land) is farmed for food or fibre.[7]

The ABS documents the following Victorian agricultural economies (2011–2012):

- agriculture – $11.3 billion
- wheat – $867 million
- canola – $335 million
- grapes – $343 million
- apples – $257 million
- vegetables – $840 million
- milk – $2.5 billion
- wool – $671 million
- cattle and calves – $1.3 billion
- sheep and lambs – $1.1 billion.[10]

2.1.2 Environment and ecosystem services

The use of land for both environmental and agricultural outcomes is complex – requiring trade-offs and creating tensions, while simultaneously food policy and food security is dependent on the ecosystem services that our natural capital and ecological processes provide.[11, 12]

Many different modes of production interest a multitude of diverse consumers across regions and sectors, and we do know that the methods we adopt to grow the food we eat has a massive impact on the environment.[13]

As discussed in Foundation Paper Two, *Land and Biodiversity Victoria: The Science, Our Private Land Holders, Incentives and Connectivity*, ecosystem services are fundamental to sustaining human wellbeing. The environmental impact of farming on ecosystem services in Australia has included:

- the clearing of land for grazing or cropping resulting in the loss of native habitat
- soils eroded and degraded by extensive ploughing and grazing
- water exported from rivers for irrigation
- waterways polluted by agricultural chemical run-off
- an increased nitrogen soil budget[14]
- greenhouse gas emissions attending almost every step of the food production process, including the value-adding processes involved in manufacturing.

Innovative farmers, committed to sustainable outcomes, are working on these issues, facing an array of challenges – from the creep of urban development across arable land to climate change.[15] The community, local government and organised, innovative, food producers and retailers are also contributors to changing the ways we do things. Communities are driving these changes, not just waiting for others to do so.[16] At the extremes, responses to new conditions will include adaptation – which requires intelligent adjustments – or retreat.

Nhill community gardeners

Newstead College vegetable garden

PepperGreen farm, Bendigo

Newstead community garden

Horsham House kitchen garden

2.1.3 The response of the farming community

Broadly, farmers have been concerning themselves with the environmental bottom line, and this interest is illustrated in a number of places, and in the work being done between farming communities and government agencies.

The Environmental Farmers Network, Birchip Cropping Group and Australian Master Tree Growers are prime examples of the sort of research and networking addressing these issues.[17–19]

Examples exist across the agricultural landscape of farmers engaging in 'regenerative agriculture'[20, 21] and seeking to address the legacy of our environmentally unsustainable farming practices. This was outlined in the PMSEIC 2010 report,[9] where the national land and water resources audit tells us that 5.7 million hectares are affected by (or at risk of) salinity, soil acidification impacts 50 million hectares (surface soil) and 23 million hectares (subsurface soil), and erosion continues to be a major issue.[22, 23] Efforts to address these issues include:

- the non-government program Soils for Life,[24] which has received support from Caring for our Country and promoted holistic management
- time-controlled planned grazing (Dukes Plain)
- weed control without herbicide (Shannon Vale)
- strategic earth works to slow water run-off (Three Rivers Station)
- the strategic use of foliar fertilisers (Clover Estate).

The 2013 Winter Edition of *Victorian Landcare and Catchment Management* describes a number of examples of the adoption of more sustainable farming practices.[25]

Project Platypus Landcare near Stawell most southerly stand of buloke and farmers' replanting

Efforts that are not strictly speaking examples of 'regenerative agriculture' are also increasing as farmers make efforts to develop better practices while working within their economic and other constraints. Instances of energy-use reduction strategies appear to be proliferating. Solar panels are appearing on milking and shearing sheds.

One example offers an illustration. Our visit to Boort in 2011 included a visit to Simply Tomatoes, where pesticides and herbicides are no longer used. Drip irrigation has replaced more wasteful use of water. Refrigeration costs are reduced by embedding old shipping containers in the earth to gain a cooling advantage.[26]

Simply Tomatoes container refrigeration, Boort

Other examples are found in a range of settings. For example, the Jigsaw Farms and Dust Busting Croppers are explored in Foundation Paper Two, *Land and Biodiversity Victoria: The Science, Our Private Landholders, Incentives and Connectivity*.

Case Study: Jigsaw Farms helps answer the future farming puzzle

Which is more important for the future – meeting growing global food demands, or improving our performance on managing biodiversity, greenhouse emissions and water quality? Some innovative farmers in Victoria's south-west, adopting a more 'systems' thinking approach, have discovered a pathway that shows us how positive environmental outcomes do not have to be at the expense of increasing on-farm productivity and food production.

It has been suggested that, with some deviations, mixed cropping and grazing farming techniques:

- improve nutrient cycling
- increase spatial biodiversity, resulting in improved outcomes for ecosystem services.[27]

Jigsaw Farms is a 4,900 hectare farming enterprise owned and managed by Mark Wootton and Eve Kantor. Over the past 13 years, Mark and Eve have been striving to build a farming system that brings all the pieces of the sustainable agriculture puzzle together – hence the name Jigsaw Farms.[25]

Mark said, 'We run the farm as a company, but with a family farming model. There are six staff with their young families all involved in Jigsaw Farms. By consolidating farming into a system there is a greater access to capital and agribusiness knowledge and innovation while the social and landscape values of farming are also maintained.'

As owner-managers, Mark and Eve planned to combine a high-productivity sheep and cattle operation, while protecting remnant vegetation and revegetating Jigsaw waterways on a landscape scale. They are aiming for 25% of land being revegetated. They are well on the way, having planted their millionth tree.

Their plantings are a mix of permanent indigenous revegetation, riparian protection (along creeks), wetland protection and farm forestry plantings in corridor belts – managed on a cycle of harvest and replant. Using farm planning principles, the Jigsaw revegetation program has been focused on the 25% of the farm's less productive and degraded soils, which includes areas of salinity and shallow soils.

At the same time, the agricultural production from the remaining 75% of the farm land has increased from 30,000 DSE (dry sheep equivalents) to 70,000 DSE over the past 13 years.

According to Mark Wootton, 'The increase has largely come about as a result of management and structural changes such as improving fertiliser rates, modern perennial pastures, fencing to land type, developing an extensive laneway system, expansion of a deep water storage and reticulation system and continual development of staff to understand the key profit drivers of professional grass growing.'

All of the developments on Jigsaw Farms are done with concern for future sustainability, with Mark and Eve being passionate about tackling climate change. Mark can now claim, 'I've estimated that the emission reductions (carbon absorbed) by our new forests while they are actively growing will outweigh all of the on-farm agricultural emissions, which is about 15,000 tonnes per year of CO_2 equivalents.'

As for local birdlife, local ornithologist Murray Gunn has conducted seasonal bird surveys at Jigsaw Farms since 1998 and has recorded an increase from 49 species to 155, with total number of birds across these species quadrupling. These figures are seen by Mark and Eve as an indicator of improved biodiversity and a vindication of Jigsaw's connected wetlands and revegetation corridors.

Mark observes that, 'The farmers I speak to are keen to explore practical and market driven solutions to climate change and not to focus on the negative. They realise that the world has an increasing demand for food and fibre. They also realise that we are moving at great speed in an increasingly carbon-constrained world. The challenge is to meet this challenge now and to stop just talking about it.'

Mark and Eve are also confident that the carbon footprint of farming can be significantly reduced in the future, while still maintaining high levels of fibre and meat production. While many people ask if it's possible to meet the future challenge of growing more food, reducing emissions and developing sustainable and profitable farms, Jigsaw Farms offers a key piece in solving that puzzle.

Commissioner for Environmental Sustainability visits Jigsaw Farms

Case Study: Dust Busting Croppers – We Can Innovate and Change

Victorian grain growers have demonstrated how far farming systems have come in 30 years. Images of wind-blown Wimmera and Mallee soils darkening the sky above Melbourne in 1983 are a far cry from the current situation. Despite low rainfall during the 2012 cropping season – equal to the rainfall in 1983 – crops generally produced fair to average yields (1.5–2.5 tonnes per hectare in the Wimmera–Mallee) with minimal erosion.

What has changed to make crop production systems better and more resilient? Many things – starting with conservation farming practices. Use of conservation farming practices has been increasing ever since the devastating combination of drought and soil loss of 1983. Farmer groups, in conjunction with Victorian government agronomists, introduced conservation farming practices. Conservation farming practices enable retention of crop residues to protect the soil from erosion, and retention of water and nutrients while managing issues such as weeds and equipment capabilities. The result is that where wind erosion is seen today it is generally in isolated paddocks without crop cover.

Retaining crop residues improves soil function by increasing its ability to store water and retain nutrients, enabling the next crops to use them. Information disseminated about trials undertaken with new crop varieties gives farmers confidence that these will grow using conservation farming methods and encourages them to sow many of their crops under lower risk conditions. Timely control of summer weeds preserves summer rainfall for the following crop, and prevents nutrients being used by weeds. Integrated management of weeds and pests prevents the need for frequent removal of crop residue, protecting the soil from erosion risk and the crop from damage and competition for resources.

Synergy between conservation tillage practices and the more careful use of modern herbicides has allowed cropping farmers to sow a larger proportion of their crops either early or on time.

This has great productivity and environmental benefits, particularly in years with low spring rainfall. This system also allows farmers to gain greater efficiencies of scale to offset against declining terms of trade.

Work by Department of Environment and Primary Industries (DEPI) in measuring and promoting conservation farming practices in northwest Victoria reveals that the proportion of paddocks under conservation management nearly doubled from around 44% in 1996 to over 82% in 2009.

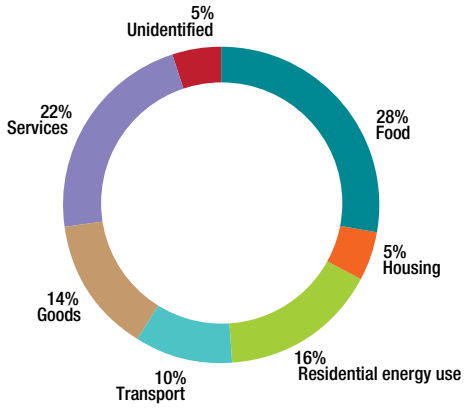
The monitoring of soil management practices promotes more targeted efforts to work with farming groups to protect soil. Areas of bare and high-risk soil in the north-western Wimmera are of higher priority than are those in the south-west, which are of moderate to low soil erosion risk. Communicating activities focusing on the benefits of crop residue retention has involved some novel approaches.

New tools developed by DEPI for working with farmers to protect and maintain soil health demonstrate that retained crop residues reduce erosion and also trap airborne soils and nutrients from distant sources. The erosion fan rig, for example, enables farmers and agronomists to measure and understand the greater protection that retained crop residues provides to productive soils.

2.1.4 The response of consumers – a public opportunity and a community responsibility

Food production is not undertaken in isolation from food choices and food consumption. The food we consume is produced by farming. In 2008, food made up 28%[28] of the average Victorian's ecological footprint – more than any other item of our consumption.[29]

Figure B.2.1.1: Average Victorian's ecological footprint



Making our food ecological footprint sustainable involves us all – not just producers. What follows from this is that the impacts of food production are driven by the demands and needs of consumers.

For our agricultural practices to have a lighter environmental footprint, the public needs to be prepared to adjust patterns of consumption to effect change.

Creation of a sustainable food system relies on addressing every food production-to-consumption step from farm to fork. While we are correct to focus on 'food security' as a 'master frame' for food regimes and systems discussions,[30] this is not simply about producing more food; it is also about environmentally sustainable production methods, equitable outcomes and fulfilling needs.[31]

An effective sustainable food policy would consider a wide range of issues in local – rural and urban[32] – regional and national settings, including:

- what we produce
- where and how we produce it
- how farming communities, farming cooperatives, food companies and retailers influence the system.

The research community is increasingly calling for the study of sustainable food policy, as distinct from embracing 'food security' as a social and economic issue divorced from environmental outcomes.

Interdisciplinary, community-focused, systems approaches which move away from a tight 'productivist' agenda are seen as promoting environmentally sustainable outcomes. This shift is being driven at the national level, and locally it is being forged by the public and agricultural communities. Short-term project funding arrangements with a vertical and agricultural commodity focus and a lack of policy options will not meet the needs of the 21st century.[33]

RECOMMENDATION 10

It is recommended that the Victorian Government develop a comprehensive sustainable food strategy.

ATTRIBUTES

The strategy will promote and plan for the triple-bottom-line outcomes of:

- **what we produce,**
- **where and how we produce it, and**
- **how farming communities, farming co-operatives and food companies, and retailers influence the system.**

Although food 'security' would be considered in the strategy, it would be addressed in terms of environmental sustainability rather than 'productive' landscapes.

2.1.5 Food production opportunities for environmental improvements

Below we explore in summary the possibilities of improving soils, water efficiencies and the reduction of greenhouse gas (GHG) emissions for better outcomes for agriculturalists and the environment.

2.1.5.1 Soil health improvement

The Victorian Government has recently released a Soil Health Strategy to generate knowledge of the environmental impacts of our agricultural practices on soils and improve practice about soil maintenance. Good, healthy soils produce the food we eat. Soils provide ecosystem services that cannot be replicated artificially.[34–37] The strategy promotes an ecosystem services approach to soil management.

It is well recognised that some farming practices contribute to increasing soil salinity and acidification, as well as to erosion and soil structure decline.[34] Combined, these effects have been estimated to cost Victoria over $500 million per year in lost agricultural output.[38] The Soil Health Strategy notes the role of soil in supporting $9 billion worth of agricultural production each year.

Internationally, Cornell University's College of Agriculture and Life Sciences reflects the importance of this sort of work,[39] and nationally the University of New England and others run soil health research programs. Published research tells us that there are both impediments to change and a role for incentives in attaining better outcomes. A well-resourced, scientifically supported Soil Health Strategy is an essential ingredient for improved and more sustainable agricultural practices.[40] The operationalisation of the Soil Health Strategy is a fundamentally important step in promoting sustainable food production practices.

The Victorian Soil Health Strategy arises out of long-term research concerns and in response to a recent report from the Victorian Auditor-General's Office (VAGO) in which a more integrated Soil Health Strategy was recommended.[41]

The Commissioner for Environmental Sustainability endorses the recommendations of the VAGO contained in the report Soil Health Management 2010.

Landslip, west Gippsland

2.1.5.2 Water health – water footprinting

What we do on the land affects the health of our waterways. The interface and impacts are multiple and complex.

For instance, changing irrigation techniques – to centre pivot applications – threaten old-growth singular paddock trees. The removal of these trees impacts bee and bat populations. University of Melbourne researcher Dr Pia Lentini reported to the University of Ballarat Biodiversity Conference (2013) that one single old-growth paddock tree had been the roosting place for 19 different species of bat, all of which had ecosystem services to perform.[42]

More recently, it has been reported that some pesticides are having a major impact on bee populations.[43–46] This deleteriously affects the fundamental ecosystem service of crop pollination, which forms the basis of rural cropping economies.[47] Concerns about pollination are increasingly reported in research.[48]

The 'Apiculture on Public Land Policy' was recently released by DEPI. This policy represents years of research by beekeepers, DEPI and Parks Victoria to improve apiculture management on public land. The policy aims to assist industry expansion, cut red tape and provide beekeepers with greater access to public land.[49]

Excess fertiliser – applied in an effort to address declining phosphorous and nitrogen levels – not only causes soil acidification but also leaches into waterways. Pesticides also run off into and pollute creeks and rivers.[50–53] These chemical applications can have disastrous consequences for aquatic ecosystems, even as they make a valuable contribution to food production.[54–58]

Broadly, agriculture uses 52% of total state water consumption[59] and, as reported in Part A of this report, 75% of the surface water harvested in Victoria is typically used for agriculture.

As the impacts of food production are not just the responsibility of the agricultural community, it is increasingly important for consumers to be aware of the water footprint of food. 'Virtual water' is an estimation of the amount of water required to produce an amount of food. The work of Hoekstra and others has been providing us with water footprinting for the last decade.[60, 61]

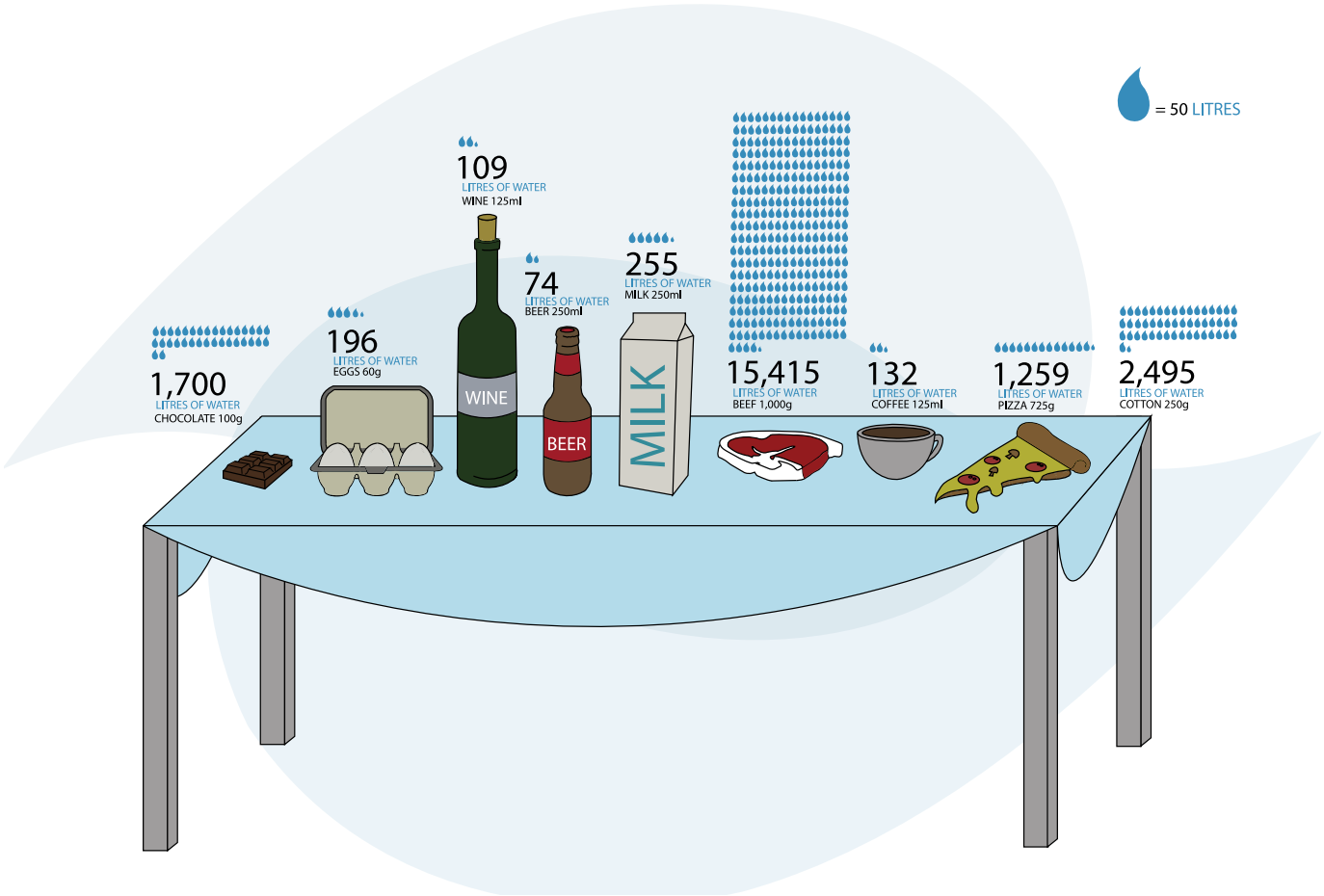


Figure B.2.1.2: Water footprinting

Water footprinting has been cited as a poor basis for policy given the variety of conditions in which products are produced.[62] This is a fair criticism in relation to water availability – as arid areas will have different policy criteria than humid ones. However, as an accurate assessment of the water associated with the consumption of food, water footprinting provides an indication of the environmental impact of our consumption choices. UNESCO has recently reported on the methodologies that underpin both water and carbon footprinting illustrating the importance of understanding underlying issues.[63] City West Water, Yarra Valley Water and Melbourne Water are all showing their customers and the broader public, water efficiency improvements and environmental and economic co-benefits.

It is important that consideration be given to a water footprinting public information campaign to better inform people of this issue particularly as our climate changes. The modelling presented in Foundation Paper One, *Climate Change Victoria: The Science, Our People and Our State of Play* illustrates the potential for changes to drier and hotter climates here in Victoria, and the consequent importance of water footprinting in understanding the breadth of our environmental impacts.

2.1.5.3 Greenhouse gas emissions

Methane emissions

Cattle and sheep make a substantial contribution to our overall greenhouse gas emissions, chiefly through methane produced by enteric fermentation[64] (bacteria found in the stomachs of ruminants). Approximately 11% of national GHG emissions are produced in this way.[65, 66]

Methane (CH_4) as a greenhouse gas

Methane has the second-greatest warming effect of human-emitted greenhouse gases, after CO_2,[67] contributing approximately 20% of global radiative forcing.

Atmospheric residence time[67]

Greenhouse gas	Lifetime in atmosphere years
CO_2	30–95[68]
Methane	12
Nitrous oxide	114

Global warming potential is a relative measure of how much heat a greenhouse gas traps in the atmosphere, compared to CO_2. Over 100 years, 1 tonne of methane will trap 25 times as much heat as 1 tonne of CO_2.

Greenhouse gas	Global warming potential over 100 years[67]
CO_2	1
Methane	25
Nitrous oxide	298

Atmospheric concentrations of methane have risen from 715 ppb (parts per billion) pre-1750 to 1700–1800 ppb in 2010.[69]

The IPCC considers it very likely that the observed increase in methane concentration is due to anthropogenic activities, predominantly agriculture and fossil fuel use, but relative contributions are not well determined.

The main global sources of methane are:[70]

- fossil fuel production and use
- livestock
- landfills.

In Australia, the agriculture sector is the dominant source for methane emissions (58%).[71]

Methane accounts for approximately 20% of Australian greenhouse gas emissions, and emissions have fallen by 3.1% between 1990 and 2011.

Secondary impacts of methane

Ozone is an important greenhouse gas and air pollutant.

Methane is a precursor to background tropospheric ozone, and its growth since pre-industrial times has contributed to an increase in ozone globally. Future changes in methane emissions are expected to affect ground-level ozone concentrations, including in polluted regions.[72]

Farmers are now engaging in practices that seek to capture methane as a resource, and various schemes provide incentives. An abattoir in Inverell in northern NSW is in the process of installing a biogas energy system to reduce its reliance on coal.[73] Organic waste from the cows passes through a digester, creating methane that can be burned to power equipment. This will reduce the emissions of the Bindaree Beef processing facility by 95%. The innovation is partly funded by a $23 million grant from the Clean Energy Fund.[74, 75]

Piggery methane capture methods are expected to increase to 30% of the herd by 2019–2020. As at 2013 ClimateWorks reports that 7% of piggeries are already undertaking this abatement of GHG emissions.[76] At the Blantyre Farms near Young in NSW, methane capture methods earn the farm $5,000 per month in sales of electricity to the grid. The sale of carbon credits will also earn the farmer $175,000 per year.

Kaniva College pig – not all pigs enjoy free range conditions

Pig Farmers Anaerobic Digestion (AD) efficiencies and environmental and economic co-benefits

Internationally, the *UK Green Investment Bank First Report on Anaerobic Digestion 2013* records the environmental and economic co-benefits of finding new ways to use 'waste products'.[77]

The key findings of the report are:

- **AD is a growing opportunity: There was 106MWe of capacity installed or in construction by FY [financial year] 2012, more than double that of FY 2010. An additional 148MWe of specific capacity has been identified as potentially available to be developed.**
- **Fragmented and young market: The top five operators account for less than 28% of the market, which compares to 71% in the offshore wind sector. The majority of AD facilities in the UK have been in operation for less than three years. This presents a funding challenge for the sector, as it lacks an established and informed investor community.**
- **Wide ranging performance factors: There is a marked divergence in operational performance between different facilities.**
- **Critical factors to project success: The main barriers to growth in the sector are feedstock selectivity; deep understanding of, and access to local markets for digestate; dedicated operating personnel; active process management.**
- **Finance: The identified development pipeline requires capital investment of approximately £650 million. Although the AD market has indicated that it is in need of debt funding, equity may be more appropriate in many cases due to the youth of the market.**

Pay-for-performance methane abatement is of increasing interest internationally, as it is capable of being effected relatively easily and it can have quick and significant implications. The World Bank and the G8 have recognised the potential.[78] These farming process opportunities will impact methane in important ways and they should be actively encouraged (see Incentives for better practice and conflicted possibilities below).

Food transportation – carbon food miles

Of the embodied emissions associated with food, it is clear that 'food miles'– the distance food has travelled to arrive at the retailer – produce emissions. However, research informs us that the carbon food miles equation is complicated. Food miles as a tool for assessing the environmental impact of production and consumption are 'one part of a larger complex life-cycle assessment'.[79, 80]

While transport emissions can be reduced, it is now apparent that they do not actually represent a major proportion of the overall emissions associated with the production stage of food.[80, 81] Many more emissions can be involved in the growing and processing of food than in the transportation of food to consumers,[80] with the consequence that dietary changes can be more effective at reducing GHG emissions than simply 'buying local'.[82] This is not to say that buying local does not have multiple other benefits – it clearly does.

2.1.6 Cyclical Implications of climate change – produced and exposed

'The battle on the 2 degree warming limit is lost – we must come to terms with a 4 degree warmer atmosphere and urgently focus on adaptation, on flexibility and resilience to cope with the daunting challenges. Agriculture will become the key battlefield of the 21st century because there will be an unprecedented rush for water and arable land and huge migratory movements thus triggered. That's the language of facts and figures.'[83]

Ulrich Hoffmann, senior trade policy adviser UNCTAD Secretariat – 2013 (OECD)

Climate change will increasingly affect agricultural processes across the world. As it does, it will aggravate impacts on already stressed environmental systems, adversely affecting ecosystem services and all the diversity upon which we rely. Food production will be impacted.

We discussed these impacts in Foundation Paper One, *Climate Change Victoria: The Science, Our People and Our State of Play*.[84] Impacts will include:

- reduced rainfall at key times of year affecting cropping capacity and economic returns
- heat stress on livestock
- more arid conditions reducing pasture growth
- elevated issues with pests and disease
- reduced yields and poorer quality produce as a result of sharper frosts (even though there will be fewer frosts).[85]

We depict impacts in the following info graphic (see Figure 2.1.3).

Figure B.2.1.3: Impacts of climate change on primary production


Reduction in water resources available for agriculture
Increases in pests and disease reducing yields and raising management costs
Possible increase in crop and forestry yields when not limited by other climate change impacts
Relocation of agricultural industries to more suitable areas
Reduction in crop yields from hotter, drier climate and more severe storms
Less frequent frosts reducing the yield and quality of crops that require chilling for production
Rising ocean acidification will impact on many commercial species
Migration or loss of marine species will affect the viability of current fisheries
Impacts on seagrass beds and coastal habitats important recruitment sites for many commercial species
Range extensions of marine pests threatens fisheries such as Rock Lobster and Abalone

As average temperatures rise over time, reflecting the trends we have already witnessed and the scientific projections, it is possible that some current agricultural industries will need to move out of Victoria.

The wine industry has already started to move its operations from northern Victoria into cooler climates. Brown Brothers, an iconic Victorian producer over generations, has purchased large tracts of land in Tasmania – with mixed results.[86]

While climate change may impact our own food production, it will also affect food production globally. Climate change and associated drought conditions may produce stronger demand for Victorian produce if crops fail or are destroyed internationally. Conversely we can also expect to suffer when others compete for markets and our own agricultural production is reduced due to the predicted increase and frequency of droughts.

Significant socioeconomic change, including job losses and regional town retail closures, is expected to eventuate.[87] Just as we stand to benefit economically from the misfortune of others, we are also exposed. To improve environmental, social and economic outcomes we need to grasp the possibilities of developing sustainable food production methods and mechanisms.

2.1.7 Government programs, incentives, research and environmental outcomes

The Millennium Ecosystem Assessment[58] and a report to the UNEP, *Report of the Working Group on the Environmental Impacts of Product and Materials to the International Panel for Sustainable Resource Management*[88] – have stressed the need to reduce the impact of agricultural production methods on ecosystems. This research tells us that these impacts are a threat to ecosystems and also to food production.

Research is being conducted in many jurisdictions to reduce the impact of food production on the environment.[54] This work often aligns with a shift to farming techniques likely to prove valuable as climate change impacts become more severe. For example, water resources are vulnerable under climate change scenarios, and improved outcomes will follow for farming ventures if water resource use is reduced with the adoption of no-till farming methods.[89]

2.1.7.1 Incentives for better practice and conflicted possibilities

Governments can assist in driving conservation tillage changes with the introduction of incentives, as has been occurring in no-till farming where tax offsets are provided for the purchase of the farming equipment necessary to change practices.[90]

Also genetic modification,[91, 92] noting all the associated controversies,[93] is promoted as having the potential to assist in the adaptation of agriculture to climate change.[94–97] Our regulatory environment may not be positioning Australia to take advantage of these possibilities.

The Federal Caring for our Country program aimed to increase the uptake of sustainable farm and land management practices among 30% of farmers by 2013, with the goal of delivering improved ecosystem services.[98] By 2012 this program had already reached approximately 33% of farmers with a range of projects, including information campaigns and the provision of assistance in the preparation of property management plans.[99]

In Victoria, the Department of Environment and Primary Industries runs the FarmPlan21 program, designed to assist farmers to develop a whole farm plan, incorporating training and practical work addressing productivity, biodiversity and adaptation to climate change. Program outcomes and co-benefits include the encouragement of innovative programs and the promotion of:

- crop rotation to limit weeds and diseases, which has the beneficial environmental impact of reducing the need for external inputs such as pesticides
- controlled traffic, keeping farm machinery on the same tracks through paddocks, which improves soil quality by reducing overall soil compaction
- reduced tillage of fields and modern technology, which aids the sowing of seed through residual crop stubble and promotes the retention of soil moisture
- the take-up of GPS and optical sensing, which promotes precision farming and enables the more targeted use of chemical additives, which is also better for the environment.

RECOMMENDATION 11

It is recommended that the Victorian Government extend the use of incentives to agriculturalists to adopt environmentally sustainable farming practices and deliver improved ecosystem services.

ATTRIBUTES

These activities would include, but are not limited to:

- **crop rotation**
- **on-farm traffic control**
- **reduced tillage**
- **reduced and targeted use of chemicals, and**
- **increasing biodiversity.**

Case Study: Innovation Promoting Productivity and Environmental Outcomes

Our visit to the Hamilton DEPI research farm introduced us to the work that agricultural scientists have been undertaking to improve productivity – more lambs per ewe, better weights as a function of understorey and grass shelter belts, and scrutiny of the potential for some grasses to do better under increased CO_2 conditions. While this research is being driven by a desire to gain increasing productivity, it also illustrates the sort of environmental co-benefits that can eventuate. For example, shelter belts for biodiversity outcomes.[47]

Commissioner with DEPI researchers

Outside Horsham, DEPI is conducting experiments on free air carbon dioxide enrichment, for which crop scientist Garry O'Leary has won a Victoria Wheat Research Award (2013).

These experiments are designed to understand how higher atmospheric levels of CO_2 might affect crop growth and production. As such they are instructive, provide guidance and promote best practice.

Adopting different varieties of crops may provide environmental advantages. It is reported that dryland salinity affects more than 2 million hectares of southern Australia. Some cropping innovations may help to settle associated environmental issues. For example, the CSIRO has researched a variety of durum wheat that can be grown on salt-affected soils, with up to 25% improvements in yield.[100] Not only are yields expected to improve but environmental outcomes, including avoidance or reduction of wind and soil erosion, are anticipated as a function of the stabilisation of saline soils.[101]

2.1.7.2 Industry innovations with environmental benefits

Our regional tours took us to the no-till farming work being undertaken east of Horsham where farmers, with limited or no government assistance, have established their own farm planning enterprise. The no-till farmers hold their own conferences, share insights at field days, have reduced their water use, improved their soils, recorded better productivity in dry years and better soil health as a direct function of their efforts.[102–105]

Industry-led Target 100 seeks to deal with livestock environmental impacts and involves research, development and extension projects. In its first 12 months, it has received awards from the Banksia Foundation and held events and programs that have reached over 200,000 people.[106] In 2013, Target 100 won the UNAA World Environment Day Award for Sustainability Education across the agricultural sector, forming networks and informing the community about agricultural opportunities in sustainable production.[107] These initiatives will all have education functions. The benefits of informality are clear but it is also timely to consider and actively promote environmental education in agriculture at the post-secondary level.

Across all of these areas we need to be actively cultivating a skills base for the 21st century challenges we will be facing as our population grows, climate change impacts and agriculture and food security is affected. The loss of skills in the agricultural sector in organised broad-scale farming, is an issue that needs to be addressed.[108, 109]

2.1.7.3 Regeneration and organic farming

A wide range of emergent and already embedded opportunities for better practice in food production have started to take root in Victoria. Some of them are explored above. Research supported by the Food and Agriculture Organization[110] suggests that:

Mixed farming is probably the most benign agricultural production system from an environmental perspective because it is, at least partially, a closed system. The waste products of one enterprise (crop residues), which would otherwise be loaded on to the natural resource base, are used by the other enterprise, which returns its own waste products (manure) back to the first enterprise.

Because it provides many opportunities for recycling and organic farming and for a varied, more attractive landscape, mixed farming is the favourite system of many agriculturalists and environmentalists.

Victoria Market

Organic farming, often conducted at a smaller scale than mainstream farming methods, is one of a number of a growing list of regenerative and mixed farming techniques[111] building on systems thinking and responding to concerns about the need to improve farming methods and protect the environment.

Regenerative agriculture builds an understanding of farming as a system working with natural processes and focusing on storing carbon, supporting biodiversity and watercourses, and improving soils.

In Australian contexts regenerative agriculture is promoted as holistic management, no kill cropping, pasture cropping, natural sequence farming and biological farming of which biodynamic and organics farming are subsets.[112] It should be noted that the regenerative farming movement is a broad church.

If we explore organic farming as an alternative to farming techniques which are criticised for their deleterious impact on the environment, organic farming techniques have been shown to:

- reduce soil loss
- increase soil organic matter – storing carbon and improving water holding capacity
- typically, provide improved biodiversity outcomes when compared to many conventional farming techniques
- avoid the use of harmful chemicals
- improve energy efficiency when contrasting inputs and outputs.[113–117]

Organic farming is not focused on higher productivity and reportedly engenders lower productivity.[118] Longitudinal studies from the Rodale Institute in Pennsylvania, USA, suggest, however, that yields from organic farms are equivalent to conventional farms.[119] The Leopold Centre for Sustainable Agriculture at the Iowa State University provided the research environment for a long-term organic farming research project – 1998 to the present – and results indicate that there are discernible soil health benefits from organic farming methods.[120] In drought years, organic farming has been shown to deliver higher productivity.[113, 121]

Having regard to these observations it is clear that organic food production is one part of the puzzle to produce our food supplies more sustainably.

Katie Finlay, Mount Alexander Fruit Farm

2.1.8 Urban agriculture

As agricultural land is affected by continuing urban expansion, people embrace the slow food movement, and the farmer's market movement moves into cities, suburbs and regional towns – urban agriculture may begin to make a greater contribution to our food production systems.[122, 123]

Potential exists for urban food production to provide a much greater share of our unprocessed food. International examples are proliferating. Local opportunities are being explored. This potential could be achieved through the active promotion of a combination of:

- community gardens on public land (such as the PepperGreen Farm in Bendigo)[26]
- more widespread use of backyard vegetable gardens
- locally operated food-preserving efforts (such as in Castlemaine)[26]
- the development of innovative and highly productive commercial urban greenhouses (such as polydomes).[124]

Again the picture is complex. While there are many diverse examples of community gardens, it is simplistic to assume that these are necessarily 'sustainable' although they can engender an interest in sustainable living and sustainable food production in particular.[125] The role of these gardens is as much social as environmental.[126]

2.1.8.1 Food-sensitive planning and urban design, a Victorian proposal

Addressing these developments and understanding the need for a framework to drive organised or systemic change, the Heart Foundation commissioned a report on urban food production systems from the Victorian Eco-Innovation Lab (University of Melbourne) in 2011. A *Conceptual Framework for Food Sensitive Planning and Urban Design* was developed. A number of case studies – state and international – were considered and compared.[127]

Examples of the growth of sustainable food production efforts in Victoria included:

- Yarra Valley Gateway Estate – a producer, and value-adding vending enterprise providing an outlet for others as a function of its diverse business model.
- Vic Urban Meridian Public Orchards – where development uses water-sensitive urban design, stormwater harvesting and involves the Homeowners Association through a $50 quarterly levy in the upkeep of public orchards.
- VicHealth Food for all projects – a five-year program involving Victorian local governments, all of which were evaluated. Micro movies were produced at the time to publicise the work being done. Of these projects, Wodonga adopted land-use planning outcomes, including a Municipal Strategic Statement which was 'food security sympathetic', and provided for walkability in catchments and higher residential densities. Baw Baw Shire established 'Active by design' to enable subdivisions to promote active transport and local quality of life.
- Melbourne Municipal Markets (including Queen Victoria, South Melbourne, Prahran, Preston and Dandenong Markets) promoted more sustainable food choices.

Victoria Market vegetable stalls

Demonstrating the elevation of interest in this issue the Victorian Eco-Innovation Laboratory (University of Melbourne) with partners including DPI South Australia, VicHealth and the Department of Health South Australia and Horticulture Australia, is embarking on a project 'Modelling Policy Intervention to protect Australia's Food Security in the Face of our Sustainability Challenges'.

The earlier study, framework and the planned research provide the beginnings of an interesting road map for change. Our current planning reform agenda in Victoria offers a unique opportunity to marry this research to organisational and institutional structures to promote changes in the way we understand and produce food.

The environmental benefits of urban food production may not be so clear on a simple comparison of inputs and outputs with rural agriculture, but there a number of additional benefits.[128] Locally produced food can build community resilience and provide food security.[129] Local production can help promote healthier diets producing fresh fruit and vegetables.[130]

As food waste in Australia is estimated at AUD $5.2 billion annually[131] – with vegetables and fruit comprising $1 billion[132] – the short supply chain associated with urban production can reduce food waste. It has been estimated that 30–50% of all food that is produced globally is wasted.[133] The UNEP has just released its alarming report on the implications of food waste on natural resources – *Food Wastage Footprint: Impacts on natural resources*.[134]

There is potential in Victoria's urban areas to investigate more intensive urban food production options to maximise the benefits outlined above and, potentially, reducing the strain on marginal land in rural areas.

RECOMMENDATION 12

It is recommended that the Victorian Government develop a strategy to support and promote food production in urban contexts.

ATTRIBUTES

This review will complement a sustainable food strategy by:

- **improving sustainable food outcomes**
- **embedding spatial planning for food-sensitive urban design**
- **increasing biodiversity.**

2.1.9 Sustainable local food manufacturing – community self-help in Victoria

Sustainable food production is not just about growing the product and getting it to the table in its unprocessed state. There are also real possibilities in community management of food systems and the manufacturing which can be undertaken beyond the operations of the big food processing factories.

Goulburn Valley Food Co-operative

Recently, a north-east Victorian food processing community demonstrated its ability to think laterally in working to save jobs in tomato processing, establishing a food processing co-operative and using a 'virtual factory' to generate employment and local food production outcomes.

The Goulburn Valley Food Co-operatives launched its first tomato and pasta product manufactured from local produce in mid-2013.

A food processing factory closed in the Goulburn Valley, jobs were lost, and no factory premises could be found for this enterprising co-operative group to purchase. The co-operative decided to produce a healthy $10 meal by combining local interests in pasta making, tomato growing, jobs creation, sustainability interests and sourcing a manufacturing plant which was not operating to full capacity.

The co-operative has also created a network with ten local schools which operate sustainability programs and awarded grants of $1,500 for ongoing environmental projects.

A discussion panel was convened which included the local federal parliamentarian, a senator from Tasmania, a representative from Oxfam, the marketer and manager from the local pasta manufacturing business, and the Victorian Commissioner for Environmental Sustainability. It was here that the community got involved in the big issues of tariffs, distribution, productivity and competition, safety and sustainability.

The GV Food Co-operative does not just provide an example of good local community practice but also invites consideration of sustainable food issues: production – by whom and for whom; security across and within borders; transportation and associated issues of greenhouse gas and spoilage; processing and the use of preservatives and other additives; marketing in the electronic age; access and equity; regulation; who consumes the produce – where and in what quantities; and waste, over-consumption and their impact on the market.

As the GV Food Co-operative was launching, local orchardists were pulling out trees or, where this was too costly, leaving them in the ground exposing the properties to the threat of pests.

The picture is complex and a national approach supported by sub-national and local interventions is necessary.

2.1.10 Promoting sustainable food consumption in a healthy diet – the role of agencies and government

In seeking sustainable outcomes there is value in addressing the underlying issue – the choices we make about the food we eat and what informs those choices.

In its latest statement of strategic direction, VicHealth has included the promotion of a healthier diet as one of its five ten-year goals.[135] Healthier diets are also sustainable diets, involving in-season fruit and vegetables, less processed foods, reductions in red meat and dairy consumption[82, 88, 136–141] and consideration of the source of fish products.

There is the potential for change. The Buying Better project, run by NSW-based group Green Capital and affiliated with the Total Environment Centre, is currently developing guidelines to assist consumers to make better environmental choices at their supermarkets, including guidelines for meat and dairy.[142]

2.1.10.1 Food planning

A five-point approach to tackling the sustainability of our diets has been presented to the United Nations Food and Agriculture Organization (FAO).[143] Beyond consideration of the consumables themselves – the definition of a sustainable diet, clarity about environmental impacts and the need for research – the FAO sees a benefit in understanding the institutional structures necessary for reform. The Danish Government provides an illustration of the role and extent of potential government intervention in the development of their Nordic Diet.[137, 144, 77]

National and sub-national food plans are being developed in a number of jurisdictions, and they go well beyond the issue of food security which deals with only some of the issues and which can promote 'food productivism' to the exclusion of sustainable food outcomes.[145]

Vancouver's Food Policy Council is a collaborative effort between the community and government and it has delivered:

- changes to local government by-laws
- changes to the *City of Vancouver's Urban Agriculture Design Guidelines for the Private Realm*
- the publication of a *Food Assessment Report*
- the *Vancouver Food Charter 2007*, which provides for street vending, beekeeping and backyard chickens.

The *Scottish Food Manifesto*,[146] which builds on four themes – low carbon communities, culture and education, health and wellbeing and innovation and enterprise – and the *Canadian People's Food Policy*,[147] promoting education, ecological production and localisation are both advanced at the community level as much better models than the Australian *National Food Plan*.

The Australian *National Food Plan*[148] references food in the curriculum, moving food, community food grants, and becoming a food production power house in our region. The issues paper that produced the plan, however, had only one question on environmental sustainability, and much of the plan is built on the assumption that the future will look like the past. Given our exposure to climate change and the current population projections, the future is considerably more uncertain.

Reporting and evaluation may assist in this regard, and it will be interesting to see what the *State of the Food System* report (every five years, first due in 2018) and the ongoing effort in *Foodmap* deliver.[149]

2.1.10.2 Reducing our food waste

There is clearly a role for governments in food policy and planning. Leadership and community consultation is necessary to promote sustainable production and limit waste.

The potential for innovation is enormous. For instance, the European Landfill Directive requires European Union member states to 'reduce "biodegradable municipal waste" sent to landfills to 35% of 1995 amounts by 2016'.[150] In 1990, Copenhagen ceased accepting food waste as landfill.

Household food wastage has been attributed to:

- a combination of relatively low food prices
- consumers having high expectations of how food looks
- a growing disconnection between consumers and where and how their food is produced.[151–153]

Reduction of food waste is important. Studies from the UK have found that the majority of this waste occurs at the household stage, and that 25% of food wasted was edible.[154] In Victoria, food waste represents about 40% of total household waste to landfill.[155] Food waste is not only financially inefficient, but it also involves wasted energy, soil nutrients and, significantly, given the water footprint of food, water.

New initiatives outlined in the Victorian Government's waste policy include an awareness campaign to help reduce waste from households, and to have better monitoring of and data collection from waste streams to improve our understanding as to where program intervention would be of greatest value.[155]

There is a broader discussion of these issues in the text which follows.

The announcement of the Melbourne Metropolitan Organics Plan, designed to take food and garden waste from across the metropolitan area and convert it into compost and fertilisers, may address some of these issues, identifying markets for end products.[156]

Closed Loop Cafe, Castlemaine

2.1.10.3 Labelling schemes

As we develop methods of working on these issues, there are some seemingly smaller but equally ambitious and perplexing problems to deal with, including the question of labelling food to better inform an interested community, reflect better environmental practices and ensure standards are being met and improved.

The labelling discussion – questions of benefits, difficulties and limitations – is ongoing, and it crosses sectors and interest groups, with environmental sustainability being only one of a number of considerations.[157–159] The Fair Trade movement illustrates the potential for change, using every possible marketing tool to improve outcomes, most recently ascribing to a Better Cotton Fast Track Fund and continuously seeking to improve and report on outcomes.[160]

The complexity of the choices for consumers can be difficult and overwhelming.[161] Consistent with international studies,[162] surveys of Australian consumers of organic products suggest that their choices are driven more by health than environmental concerns.[163]

There is typically an information gap or misunderstanding between consumer and producer.[162] Consumers either cannot know as much about a food product as the producer or misinterpret words or phrases on packaging (such as 'all natural').

Labelling schemes can help address these issues and there is a significant role for government in working through the jurisdictional and other complexities. Research has shown that certification-based labelling schemes are more effective when regulated by government.[162]

The Legislative and Governance Forum on Food Regulation is currently oversighting a national labelling agenda with varying degrees of anticipated success.[164]

An alternative approach is for supermarkets and other large retailers to take a lead role in making these decisions for consumers, i.e. by minimising the availability of products that have sub-standard environmental performance.[81] We have not seen much evidence of the potential for success of such a proposal in Australia, although some better examples exist in other jurisdictions.[165]

2.2 Sustainable Use of Urban Water

Proposition

Uncertainties in future water supply and the increasing need to provide adequate water to aquatic ecosystems mean that wise water use is essential in the 21st century.

Integrated water cycle management (IWCM) and good urban design and planning can help deliver this but these need to be supported by public and political will. This work has been begun by the Office of Living Victoria, and will need to be continued over the long term by changing our overall approach to water management in urban areas. The water-sensitive cities of the future need to use good design and integrated water cycle management to use the city itself as a catchment, providing fit-for-purpose water for a broad range of uses.

Context

City water services – the provision of potable water (drinking water) and 'sanitation' services – are ecosystem services for which we need to share responsibility.

'Town water' is energy-driven into our homes from distant storages – through pipes, out of taps. It is delivered on demand – sanitised and safe – as a commodity. It is no longer a 'commons'.[166] In this driest of continents, potable water has often been treated as if it is plentiful.

Drinking water should not be used to flush toilets, wash clothes, water trees, wash down driveways and cars or water lawns when other water would serve just as well. The International Water Association's draft *Montreal Declaration on the Cities of the Future* program Principle 7 reminds us that 'sustainable cities will recognise that all water is good water – based on the concept of "fit-for-purpose" use'.[167]

2.2.1 Fit-for-purpose water

Associated with our historical lack of interest in the sourcing and management of the water we use, we have not readily questioned the hundreds of thousands of litres of water which we waste. When we actually know how much water we lose, centralised and non-integrated water resource supply methodologies seem odd, if not cavalier.

For example, we know that approximately 650 GL (gigalitres) of rainwater, nearly double Melbourne's annual consumption, falls in urban Melbourne,[168] and less than 2% of this water is used.[169]

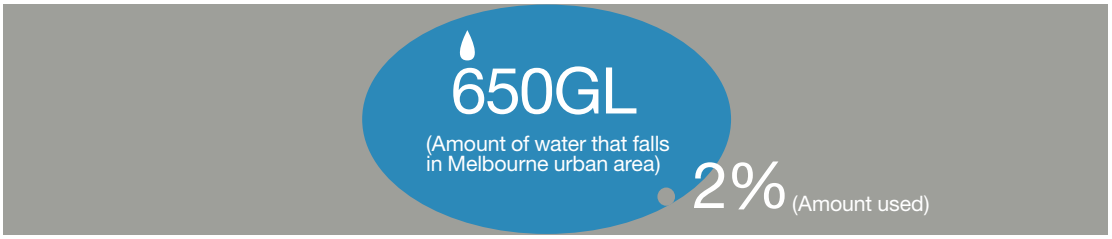


Figure B.2.2.1: Rainfall and water use in Melbourne

In Melbourne we generate upwards of 540 GL per year of excess water through stormwater run-off. Add to this the fact that only 30% of the water demand in Melbourne is for quality drinking water,[170] and it is clear that – in terms of fit-for-purpose resource use – we have, as a community, vast potential for reforming our water-use habits and our infrastructure.[171]

2.2.2 Water in the future: availability and demand

As the global climate changes, Victoria will become warmer and rainfall patterns will change (see Part A and Foundation Paper One, *Climate Change Victoria: The Science, Our People and Our State of Play*). While there is uncertainty in exactly how rainfall will change, it is reasonable to expect that historical decisions, made on the assumption of stationarity (rainfall that fluctuates within set boundaries but is essentially predictable over long time scales), will not necessarily meet future needs – particularly in the light of anticipated population growth. Additionally it is probable that future water will need to have a larger proportion committed to maintaining vital ecosystem services and less for consumptive use than has traditionally been available.

On the demand side, Melbourne's population is expected to grow by over 2.3 million in the next 40 years.[172] The infrastructure we put in place today will have to provide adequate water to future Victorians. In regional areas, total water demand is expected to grow by 6.5–9 billion gigalitres by 2021.[173]

A potentially growing demand and an uncertain water supply require robust and sustainable planning.

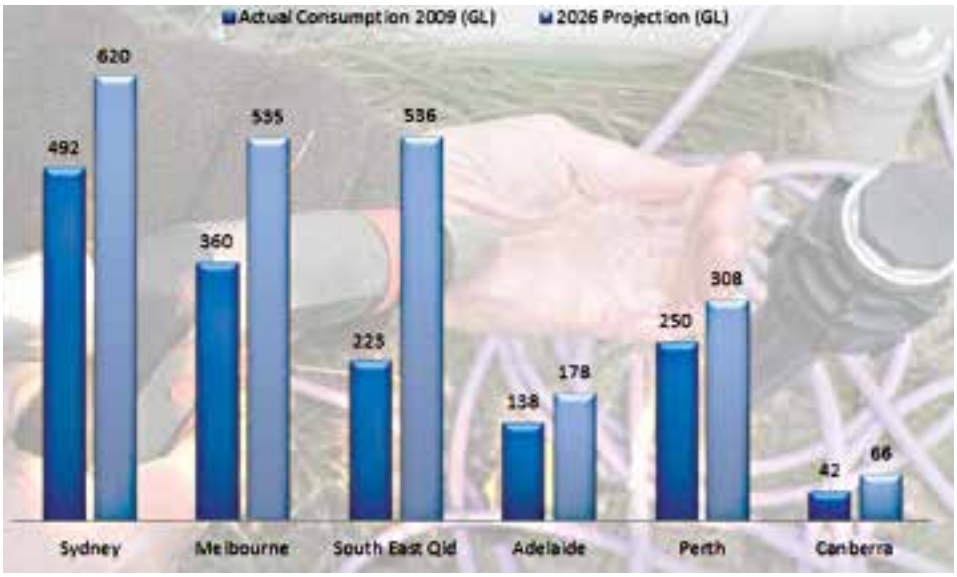


Figure B.2.2.2: Projected total urban water consumption, 2026

Source: Water Services Association Australia Report Card 2009–2010.

2.2.3 Living Melbourne, Living Victoria and the Ministerial Advisory Council

The Living Melbourne Ministerial Advisory Council (MAC) was appointed In recognition of the need to properly integrate sustainable water use with urban development. The MAC was formed to provide independent advice to government and this was delivered in the form of the *Living Melbourne, Living Victoria Implementation Plan*. The plan contained a suite of recommendations to government that fell into three broad themes:

- Transform the way we manage water resources and the water system.
- Establish the Office of Living Victoria (OLV) to drive reforms by coordinating urban and water planning.
- Overhaul the water planning framework to respond better to broader community needs and more effectively integrate with urban planning.[174]

In response, the government adopted many, but not all, actions from the MAC. The immediate actions that the government has committed to are:

- a review of the current Water Supply and Demand Strategy
- changes to the tariff arrangements, providing greater choice, pursuant to the water industry regulatory order
- developing investment guidelines that reflected the true values of amenity and environment
- partnering local government and water authorities to extend Melbourne Water's stormwater licensing arrangements for government infrastructure
- aiding investment in wastewater reuse, impacting sewer mining guidelines
- improving regulatory arrangements
- working with the Smart Water Fund and the CRC for Water Sensitive Cities.[175]

The government response was also broadly supportive of the remaining actions from the implementation plan and has implemented a broad range of actions to achieve them (details are given in *Melbourne's Water Future*, including 19 case studies of current initiatives ranging from stormwater action through to intelligent networks). However, in the case of longer-term recommendations that are concerned with transforming the broader water management landscape, the government has stated that implementation of the recommendations will depend on cost to and regulatory impacts on the water industry.

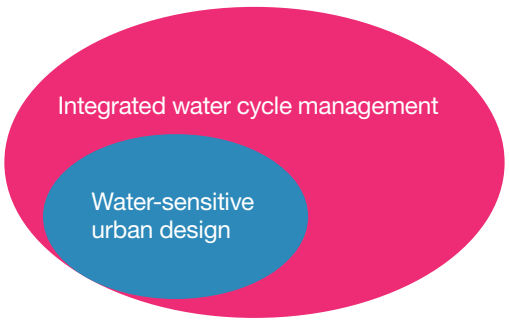


Figure B.2.2.3: Relationship of IWCM and WSUD

2.2.3.1 The Office of Living Victoria (OLV)

Also key to the government's response to the implementation plan was the formation of the OLV, which seeks to develop strategies for integrated water cycle management (IWCM) that are suitable for Melbourne, and to embed these in planning processes and design standards.

In July 2013 the OLV released *Melbourne's Water Future*, the draft plan for water management in Melbourne for the next 40 years.[176] This has been endorsed by the State Government and identifies priority areas for action:

- Engage the community in whole-of-water-cycle management.
- Design our old and new suburbs with water in mind.
- Encourage sensible use of water in our homes and businesses.
- Build resilient water systems that work well during flood and drought.
- Improve the health of natural waterways.
- Reduce inefficiency and waste.
- Accelerate water innovation and world recognition of expertise.

The plan adopts a 40-year outlook for water planning in Melbourne and lays out initiatives for achieving each long-term goal, advising that water management plans be reviewed and updated every three years.

2.2.4 Integrated water cycle management (IWCM)

The practice of IWCM (also called whole-of-water-cycle management by the OLV[177] – there are other definitions of IWCM which are narrower and less ambitious)[178] – involves coordinating water and land-use planning and development. IWCM is a multidisciplinary and multi-objective approach, used to promote the sustainable use of all available water resources in ways that best deliver multiple community objectives.

In practical terms, IWCM may fulfil multiple purposes and operate over longer time frames than traditional planning. It has the potential to harness and promote many of the intangible yet vital attributes of urban liveability, across landscapes and the built environment.

When applied ambitiously, integration may address traditional and new-generation climate change and water cycle concerns, and promote the following:

- meaningful, long-term water supply security
- greenhouse neutrality
- public health protection
- economic vitality and robustness
- flood and flash-flood protection
- intra and intergenerational, cross-cultural, socioeconomic equity
- waterway health and ecosystem services protection
- amenity, recreation, mental health and other co-benefits of demonstrable long-term environmental sustainability
- reputational benefits.

Figure B.2.2.4: Stormwater harvesting

Moonee Ponds Creek

Royal Park Wetlands
Courtesy of City of Melbourne.

2.2.3.2 Stormwater

Planning for the use of fit-for-purpose water and the clever and sustainable retention and use of stormwater will help to address Melbourne's future water needs.

The most obvious effect of urbanisation on catchment hydrology is the increase in the magnitude of stormwater flow events in urban streams. As climate change drives an increase in rainfall extremes we will need to deal much more effectively with impacts of flooding, stream erosion and loss of aquatic habitats, and threats to public safety.

Stormwater management has traditionally focused on drainage. The principal technical challenge – and often the primary objective – has been to convey this run-off away quickly and safely to 'receiving' waters. Traditional approaches in 'efficiently' conveying stormwater and its pollutants as they are flushed from urban areas into receiving waterways have a double negative impact. The potential for reusing the stormwater is wasted, but this sort of management also produces a waste product – as the outflow causes the deterioration of the water quality in the receiving water environment.

Fifty years ago, the water quality of Moonee Ponds Creek was very poor due to these conventional management methods.

More recent waterway treatments understand waterways as ecosystems with ponds, wetlands, currents, rockfalls and riparian zones, need to be nurtured as habitat zones, and as having social and cultural meaning. These wetland ecosystems help derive benefits from stormwater in creeks because they slow down the flow of water and help reduce the amount of sediment in stormwater run-off. They also allow natural processes, the sunlight and time to help clean the water.[179]

The Merri Creek – once neglected but never a concreted drain – is now a community project and meeting place. It provides valuable social and recreational ecosystem services across cultures and generations.

Its management enables the development of wetlands. New infrastructure investments in greenfield developments, which draw the pollutants out of stormwater and which also reduce run-off, allow us to redefine stormwater management services, reflecting the many attributes associated with water-sensitive urban design.

Engineering solutions and analysis of the benefits of sensitive water design have a significant place in addressing future water supply and demand, but this project also illustrates the outcomes that can be achieved by integrated planning and multidisciplinary collaborations.

A network of 'green and blue corridors' of open spaces – places for walkability and of amenity – is a longer-term possibility for installations that process stormwater. Corridors will filter urban stormwater through vegetated treatment systems, detain and convey flood waters, and provide potentially productive landscapes intrinsically linked to soft and hard infrastructure.

This will contribute to human thermal comfort in areas immediately adjacent to corridors – within 100–300 metres.[180, 181] Water spaces, canopy, and grassed areas will also promote biodiversity in the urban environment.

Merri Creek, Northcote

2.2.3.3 Water-sensitive urban design – an international context

Water-sensitive urban design is the practical application of water conservation efforts, and is an essential component of integrated water cycle management. This sort of design has delivered rain gardens, roof gardens, rainwater tanks, bio-retention swales (areas of land designed to retain rainwater), mini wetlands, and stormwater collection and use.

Adoption of this design strategy gathered pace as we felt our way through the big dry – crisis drove change.[182] Reactive action is what we now want to avoid. Design of this type needs to become the new normal and it needs to expand its reach and influence moving from a design feature to an operational water cycle integration ethic.

The practice of water-sensitive urban design (WSUD) will almost invariably encapsulate the principles of integrated water cycle management, so our baseline is good. Water-sensitive urban design represents the integration of urban planning with the management of urban hydrology and the water cycle, and is the design component of integrated water cycle management.

Taking a holistic view, and including the public in the conversation, it is the incorporation of water-sensitive urban design within integrated water cycle management that will give us water-sensitive cities. These are the sort of cities we will need to adapt to climate change and help insulate us from drought.[183]

WSUD reinforces the view that is possible to develop cities as sustainable ecosystems,[184] or biophilic cities[185] and build green infrastructure.[186] By choosing inventive and responsive urban design strategies it is possible to reconsider the way we use water, our demand for it, and also our responsibility for (re)producing it.[187]

Water-sensitive cities, in which urban water cycles are designed and managed as integrated systems enmeshed with urban design and communities will be the 'cities of the future'.

To deliver WSUD – with all its multiple attendant benefits – the following social, economic and environmental ethos will be necessary in these cities of the future:

- a community with a heightened receptivity to innovative practices for sustainability, which is also striving to live an ecologically sustainable lifestyle, aware of the balance and tension between consumption and conservation of the city's natural capital
- reflective practitioners threaded through the water industry demonstrating inventive capacity and showing an active interest in innovation and adaptation
- enabling regulatory regimes and policies, formulated by proactive governments which will be used to facilitate an ongoing adaptive evolution into the water-sensitive city.

2.2.3.4 Water-sensitive urban design in Victoria

Great progress in implementing water-sensitive urban design projects has been made in many municipal areas. Numerous towns and cities across Victoria have offered stories of success, inventiveness and willingness to adopt new and sustainable water conservation development practices.

Melbourne has developed several major stormwater harvesting projects because it currently generates large amounts of unused stormwater. In the Fitzroy Gardens, a new garden area will include a biofiltration area to clean stormwater that can be used to irrigate nearby street trees.

At the Alexandra Gardens and Queen Victoria Market, existing ponds and underground tanks are used to produce fit-for-purpose recycled water to replace 119 ML/yr of potable water historically used for irrigation in Melbourne.[188]

In Swan Hill, the development of the Tower Hill subdivision is an example of achievable water technologies. VicUrban drove the initiative in tandem with the local council. The site was a greenfield and leant itself to innovative design. Growing housing demand promoted the proposal. Sited to the east of the development is a wetland, providing thermal comfort but also a habitat for native bird life. Water used on playing fields is 'recycled', roadscapes are used to catch and retard stormwater, and drought tolerant plants have been installed. Pocket parks dot the development.

Developments across Shepparton have become demonstration sites for changing ways of thinking about and valuing water. At Kialla Lakes a wetland, roadside drains, drought tolerant plantings have turned a dry and hot plain into a cool and comfortable residential development. Elsewhere in the city, the Boulevard development has pocket parks, a wetland and dry creek water retention area has produced a sandy environment which has water-sensitive features across its whole expanse.

The City of Greater Geelong and Barwon Water have worked closely together over years to address the issues of population growth and climate change adaptation (e.g. the Eastern Park Stormwater Harvesting Project).

Wodonga City Council expresses its commitment in its planning instrument, which states that:

- the position of Wodonga in the upper catchment of the Murray River will be respected at a local level through the implementation of *Urban Stormwater – Best Practice Environmental Management Guidelines*[189] and *Water Sensitive Urban Design Engineering Procedures Stormwater Technical Manual*
- the encroachment of urban areas onto the floodplains of the Murray and Kiewa Rivers will be restricted
- the retention of existing wetland systems will be encouraged through the implementation of the principles defined in the *Urban Stormwater – Best Practice Environmental Management Guidelines*[190]
- a water capture and storage system is being installed with tanks, pumps and integrated pipe systems for the Bonegilla Migrant Experience.[191]

Furthermore, Yarriambiak Shire Council is working on the installation of rainwater tanks.

These regional centres are framing the discussion in terms of a wider ecological understanding of the role and management of water. They are reflecting the culture of change which is found in IWCM across the state. The challenge is to craft this as the new normal, to embed it in every practical effort and to import this sort of change into the difficult and resistant places, not just overlay them on the greenfield sites.

RECOMMENDATION 13

It is recommended that the Victorian Government adopt a strategy that delivers water-sensitive urban design (WSUD) and integrated water cycle management (IWCM) as standard practice.

ATTRIBUTES

The prerequisites of this framework are:

- **establishing an economic valuation for urban water projects based on WSUD and IWCM principles**
- **establishing clarity in governance structures**
- **strengthening science-policy partnerships**
- **fostering evidence-based policy development**
- **active community engagement.**

Public policy developed and implemented to meet these priorities will have to explicitly attend to:

- **determining the economic value of urban water infrastructure and water reuse benefits**
- **identifying decision-support frameworks for policy makers.**

2.2.5 A vision for Victorian cities

It is critical that urban water management change from water provision and processing waste water (taps and toilets) to treating the urban space as its own catchment. This transition needs to be led by good urban design.

Three fundamental principles of practice have been developed by the CRC for Water Sensitive Cities for the attainment of a water sensitive city:

- Cities will see themselves as water supply catchments, promoting the access of a portfolio of alternative water sources through a diversity of supply scales – in a catchment.
- Cities will align themselves with the provision of ecosystem services: allowing us to understand the city as a built environment which actually functions to supplement and support the natural environment.
- Cities will be comprised of water-sensitive communities: asserting the existence of socio-political capital for sustainability and enabling citizens' decision making and behaviour to encourage urban water sensitivity.[192]

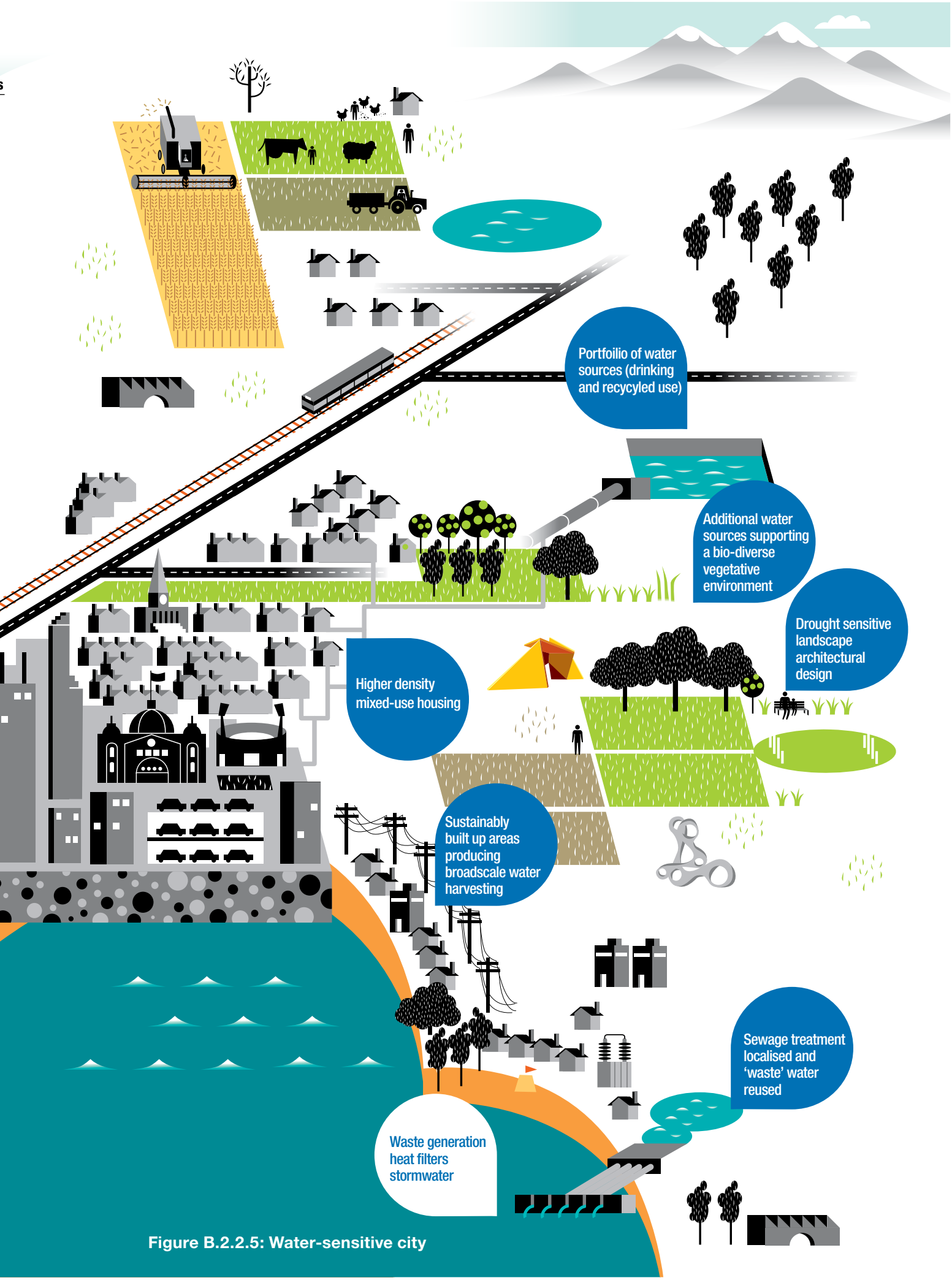


Figure B.2.2.5: Water-sensitive city

In the water-sensitive Victorian cities of the future, these principles will need to be supported by community norms actively encouraged and maintained by government:

- active engagement and strong community adoption of best practice
- community participation
- the public will be better informed about the role of Victorian ecosystems in providing water as a resource from which we derive numerous services
- the community will be interested in water conservation, water's ecological and other attributes
- the community will be more resilient in the face of climate change.

Ultimately, we need cities that are optimised for sustainable water use and use higher-density mixed-used housing types to provide a basis for innovation in:

- localised sewage treatment and recycling
- stormwater treatment
- optimal harvesting of rainfall from roofs, streets and urban drains.

Collectively, these additional water sources will work to support a bio-diverse vegetative environment that does not depend on conditions in the city's water catchment. Urban vegetation can then be incorporated into precinct design. Green corridors and pocket parks will serve as flood detention and conveyance systems during extreme storms.

Public participation in this vision is key. When a city is truly water sensitive, people are better informed about water and the broad range of services it provides. They are also more able to deal with its conservation and management in climate-constrained times.

Active engagement and strong community links are critical to realising this vision for the future.

Scientists and engineers will play a role in designing the new systems and structures, but will integrate their knowledge with a broad range of other disciplines. This 'new normal' interdisciplinary research agenda will need to cross domains as diverse as landscape architecture, social and development aid discourses, sociology, anthropology (all about public participation, evaluation and, more obscure, the cultures which attach to our understandings of water) and the design professions.

The range will extend to those concerned about water conservation and efficiency, including those already working in water organisations. The disciplines which need to be included to address supply security will extend beyond engineering and even environmental engineering. The role of engineers in understanding the cultural meaning of water should not be underestimated.

To attain the outcomes we desire we will need to include the insights of public health professionals, geo-morphologists, water body health scientists and the public; biodiversity scholars, wetland ecologists, design scholars and social scientists with an interest in amenity and recreation and environmental interpretation.

The new planning paradigm will need research to go beyond the existing knowledge bank, and include both thematic aspects such as water production, harvesting, anticipating extreme events and spatial scales that transport us from households to landscapes.

2.2.6 Community participation

At a national level, WSUD is being explained and promoted, but we should consider whether there is adequate administrative, legislative and institutional support for the step change we require. To effect change we will require enabling policies and water pricing measures that are conducive to change and that provide policy stability. For the creation of the new 'normalised' water-sensitive city we will also need to actively cultivate the public.

The rate of adoption of water saving efforts by the community, such as installation of rainwater tanks, suggests enthusiasm for the practical work being done.

While this work builds critical mass, the overarching question continues to be whether a plethora of individual, somewhat circumscribed WSUD projects is actually delivering integrated and systemic change.

Plainly, reforms to the whole water cycle will not be driven by local government and community efforts alone. Local government does not have the water and sewerage management capacity or responsibility to progress WSUD to the same level as do water corporations or higher tiers of government.[193]

For this reason, State Government intervention – through the Office of Living Victoria's intention to actively engage communities[176] – is welcome. All of these efforts can be seen as prongs of systemic and necessary erosion of the old centralisation paradigm. They should not be seen as ancillary to, and paradoxically supportive of, its continuation.

2.3 Reducing Resource Use

Proposition

It is critical that we support transition to an economy with an emphasis on the environmental provision of services and goods, and where consumer choices are informed by assessments of the environmental impacts of consumption.

Ultimately, we need a movement from 'ownership' of products (e.g. cars) to 'access' to desired services (e.g. transport). Waste will be avoided through improved design and product stewardship and resources maximised by treating waste products as a resource stream. Life-cycle assessment (LCA) of consumer products is a valuable tool that can encourage manufacturing companies to make their supply chains more efficient.

Context

There has never been a greater recognition of the need to properly assess and protect the financial and non-financial values of natural capital and ecosystem services.

New international initiatives are providing frameworks to carry out this valuation (see Part B: 5.1 Monitoring and Data Collection). For example, after Rio+20, the financial services sector published a high-level commitment to incorporating long-term sustainability into its operations.[194] However, there is still a disconnect between these high-level frameworks and pledges, and the consumption of goods and resources in the developed world.

2.3.1 A contemporary approach to consumers and consuming

When the costs of resource use and ecosystem degradation are fully quantified and included in company accounts (and not simply cited as 'externalities'), we will know the true costs of consumption. This will enable us to evaluate the real costs and benefits of our actions. Clearly demonstrating the economic benefits of, for example, improving essential ecosystem services could form the basis of an incentive structure in the market that would cause rational, self-interested decision makers to maximise environmental benefits.

Minimising waste is an essential step in improving production efficiency. This extends to recognising the resource value of materials that would historically have been treated as waste. State and federal governments are enacting polices to prevent high-value materials from entering landfill and promoting product stewardship initiatives.

Product stewardship requires manufacturer responsibility for products over the entire lifetime of the product, including its final disposal. This challenges designers to create goods that can be cheaply deconstructed with components recycled. Some companies (see below for specific examples) have embraced this ethos and are using it to introduce efficiencies to their processes.

A necessary condition of product stewardship is the notion that products will be returned to the resource reclamation facilities at the end of their life with the immediate cost of this borne by the manufacturer passed on to consumers according to individual markets.

For example, you might buy a laptop, use it for five years and then return it for the components to be reclaimed. While the costs of this process will be covered, at least in part, by the value of the reclaimed elements, there will be some additional cost borne by the owner. The consumer is, in essence, paying to access the services of a laptop, rather than owning it forever.

This concept of access-not-ownership – which may also be considered as a 'subscription model' – is at the core for 'collaborative consumption', encapsulated in the idea that, as a society, we can obtain maximum value from consumer goods by spreading costs across multiple users. We are witnessing an uptake of collaborative consumption in Victoria in the creation of schemes that facilitate product sharing (see below for specific examples).

These innovations are part of a range of actions being used in Victoria to reduce the environmental impacts of production and consumption.

Life-cycle assessment (LCA) provides a range of techniques for assessing the environmental impacts of products over their whole life, from manufacture to disposal. LCA techniques are increasingly being used by manufacturers of all sizes to identify and reduce risks and inefficiencies in their processes and supply chains. Ultimately the use of life-cycle assessments is influenced by initial assumptions and limited by the availability of high-quality data. However, as LCA becomes more common and the public becomes familiar with the concept, simplified assessments could form the basis of life-cycle thinking. The information generated – when used in conjunction with other measures to change consumer choices – has the potential to reduce demand for products that create a relatively high environmental impact. This would see increased awareness of the implications of consumption choices particularly if supported by initiatives focused on certain impacts, for example: greenhouse gas emissions, water use, or biodiversity losses.

It is important to note that any strategy to influence consumption behaviour may well be employed against a background of a global trend towards the use of other economic tools – primarily carbon pricing – intended to reduce the environmental impact of climate change. Therefore, any programs that use life-cycle thinking to improve resource-use efficiency need to be designed to act in conjunction with carbon pricing mechanisms.

It is important that research conducted in collaboration with best-practice business and government efforts is undertaken to compare the efficacy of strategies and tools and identify how these can be deployed.

2.3.2 Moving from ownership to access

As manufacturers use resources with greater efficiency and begin to incorporate the costs of recycling, consumers are seeking new ways to reduce individual costs and maximise the utility of products.

If, as a society, we focus solely on product greening through marginal improvements in manufacturing efficiency, then we will miss the chance to effect large changes by rethinking and redesigning how we access services and products.

Collaborative consumption represents a new model for gaining access to high-value resources in which communities can use new networking technologies to swap, barter and share products. Several successful businesses such as AirBnB[195] (recently declared illegal in New York City)[196] or car sharing services, where subscribers pay a fee-for-access to personal transport, are starting to emerge and gain traction.

Consumers, designers and service providers have the opportunity to begin to move away from the expectation that people will buy, own, and eventually dispose of products.

Two examples of this collaborative consumption are Mud Jeans and Flexicar.

In the Netherlands, the company Mud Jeans leases jeans for €5 per month.[197] After a year, the leaser can replace the jeans for a new pair. This allows the company to retain control of the material (an expensive resource) and increase the recycled content of their product to as much as 50%.[198]

Flexicar is a membership-based carshare company that aims 'for carsharing to become a mainstream public transport option for urban Australians; providing a cheap, green and easy alternative to car ownership'.

2.3.3 Reclaiming resources from the waste stream

Victorian waste policy has addressed the need to increase reclamation of high-value material that would typically end up in landfill. When the value of high commodity materials (materials that that can be profitably diverted from landfill) was assessed, an estimated $172 million was determined as 'lost to the Victorian economy' annually.[199]

In Victoria, the landfill levy – a charge for disposal of waste in landfills – exists to promote the development of resource recovery industries and the levy funds improvements in recycling programs.

The Victorian Waste and Resource Recovery Policy[155] seeks consistency with the National Waste Policy and proposes actions to ensure Victoria fully participates in national product stewardship schemes and develops trial schemes.

The State Government has promoted high recycling rates in government departments. On average, 85% of office waste has been diverted from landfill over the last four years.[200]

Although it has been cited as a best-practice organisation, Zero Waste South Australia[201] – the agency responsible for promoting waste avoidance and recycling – was closed in 2013 to reduce government expenditure[202] despite protests from some waste industry representatives.[203]

2.3.3.1 Market development

Efficiency of material reclamation needs to be complemented by creating a stable market for recycled products. There is a great deal of 'push' for creating products from recycled material but only a small 'pull' of demand from the market. There is, therefore, a role for government in accelerating the development of markets.

This could take the form of creating certainty for consumers that recycled products are fit for purpose through the enforcement of ISO standards or, where these do not exist, creating standards for sale of products in Victoria.

For example, compost is required to meet certain quality standards irrespective of whether it is derived from recycled green waste. Consumers can therefore be confident that products they are buying are functionally identical to the non-recycled equivalents and are fit for purpose. This information could be conveyed as part of education campaigns to increase public understanding of currently undesirable recycled materials (e.g. plastic, glass).

The government can also act to establish markets for waste stream products through procurement strategies that guide state purchase contracts. This process has begun with the requirement for recycled content in office products (such as paper) and could be extended to other state purchase contracts.

Similar processes can also be introduced by local governments. For example, the City of Whitehorse has made the use of recycled asphalt standard practice in contracts for road resurfacing. The council has included sustainable conditions in its tendering conditions, including a price incentive of 10% for recycled content. By adopting green purchasing strategies in line with federal guidelines for sustainable procurement[204] and reporting use of recycled products, government bodies can ensure revenue streams for manufacturers and demonstrate the effectiveness of products.

There are a number of initiatives that are leading this process. Within government, Health Purchasing Victoria – which guides procurement for the health services sector – has appointed a sustainability officer to ensure that the environmental impact of purchased goods is minimised.[200]

This example could be followed by the other key authorising agencies – the Victorian Government Purchasing Board and the Building Commission. Outside government, the EcoBuy program is working primarily with local governments, but also state agencies, to establish such polices and provide tools that facilitate the purchase of lower impact products.[205] EcoBuy is already working with a number of State Government departments and agencies.

RECOMMENDATION 14

It is recommended that the Victorian Government strengthen incentives and assume a leadership role to improve the efficiency of material reclamation from the waste stream.

ATTRIBUTES

Initiatives to assist Victoria in becoming a leading jurisdiction could include:

- **establish and develop markets, and remove barriers, for trade of resources from the waste stream**
- **facilitate information for transfer of waste stream between sectors**
- **promote design standards to ensure efficient reclamation of reusable materials**
- **government and industry coordinating the monitoring of material flows by sector.**

2.3.4 Encouraging the adoption of product stewardship

Encouraging efficient manufacturing and informed consumer choices is crucial to reducing consumption impacts.

There are numerous complementary approaches to current LCA techniques, and to further reduce impacts we need to assess how we can use and reuse the resources already in circulation that are often lost as 'waste'.

We must learn to view the waste stream as a valuable resource. In fact, we should think in terms of 'resource recovery' rather than waste.

Product stewardship is exemplified in Australia in container deposit legislation (South Australia), which has, for decades, provided for a refundable deposit on reusable food containers such as bottles.

Minimising the impacts of product disposal is central to the National Waste Policy. To this end, the *Product Stewardship Act* was introduced in 2011. This provides the regulatory framework to effectively manage the environmental, health and safety impacts of products, and in particular those impacts associated with the disposal of products. The Act includes voluntary, co-regulatory and mandatory product stewardship.[206] It includes regulations that enable:

- a National Television and Computer Recycling Scheme
- a National Packaging Covenant
- recycling of tyres
- recycling of mercury-containing lamps
- recycling of some plastics (e.g. degradable plastics, plastic bags, PVC).

The National Television and Computer Recycling Scheme provides households and small business with access to free recycling services for televisions, printers, computers and computer products (such as keyboards, mice and hard drives).

The scheme is intended to increase the recycling rate for television and computer products in Australia from an estimated 17% in 2010 to 30% in 2012–13 and to 80% by 2022.

Porland Sustainability Group TV recycling effort – 26 tonnes
Courtesy of Portland Sustainability Group

The scheme is funded by mandated contributions from large manufacturers and importers of televisions, computers and computer products.

Product packaging is now covered by the Packaging Covenant, and there are stewardship schemes in place for tyres and lamps (that contain mercury). Schemes like these could be used as the basis for devising product stewardship initiatives for other consumer products.

A proposed framework for product stewardship in Australia has identified factors that will increase the likelihood of success.[207] For example, products that contain hazardous or valuable materials may lend themselves to this approach.

Other factors that may be conducive to change include:

- concentration in supply side of market
- significant local production relative to imports
- strong industry cohesion
- a mature market
- an industry characterised by repeat business.

RECOMMENDATION 15

It is recommended that the Victorian Government develop a Product Stewardship Strategy.

ATTRIBUTES

The product stewardship strategy would:

- **act to identify mature and stable sectors for new schemes**
- **develop inclusive schemes in consultation with industry and stakeholders**
- **amend regulation (if required) to integrate with new schemes.**

AroundAgain Mildura Waste Facility

2.3.5 The importance of good design

The philosophy of product stewardship intersects with the principles of good design.

If a company expects to reuse products (either whole or as components) across iterations of production, those products should be designed to fulfil this purpose as efficiently as possible.

This means products need to be designed for longevity or recycling.

Figure B.2.3.1: 'Four design models for circularity'

Source Great Recovery UK

These principles can be seen in action at global companies like Interface Carpets[208] (who produce carpet tiles that can be easily recycled) or BMW[209] (with its Design for Recycling program).

2.3.6 Life-cycle assessment

Life-cycle assessment provides a tool whereby the environmental impacts of production can be assessed and potential 'hot spots' identified that can be used to focus efforts to improve production efficiency. The key elements of LCA are:

- compiling an inventory of relevant energy and material inputs and environmental releases
- evaluating the potential environmental impacts of those inputs and releases
- interpreting the results to better inform decision makers.[211]

Case Study: Desso Carpets

Stef Kranendijk was CEO of Desso between April 2007 and October 2012, and a key driving force in rethinking the business model of the company. He explains, 'The idea is to become a service industry, relying on a leasing system: then you don't buy the product, you only pay for its use, which means materials remain our responsibility and of course it's not our interest to see them wasted, at the end everybody wins.'

This ongoing transition to a circular business model has demanded an ambitious strategy with challenging milestones. Desso identified that the business-to-business (B2B) market was more readily open to the performance model: 'We started with the carpet tiles for offices and industry, then we will make our sports systems Cradle to Cradle, move to our woollen carpets – in that field, we're working on a biodegradable base made out of corn by-product – then we'll tackle the consumer market.'

Designers and materials experts have also experimented in the biosphere, notably taking yarn from bamboo, which has the benefit that once the carpet is worn, it can be safely returned to the food-farming system. However, Kranendijk notes, 'We still have to improve the product though, notably to enhance its durability.'[210]

Case Study: Antarctic life-cycle assessment benchmarks

Recent environmental impact assessment in the Antarctic could provide innovative sustainability benchmarks for life-cycle assessment measures, which could be replicated in similar self-contained areas such as mining and outback communities.

Simon Lockrey, Research Fellow at RMIT's Centre for Design and a member of the Victorian Chapter of the Australian Life Cycle Assessment Society, recently travelled to Scott Base with Associate Professor Mick Abbott of Lincoln University to conduct on-site auditing and analysis.

Lockrey said, 'Each of the things they do will interact with the environment in some way. Solar panels might reduce fuel use, but at the same time increase physical footprint or diminish aesthetic values.

'A triple membrane filtration waste water system would protect the oceans, but would there be greater net environmental benefit from installing new highly efficient incinerators?

Scott Base Antarctica
Courtesy of Simon Lockrey

'For years, Scott Base has been pursuing different, excellent ideas to manage the environmental aspects of its activities.

'But there's currently no straightforward or objective way to compare apples and oranges – to figure out which ideas will actually have the most impact – or to determine what mix of options would give the best overall result.

'LCA brings it all together – you can talk a common language.'

The researchers also assessed personnel behaviour to determine where process and work-flow improvements could be made. During this process, they found storage systems forced the cook to travel daily from one end of the station to the other in order to restock food. This complexity made menu planning arduous resulting in substantial food wastage.

Abbott said, 'That's a result of how the base was originally designed, and then extended over time, but identifying these kinds of problems faced by the people on base is also part of our approach.'

The study found design improvements in the station's storage systems could greatly contribute to making the station operate more efficiently. Changes in logistics and supply systems would also greatly reduce food waste. Abbott said, 'The constraints of operating in remote environments challenge conventional approaches to logistics. It's these constraints that force us to develop innovative systems and services, that once resolved can be more widely applied in similar contexts.'

The LCA process, as defined by the Australian Life Cycle Assessment Society has four components:

Goal definition and scoping This involves defining and describing the product, process or activity, establishing the context in which the assessment is to be made and identifying the boundaries and environmental effects to be reviewed.

Inventory analysis Identifying and quantifying energy, water and materials usage and environmental releases (e.g. air emissions, solid waste disposal, waste water discharges).

Impact assessment Assessing the potential human and ecological effects of energy, water and material usage, and the environmental releases identified in the inventory analysis.

Interpretation Evaluating the results of the inventory analysis and impact assessment to prompt the selection of the preferred product, process or service with a clear understanding of the uncertainty and the assumptions used to generate the results.

When applied, LCA can supply information on the relative comparative impact of two products and help to tease out how and where impacts occur.

As an illustrative example, LCA can be used to estimate the relative impact of using polystyrene as packing material against a potentially 'greener' alternative – in this case, popcorn. In this analysis, although polystyrene is a non-biodegradable material, it has a lower overall environmental impact than popcorn due to the energy and water requirements of growing plants to use as packaging material.[212]

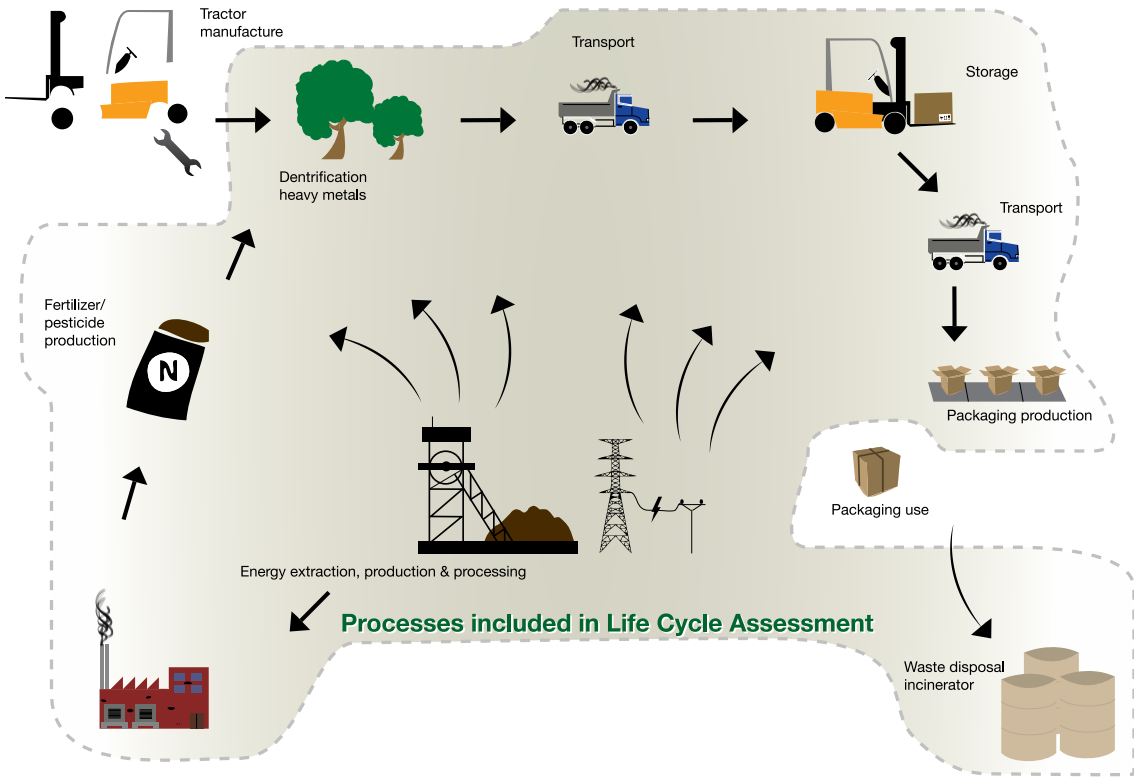


Figure B.2.3.2: Infographic demonstrating boundaries and assumptions of packing material LCA study

Two key messages emerge from this example. First, it is critical that policy decisions are based, as far as is practical, on rigorous analyses as this can yield outcomes that contradict expectations. Second, outcomes depend on initial parameters and assumptions and are subject to value judgements made in the process of setting those parameters.

Crucially, the example assumes that agricultural activity required to produce popcorn is based on fossil fuels. A change in energy sources and farming practices may shift the balance in favour of popcorn over polystyrene.

Initial parameters need to also address issues of temporal scale: how can we weigh a shorter term environmental gain (e.g. fewer natural resources expended now) against a longer-term environmental cost (e.g. low-degradable or low-recyclable materials that will create cost for future generations)?

Such issues would be highly relevant to using LCA to examine contentious policy issues in Victoria. One such issue is the adoption of a container deposit. Broadly, NGOs (e.g. Environment Victoria, Friends of the Earth) are in favour of using deposits to improve recycling rates. Financial modelling suggests that container deposits will benefit local councils.[213] However, some industry bodies oppose suggestions for change, arguing that such schemes will increase rates and undermine the current roadside recycling programs, which are well implemented.

An independent and well-defined LCA could be used to assess the costs and benefits of material and energy flows associate with container deposit schemes in Victoria.

2.3.6.1 Where LCA can be useful

It is important to take into account both the outcomes of applying LCA reporting and the methods and data it is based on. Reporting of resource use and environmental impacts can have two principal outcomes:

- encouraging manufacturers to identify and correct inefficiencies in their supply chain
- public education of the true impacts of production.

A good starting point for the application of LCA assessment would be the use by large-scale manufacturers, who coordinate large amounts of primary goods into their supply chains. Several large companies have recognised the market benefits of increased sustainability and have publically stated long-term goals to reduce environmental impacts. In an assessment by Deloitte, a small number (Puma, Nike, Nestlé, Natura, Unilever and Ricoh) have been praised for acting to embed policies into a long-term strategic vision designed to make the organisation sustainable in the long term.[214]

The race to harness the growing market for sustainable products is highly competitive, and there is still scope for improvement. Of the companies studied, none have yet reached the highest standard of delivering zero impact growth in a working product-development strategy. There is still a need to develop measurable short and long-term targets with clearly defined benchmarks.

Case Study: Puma Environmental Profit and Loss (EP&L)[215]

Working with PricewaterhouseCoopers and Trucost, Puma developed the EP&L and associated methodology using recognised ecological and economic measuring techniques.

Puma started with greenhouse gas emissions and water usage – which were reported earlier in 2011. Later Puma added land use, air pollution and packaging throughout its operations and supply chain. It then costed these as services that must be paid for – in this case, with the planet as a service provider.

The total value of these services was estimated at €133 million, with most costs incurred several steps removed from manufacture.

Analysis of where these costs were being incurred showed that €8m (£6.4m) or 6% of the costs lay with company's own direct operations, such as offices, warehouses and stores. A further 9% (€13m) lay with its Tier 1 suppliers – the companies responsible for manufacturing Puma shoes and clothing.

The remaining €124m – or 85% of the impacts – were distributed through its Tier 2, 3 and 4 suppliers going right back to the actual sourcing of raw materials – such as leather, cotton and rubber.

Puma is also launching biodegradable products.[216]

The methodologies and outcomes of Puma's reporting have been assessed by a panel of experts convened by the company.

While this approach was deemed to be a good tool for identifying business risks linked to the use of natural assets, the assessment acknowledged that there was room for improvement in the accuracy of reporting. At present the method relies heavily on estimation techniques. Reporting would be improved by gathering more data direct from suppliers or from LCA databases.

Puma's initiative gives a useful illustration of how product impacts could be communicated to consumers. The success of such an approach depends on wide-scale adoption by other manufacturers. This will be helped by further developing – with government support – simpler, easily applicable methodologies that use existing, recognised international standards.[217]

Aligning the project with related initiatives, such as The Economics of Ecosystems and Biodiversity (TEEB) for Business Coalition framework[218] may help this process.

Case Study: Food Miles – Comparative Life-Cycle Assessment of Food Commodities[219]

A life-cycle inventory (LCI) was first produced for each commodity and then a life-cycle assessment (LCA) associating inventory data with specific environmental impacts.

Each included established LCA criteria, including: primary energy use (PEU); global warming potential (GWP); acidification; eutrophication; abiotic resource use; pesticide use; and land requirement.

The study concluded that unless the UK embarks on a radical change of lifestyle, including drastically reducing the consumption of livestock products, opting for more seasonal consumption, or adopting very different food choices, including veganism, food for the UK may need to be imported from overseas to meet the demand.

2.3.6.2 Limitations of LCA

LCA is not a magic bullet for solving the problems of inefficient over-consumption.

The principles of LCA are well-established and the LCA research community is developing rapidly in terms of both methodologies and data. There are now standardised international methodologies (the ISO 14040 series),[220] as well as guides for their application,[221] which could form the basis of any new initiatives. Reliable datasets, however, remain problematic.

Manufacturing is a dynamic process, and sourcing decisions can change rapidly, meaning data is difficult to collect. These issues will need to be addressed to inform more accurate and comparable assessments of the impacts of consumption.

A further complication when using LCA is that, traditionally, it does not account for the rebound effect (described in SP-1.1). This phenomenon describes how, when production efficiency is improved, only 20–60%[222] – on average – of the anticipated benefits may be achieved. This occurs either directly (where efficiency savings drive increased demand for the same goods), or indirectly (where efficiency savings allow spending on other forms of consumption).

For example, an LCA of a product assesses the environmental impact while assuming that demand for that product remains constant (known as attributional LCA). Changing to LCA methods that represent the rebound effect through shifts in demand (consequential LCA) can better simulate the overall impacts of 'consumption as usual'.[223]

Even if these problems were to be solved tomorrow, undertaking comprehensive LCA on products is often time-consuming and costly.

It is not realistic to expect that we can one day have information on the full impacts of any given product. Instead, we could use simple assessments to guide 'life-cycle thinking' – where we use the best information available to consider the impacts of our consumption choices.

2.3.6.3 LCA reporting as the basis for life-cycle thinking

Examples like those above demonstrate the total impacts of product choices by framing them as a handful of easily comparable metrics.

However, just making this information freely available will not necessarily change production methods or consumer choices. Ultimately, long-term change to more sustainable consumer choices will require a suite of complementary initiatives. In particular, sustainable consumption policies need to find ways to tackle the question of social practices, and embed individual behaviours. Strategies will include:

- product standards, ethical standards, technical standards
- positive, well-publicised and communicated examples from role models (e.g. employers and opinion leaders)
- initiatives – complementary to simple information provision – designed to influence consumption practices by improving choice architecture (known as 'nudging').[224]

2.3.6.4 Standardised methods for LCA reporting

The precise requirements for LCA will vary between industries, and some methods for LCA are better established than others. The food packaging industry has established LCA practices in Australia, and this could be used as a model. A review of LCA reporting in this industry could identify lessons that can be transferred to other manufacturers. This will establish both best practice and a framework for transition to more transparent reporting.

Standardised methods will also require robust datasets to estimate impacts. There will, therefore, also need to be increased government investment in research that can reduce uncertainty in quantification of impacts.

Case Study: Co-Benefits – Making Better Procurement Decisions

In 2009 the Department of Health commissioned a mass balance and eco-footprint summary of the Victorian health service. These figures served as a baseline for estimating the environmental impact of the Victorian public health system as a whole.[225]

The findings of the study allowed for a rational choice of products based on environmental and financial data.

At Western Health, with this evidence, six operating rooms made the change from single-use trays with cotton gauze to reusable trays, with cotton used as required.[226] This change is expected to generate savings of US$6,500, 600 kg CO_2 emissions and 170,000 litres of water each year.

RECOMMENDATION 16

It is recommended that the Victorian Government assume a leadership role and develop expertise in LCA tools in a Victorian context to reduce carbon and environmental footprints.

ATTRIBUTES

This work commences with the development and maintenance of a public database (potentially based on the Life Cycle Database (ELCD)[229] maintained by the EU).

Future development would include:

- **establishing inventories (e.g. Australian Life Cycle Assessment Society life cycle inventory (AusLCI)[227] project) and tools (e.g. Packaging Impact Quick Evaluation Tool)[228] specific to Victorian context**
- **assisting manufacturers use LCA reporting to identify areas for resource-use efficiency along the supply chain.**