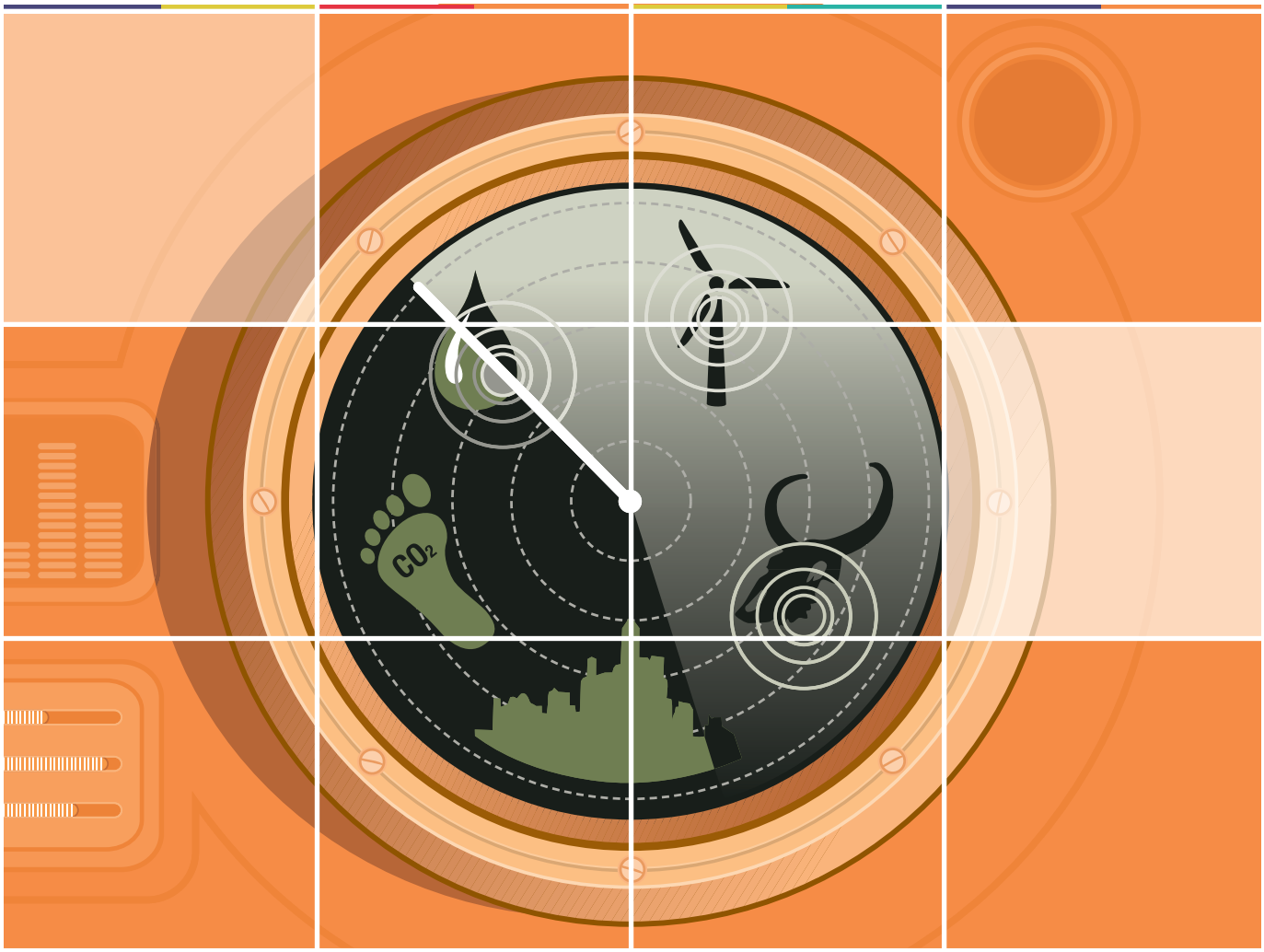
FUTUREWATCH

The economy, the environment and opportunities for New Zealand

A futures resource

Energy • Climate Change • Water & Food • Urbanisation • Consumers • Business • Investment • Government • Science



MINISTRY OF RESEARCH SCIENCE + TECHNOLOGY

MoRST
TE MANATŪ PŪTAIAO

"AN ENERGY TRANSITION, FOR EXAMPLE IS INEVITABLE; THE ONLY QUESTIONS ARE WHEN AND HOW ABRUPTLY OR SMOOTHLY SUCH A TRANSITION OCCURS. An energy transition from one type of fuel (fossil fuels) to another (alternative) is an event that historically has only happened once a century at most, with momentous consequences. The transition from wood to coal helped trigger industrialization. In this case, a transition – particularly an abrupt one – out of fossil fuels would have major repercussions…"

United States National Intelligence Council (2008).

"Our world has seen, of course, the Industrial Revolution, we have seen the Technological Revolution, the Global Revolution.
AND NEXT I GUARANTEE YOU, WE WILL SEE THE ENVIRONMENTAL REVOLUTION".

Governor Schwarzenegger, 2008, speech for World Environment Day.

This report is an overview of international trends in the environment and the economy.

IT FOCUSES ON

3 important drivers of change:

- energy & energy-related greenhouse gas emissions
- water and food production
- and urbanisation

5 responses to these drivers:

- consumer trends
- trends in the business sector
- trends in government interventions
- trends in the investment community
- trends in science

MoRST anticipates this work will be used by government departments, business and the science sector, stimulating discussion and helping to inform long-term strategy.

This international scan identifies a "megatrend" towards greater emphasis on environmentally sustainable development. This megatrend may create some significant opportunities and risks for New Zealand business. A key question for New Zealand is how it goes about positioning itself, the economic opportunities and risks, and consequently what the implications are for science in New Zealand.

Concerns about the environment and energy are moving towards the core of economic policy and business decision-making in many countries. Be it around energy security, climate change policies or how consumers are behaving, the megatrend is clear: governments in developed economies, leading corporations, significant segments of consumer markets and the investment community are all changing in an attempt to transition towards greater environmental sustainability and energy security.

Although current economic circumstances may alter the rate of that megatrend, the drivers that underpin it are not going away nor are they likely to change markedly. What is less clear is how the transition towards more environmentally sustainable development will take place, and the speed of that transition.

Globally, energy and freshwater are going to be the critical resources. Traditional energy supplies are likely to diminish (therefore increasing prices) within the next decade, or constraints will be put on their use, such as a price on carbon. Replacements, such as non-fossil jet fuels or electric cars with the range of petrol cars, are some years away. Freshwater is going to become an increasingly valuable resource as climate change reduces rainfall in some critically important food production areas and as demand for food rises. Water is non-substitutable in terms of food production.

Governments, industry and the science sector are coming together in new ways to tackle environmental and energy issues. Concerns about climate change are a key driver. "Eco-innovation" is emerging as a way of achieving a sustainable future and involves government, industry and science working together in new and different ways to tackle environmental issues and increase economic prosperity.

New Zealand has some tremendous opportunities. This country can take advantage of its good water and soil resources for food production, as globally the price of food is likely to increase in coming years. New Zealand has a high proportion of renewable electricity, and electricity appears set to play a more significant role in the energy area in the future, for instance, in transport.

But we also face some challenges. Our water resources are under pressure, with deteriorating quality in many parts of the country, water shortages, and allocation systems not designed for water shortage. Our proportion of renewable electricity has been declining (although the trend may be reversing) and our carbon dioxide emissions from fossil fuel combustion compared with GDP ranks us above the average for G7 nations.

New science and innovative ways of undertaking existing science will be needed if New Zealand is to maximise its opportunities and minimise its risks from a global move to a low-carbon, more sustainable future. Government, industry and the science sectors will need good connections with each other and be able to act as a coherent whole to maximise economic opportunities and minimise risks.

New Zealand's science system will need to be nimble and adaptable. It will need a strong and broad base, and be able to work together across and beyond its usual disciplines. It will also need the ability to identify and monitor future challenges and trends. A demand for an increased range of science will mean hard calls around priorities. The demand for greater nimbleness will challenge science policy and science managers. However, the rewards are likely to be great because science is pivotal to helping New Zealand move towards a sustainable future.

Key trends in the degree to which concerns about energy and the environment are influencing areas studied in this project.

CONSUMER TRENDS, as represented by major supermarket chains, have strongly reflected sustainability concerns only in the last few years.

"SHAPER" BUSINESSES (such as Du Pont, Whirlpool and General Electric) have been making significant sustainability-related investment decisions since at least the early 2000s.

The MAINSTREAM INVESTMENT COMMUNITY is yet to really factor in environmental sustainability in its decision-making processes, but expectations are that it will become a significant issue in the next 10 to 15 years.

ENVIRONMENTAL POLICIES in developed countries have tended to steadily become more comprehensive over many years and that trend seems likely to continue.

SCIENCE SYSTEMS are gearing up to meet the sustainability challenge, for example, developing new bio-materials, fuel sources and low carbon products. However, it will take some years for the science to flow through to new products and services.

"The world is at the cusp of a radical evolution in economic, business and technological models. We are migrating from an economic era driven by dramatic improvements in productivity from IT and digital standardisation, to one in which the imperative to optimize natural resource productivity and develop and deploy technologies to reduce, avoid or store carbon becomes the competitive game changer for industries and countries alike" *US Council on Competitiveness[1], 2009.*

"…what we see is the biggest technological opportunity that we've had for a very long time: as big as the railways, as big as electricity, as big as the motorcar, and, most recently, information technology. It's the opportunity to go for low-carbon growth." *Lord Nicholas Stern[2].*

[1] www.compete.org

[2] http://www.mckinseyquarterly.com/Audio/Connecting_climate_change_and_economic_recovery_2303

WHAT IS FUTUREWATCH?

Futurewatch can be thought of as a kind of “radar”: a way of systematically scanning the external environment for signals. Scanning is most typically used at an organisational or sector level, but is increasingly being used by governments to inform perceptions and advice and to help make timely, quality decisions that help manage what will always be an uncertain future. Futurewatch typically involves undirected or open information collection. This includes not only keeping in touch with overseas trends in science, business and society but monitoring events outside immediate areas of interest. A key aim of Futurewatch is to identify new or different patterns or events that may be signals of important change. Futurewatch is particularly relevant in areas like sustainability, that have complex pathways of development and potentially transformational implications across the economy, environment and society.

Contents

Approach: looking at drivers and responses

This document is a summary of a much larger report which is available on the Ministry of Research, Science and Technology's website[1]. During the course of this project, MoRST commissioned a number of reports and held a number of workshops. The reports and write-ups of the workshops are also available on MoRST's website.

The overall approach in this project has been to look at the economy and the environment from the perspectives of "drivers" and "responses". There are many drivers that can influence the future state of the economy and the environment, but our scan identifies these three as being significant now, with the likelihood they will become even more significant in the next two decades or so:

- energy use and greenhouse gas emissions
- water and food production, and
- urbanisation.

The signals from the drivers strongly suggest that production and consumption patterns cannot continue as they are. This is becoming clear to societies around the world and responses to these drivers are occurring in many countries. The responses part of this report focuses on:

- consumer trends
- how businesses are responding
- changing patterns of investment
- government interventions, and
- how science is responding.

This report considers how each of these responses relates to New Zealand as an exporting nation, and the implications for New Zealand's science system. This work attempts to look forward 20 years. We acknowledge that in some areas, like consumer trends, predicting the future is difficult.

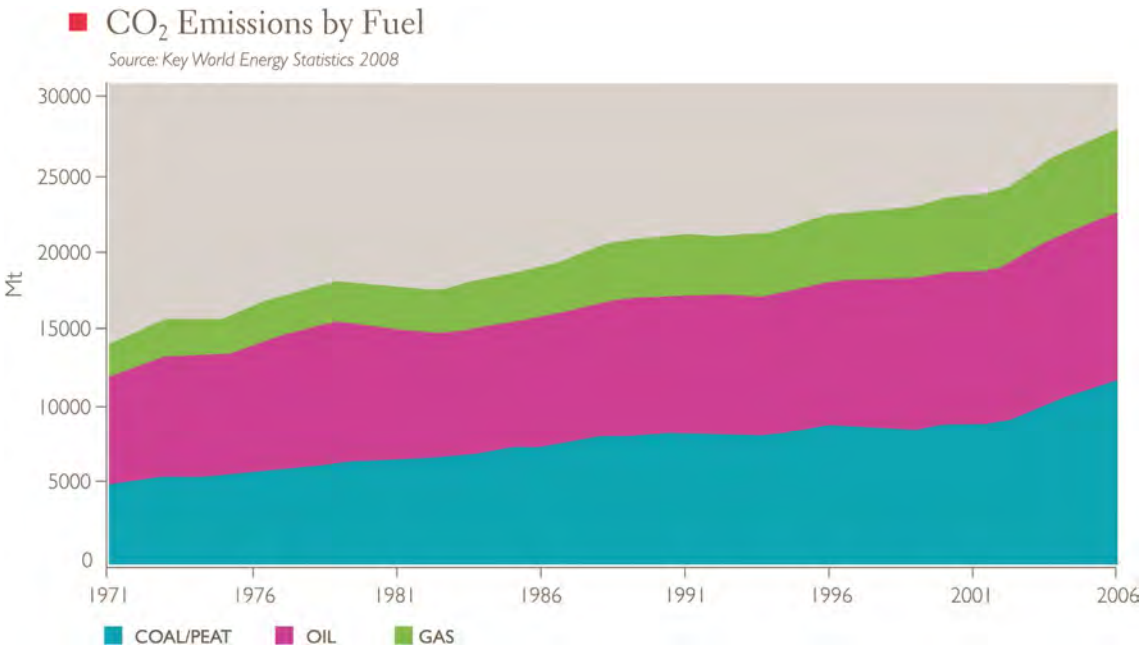
1 www.morst.govt.nz

1. Key drivers of change: the crucial role of energy

The three drivers (energy, water/food production and urbanisation) are interrelated, but a major message is the extent to which energy underpins the other two drivers. Cheap and readily available energy has enabled the rapid development of society over the last century.

1.1 The global energy situation

For two main reasons, global energy supplies are one of the key issues facing the world today. First, rising energy demands are coming head-to-head with seemingly diminishing traditional supplies. Second, energy use, especially of fossil fuels, is the main contributor to greenhouse gas emissions. These emissions are projected to double in the next 50 years if nothing is done to reduce them.

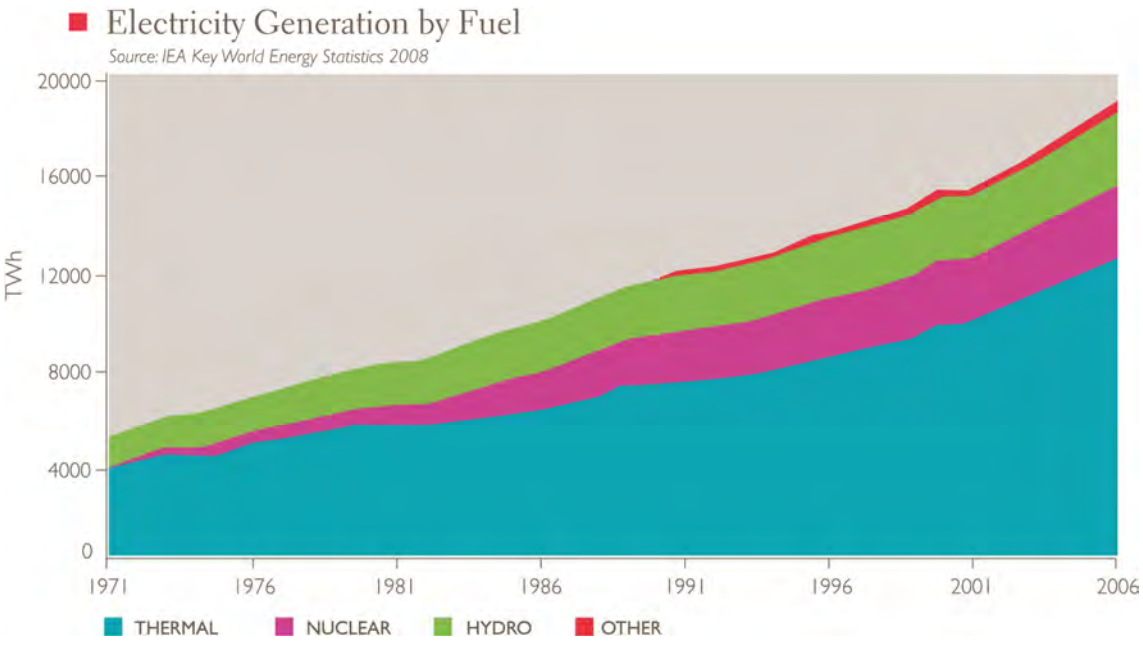


Oil production is likely to peak eventually and then begin a decline. A common view is that the peak will occur between 2010 and 2020. Some even consider that the peak may have occurred in 2005/06, pointing to how oil production has dropped since then. In the US the largest annual oil production occurred in 1970 and US oil production has gradually declined since. Some argue that 1965 was the last year that more oil was discovered than was used. Oil shortages could lead to intense competition between older and newer powers for available energy resources, migrating power and wealth to energy-surplus nations, and a growing risk of conflict over energy resources.

Fossil fuels – oil, gas and coal – are likely to dominate the fuel mix over the next 10 or more years. Among them, coal is set to grow most rapidly – with serious consequences for emissions. If rising coal use trends continue unabated, serious impacts of climate change (physical, economic, political) cannot be avoided.

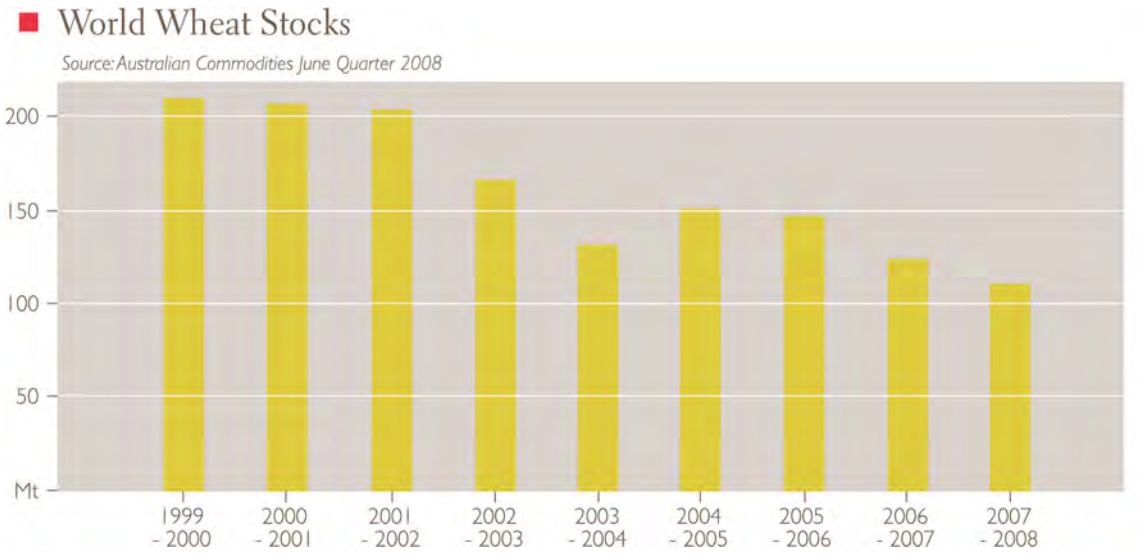
Finding a replacement fuel for transport is a big challenge and most of the alternatives so far posited have shortcomings. For instance, some biofuels use feedstocks that compete with food crops for water and agricultural land (although tree-based fuels may not), and there are concerns that diverting agricultural production to biofuel production may result in less food being available and at consequent higher prices. Another concern is that development of alternative energy sources like solar and wind is occurring too slowly to significantly offset rising global energy demands.

Partial solutions exist. Many technologies available today (e.g. solar, wind, geothermal, carbon storage, natural sinks etc) can be scaled up to reduce emissions significantly by the middle of the century. By putting significant effort into several of these strategies now, the world could take a big bite out of the carbon problem. Government and industry in some developed countries are making significant efforts to encourage renewable energy but these efforts will need to be increased substantially to avert significant climate change, i.e. the thin red part of the next graph will need to increase substantially.



1.2 Water and food

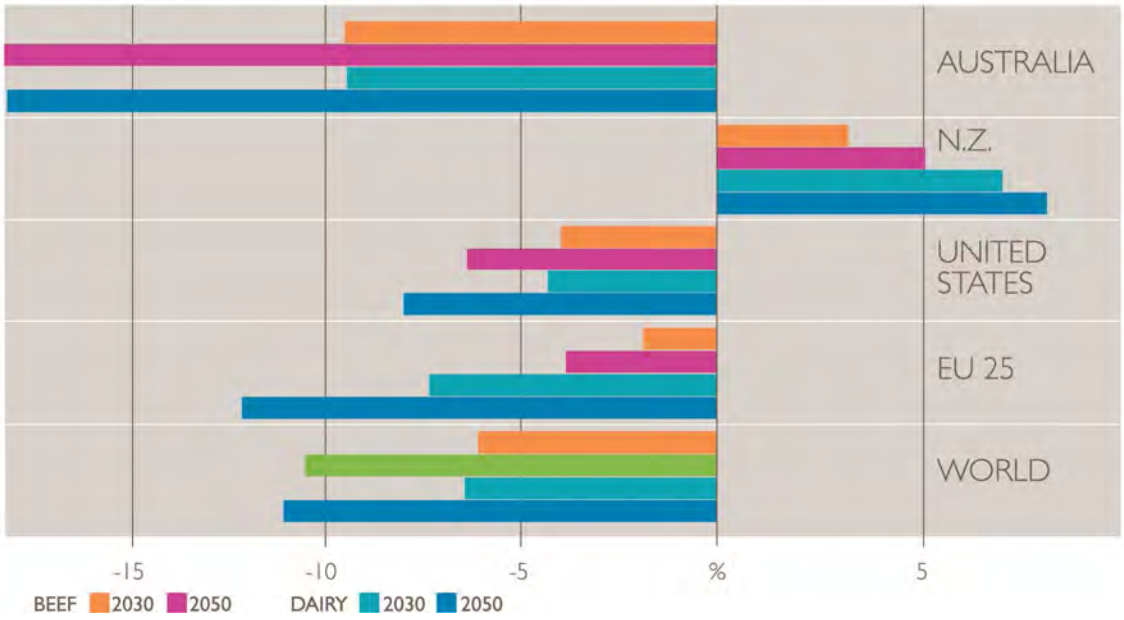
Water and food are inextricably linked to each other, and both are linked closely to energy issues and climate change. The key context for food production and water is the need to feed around 70 million new mouths per year – mostly in developing countries that are often in areas subject to water stress which climate change is likely to exacerbate.



Water is the key physical constraint. Its scarcity can be physical (lack of water) and economic (such as inadequate investment in developing water resources for agriculture or for drinking water and sanitation). Many areas of the world, especially developing countries, are under increasing water stress, and a change to western diets increases water consumption (for food production) even further. Greenhouse gas emissions to date and ongoing emissions mean that some degree of climate change is inevitable. This will have an impact on a range of food-producing regions around the world, in many areas reducing food production. Australia is a particular case in point.

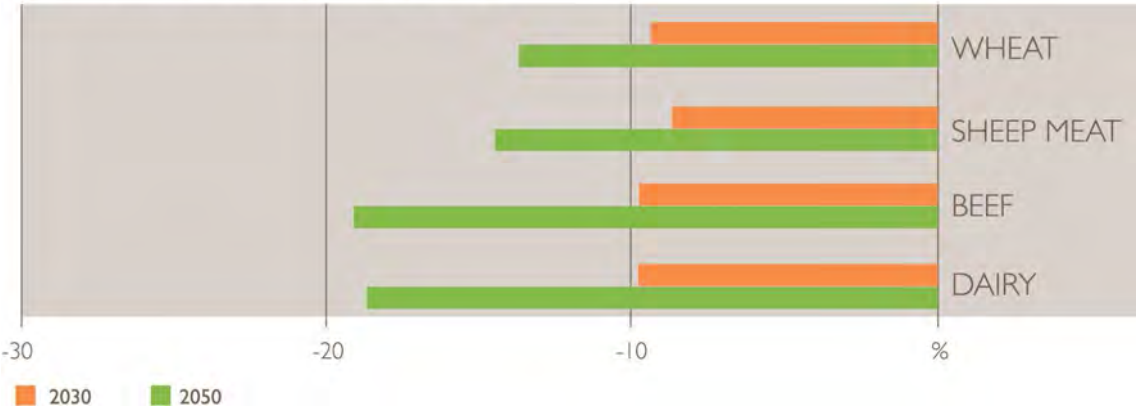
Changes in global agricultural production

Source: Australian Commodities December Quarter 07.4



Australian agricultural production

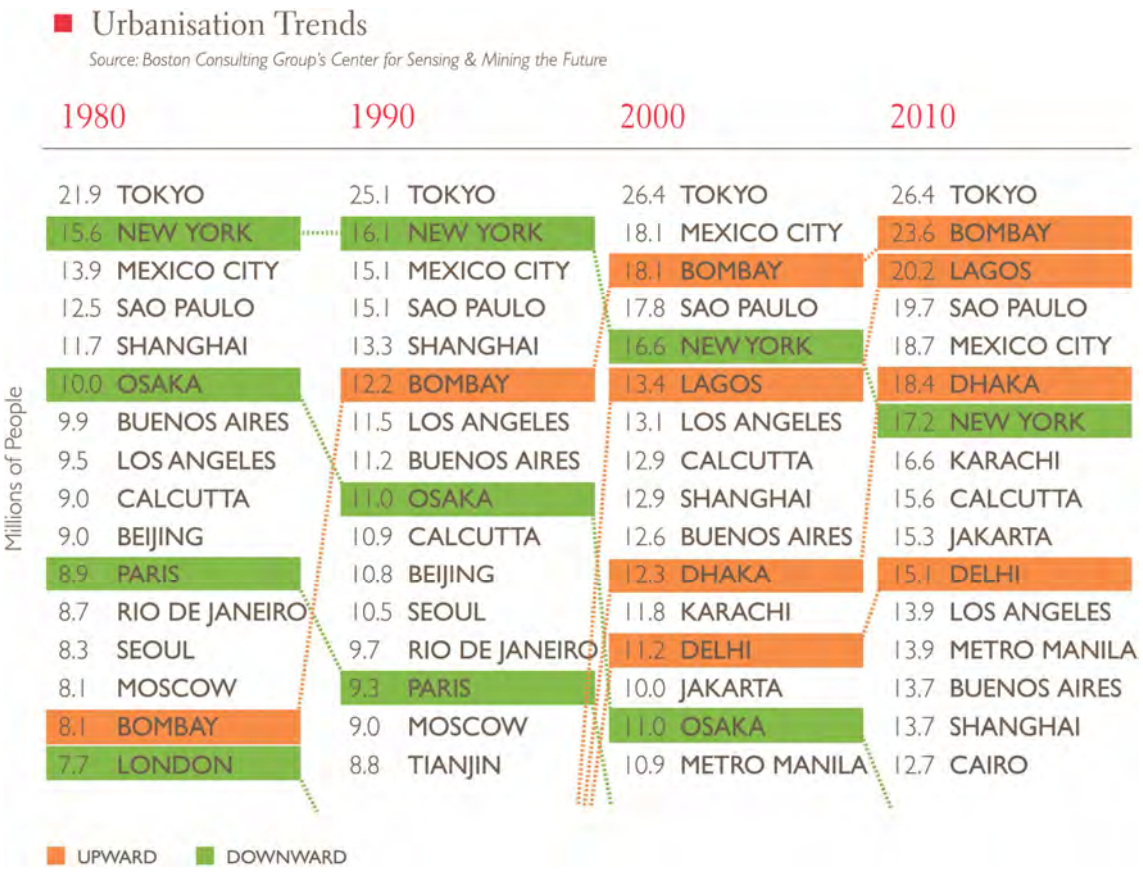
Source: Australian Commodities December Quarter 07.4



But the story of water and food comes back to energy as well – because abundant and cheap energy (in the form of fossil fuels) underpins the industrial agriculture paradigm that has enabled the rapid increase in human population seen over the last century or so. Fossil fuels supply the necessary energy for agricultural mechanisation but also for producing fertilizer, which means that energy costs and food costs are linked. Increasing energy prices are likely to result in reduced food production and increasing food prices.

1.3 Urbanisation

Powerful economic factors underpin a seemingly unstoppable global drive to urbanisation (in about 40 years from now, it is predicted two thirds of people will live in cities). As urbanisation increases "supermarketisation" of the world's food distribution system may increase. Supermarkets are set to become truly global with international standards being developed by individual chains and possibly collectively. As supermarkets grow in power they could have an increasing say over how New Zealand produces food by pushing sustainability requirements down the supply chain.



But "supermarketisation", and indeed urbanisation, depends on cheap, readily available energy to grow the food and power the vast and highly sophisticated global transportation network on which our supermarket-based food production system depends. As the price of energy increases this system may come under strain.

It does seem, however, that a number of cities around the world are trying to come up with ways – either alone or in concert with other cities – to position themselves for a low-carbon future. The most innovative and effective sustainability initiatives in cities have been realized when government officials, business leaders and non-governmental organizations work together.

2. Responses: towards an orderly future, but...

In many parts of the world across a range of sectors it is clearly recognised by many people that business as usual – production and consumption patterns – is no longer viable. Evidence from the various responses points towards a key "megatrend": one of society (especially in developed countries) transitioning towards a more sustainable future. While current economic conditions may alter the pace of this change, the fundamentals behind this view are unlikely to change in any meaningful fashion; energy supply and security will continue to be issues, as will water shortages and carbon emissions. How society transitions then becomes a major issue and has implications for how science could help enable this transition.

The responses being put in place now, or being planned for, seem to have an underlying assumption of an orderly transition towards a relatively clearly defined future. For instance, Shell's "blueprints" and "scramble" scenarios both assume that a healthy, sustainable future will eventuate. But there is the possibility that the future may be more unpredictable than is being planned for – partly because current economic models don't seem especially effective at predicting the consequences of the new kinds of global challenges that are emerging, and also because finding technological solutions to the environmental sustainability problems (e.g. substitutes for fossil fuels) seem to be hard to develop. So, maybe New Zealand's science system needs to be positioned to help the country cope with "surprises" and external shocks because globally, the next 20 years may start to become quite unstable.

2.1 Consumer trends

Changing consumer trends towards environmentally sustainable development are underpinned by rising incomes and urbanisation – particularly the growing "supermarketisation" of the world. Some consumers, though, are becoming concerned about not only the food they buy, but also the way it's produced. This has given rise – especially in high income countries – to a new type of consumer (often called LOHAS[2]) who share deep-seated values based on a fundamental concern about health and sustainability, at an individual, social and environmental level. The LOHAS market is now significant globally but it is possible that the LOHAS-driven trends may be affected by forecasted tough economic times.

Businesses, especially retailers, are responding to changing consumer demands by engaging with a greater variety of stakeholders, and looking at sustainability issues down the length of their supply chains. The increased "supermarketisation" of the food system is a critical factor likely to have a strong influence on food production in New Zealand in the coming years,

2 Lifestyles of Health and Sustainability

through for example, requiring New Zealand producers to meet sustainability standards set by global supermarket chains.

2.2 How businesses are responding

Globally, environmentally sustainable development is becoming a "top-table" concern for business. This is partly because of increasing pressure from governments, non-government organisations and some significant consumer segments. In part it's because various sectors of the economy are facing a range of risks from climate change – physical, regulatory, reputation, and litigation – some of which may be underreported and underrated by the business sector. Even as the recession deepens, leading companies still appear to be focused on sustainable development and the opportunities in that area.

Consequently, sustainability is becoming a business operating norm for many leading companies. Successful companies of the future will be, increasingly, those who can reconcile business and environmental sustainability objectives and who can move ahead of the game to seek competitive advantage. This trend has become readily apparent only in the last few years but some leading companies have been focusing on environmental sustainability since at least the late 1990s or early 2000s.

"To help earn the best possible returns for our shareowners, GE invests in strategic themes that can drive the Company's growth to the far horizon...one of these major themes is environmental solutions – what we call ecomagination. Ecomagination originated earlier this decade, the result of a growing view within GE that energy shortages and environmental concerns would challenge our customers and, more generally, society."

CEO, General Electric, 2007

"It is expected that consumers will embrace an even greater ecological mindset, which will further challenge people to adapt their consumption habits. The challenge for our company will be to continue to design products that bring together the ecological function, with consumer demands for style, innovation, intelligence and simplicity. We look forward to delivering these products soon and in some cases already are."

Whirlpool, 2007

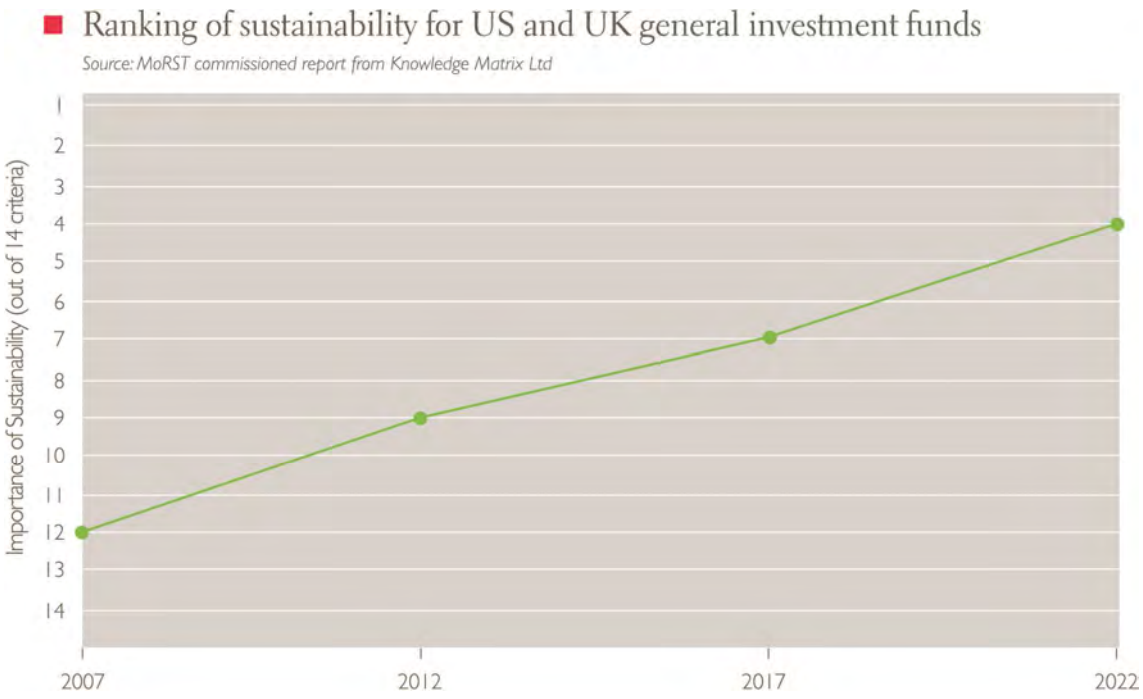
"We are anticipating and responding to changes in the global marketplace that are driving demand for solutions to major challenges such as climate change, clean energy, water and ecosystem protection. There are many reasons for this evolution in marketplace dynamics, but two stand out. One is the realization that the developed world's consumption of energy and natural resources is not a successful model for the developing world to follow as they grow...the other, also related to the consumption of energy resources is the established consensus that climate change is a real concern and that action must be taken to address its potentially far-reaching consequences."

CEO, DuPont, 2008

Some leading companies are taking action, such as setting carbon reduction targets, developing new bio-based industrial feedstocks to replace fossil fuels, and identifying ways of helping consumers reduce their environmental footprint. Some companies are engaging with a range of stakeholders, consumers, other businesses, government and non government organisations, etc, projecting sustainability standards throughout their own supply chains, and considering the environmental impacts of consumers using their products.

2.3 Changing patterns of investment

Currently, environmental sustainability is not high on the investment community's agenda, ranking around 12 out of 14 criteria for investment. But this is set to change. Predictions based on surveys of some 300 investment fund managers indicate that environmental sustainability will climb higher up the chain of factors that investment managers need to consider, becoming a very important factor in 10 to 15 years time.



Fund managers consider the biggest opportunities for environmentally sustainable investments are in the developing world, reflecting the opportunity to invest in new efficient technology in "green field" infrastructure – sometimes whole new cities. Currently, the most popular sustainability investments are energy renewables – wind, photovoltaic, water, geothermal, fuel cell, bio fuels, hydro, building technologies, wave and tidal, biomass, additional energy sources, and alternative fuel vehicles.

2.4 Government interventions

Governments are increasingly recognising they have a key role to play in guiding a transition to a more sustainable society. Governments – especially in developed countries – are using a broader suite of tools than just regulation. There is a move towards increasingly sophisticated and integrated policy frameworks. These frameworks of the future will be more prescriptive in nature, in the process directly affecting more people, and part of a mix of complementary measures.

There are signs of "eco-innovation" where industry, science and government are working together to develop new innovations and frameworks for implementing these such as new regulations. These are being jointly developed to increase the certainty for industry that there will be a market for innovative products. It is likely the state's role as a kick-starter of "eco-innovation" will become more important.

Some countries are including a sustainable development aspect to their economic stimulus packages. So far around 16% of stimulus package funding is focused on ways to climate change investment themes[3]. The values of the climate change aspects vary from 80% of the stimulus package (South Korea), to 12% (US) to 6% (Spain).

A summary of Government sustainability policies[4]

1	**Measures concerning dangerous substances** – Regulating the use of chemicals – Limiting the presence of dangerous substances in products
2	**Measures aimed at avoiding pollution and waste and reducing the use of natural resources** – Reducing pollution – Improving waste management – Reducing inputs of raw material
3	**Measures focusing on production processes** – Environmental management systems – Negotiated agreements – Greening of government
4	**Measures aimed at products** – Getting prices right – Informing consumer choices – Life-cycle analysis and ecodesign – Regulation of the composition or performance of products – Producer responsibility or product stewardship – Incorporating environmental aspects into international standards

3 HSBC, February 2009

4 Source: MoRST commissioned report on Environmental regulation and government initiatives in selected jurisdictions

5	**Measures focusing on transport and trade** - Transport - Trade
6	**Measures aimed at the public disclosure of sustainability performance** - Pollutant Release and Transfer Registers
7	**Measures for developing markets for sustainable products and services** - Ecolabels - Green public procurement
8	**Measures aimed at influencing consumption & production patterns**
9	**Measures relating to the social pillar of sustainable development (e.g. human rights, labour relations).**

2.5 Global Science Responses to Sustainability

Science has been instrumental in identifying and raising attention to environmental issues. Paradoxically though, science aimed at developing sustainable solutions seems to be lagging in some of the other areas investigated in this project (e.g. developments in the corporate sector and consumer trends). Science systems are now gearing up to provide the technological solutions needed for a more environmentally sustainable future, but given that the lag between science starting on projects and delivering outcomes can be some years, breakthroughs in technologies may be some years coming.

Sustainable energy research is moving up the research priority list in a number of countries. Concern about limited supplies of fossil fuels is also leading to an increased focus on the use of biomaterials as feedstocks for fossil fuel replacements.

Science is getting to grips with better understanding of supply chains, traceability and verifying the sustainability of products. This involves linking different aspects of science (indeed different scientific disciplines) together to provide a coherent "story" for a product that will resonate with consumers, retailers and regulatory authorities.

More emphasis is being placed on the science around understanding carbon emissions associated with producing goods, not just for the product itself but also throughout its life. This means developing an understanding of impacts right back to the early design stage of new factories, processes and products.

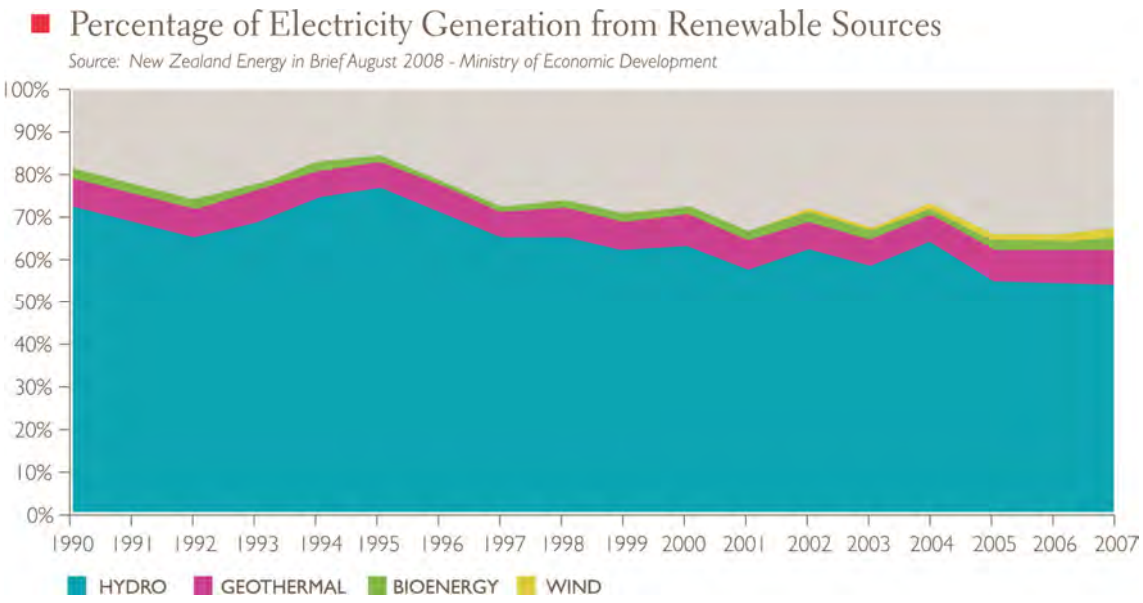
A new type of thinking is emerging – one that goes beyond even life cycle assessment. In seeking to redesign technological processes to ensure no harm is done to the environment or to people, a new "cradle to cradle" approach is starting to evolve – one that considers waste from one process as a resource for another process. This kind of new approach is demanding a paradigm shift in approaches to science as well – characterised by disciplines coming together in new ways to look at the systems of production and use.

What is slowly evolving – in the area of climate change research, for instance – is an approach based on "integrated scenarios". This is where an overall framework is created for research and scenarios, one that enables many aspects of research to be done in parallel, with regular information exchange between parts of the framework.

All of these trends point to a future where there will be a stronger linking of scientific disciplines, beyond multi-disciplinary or inter-disciplinary, into "transdisciplinary". Better ways of linking disciplines have been discussed for many years by the science community. Coming up with solutions to society's demands for greater environmental sustainability is likely to be a strong driver to actually deliver on the long-standing call for increased integration of disciplines.

2.6 Threats and opportunities for New Zealand

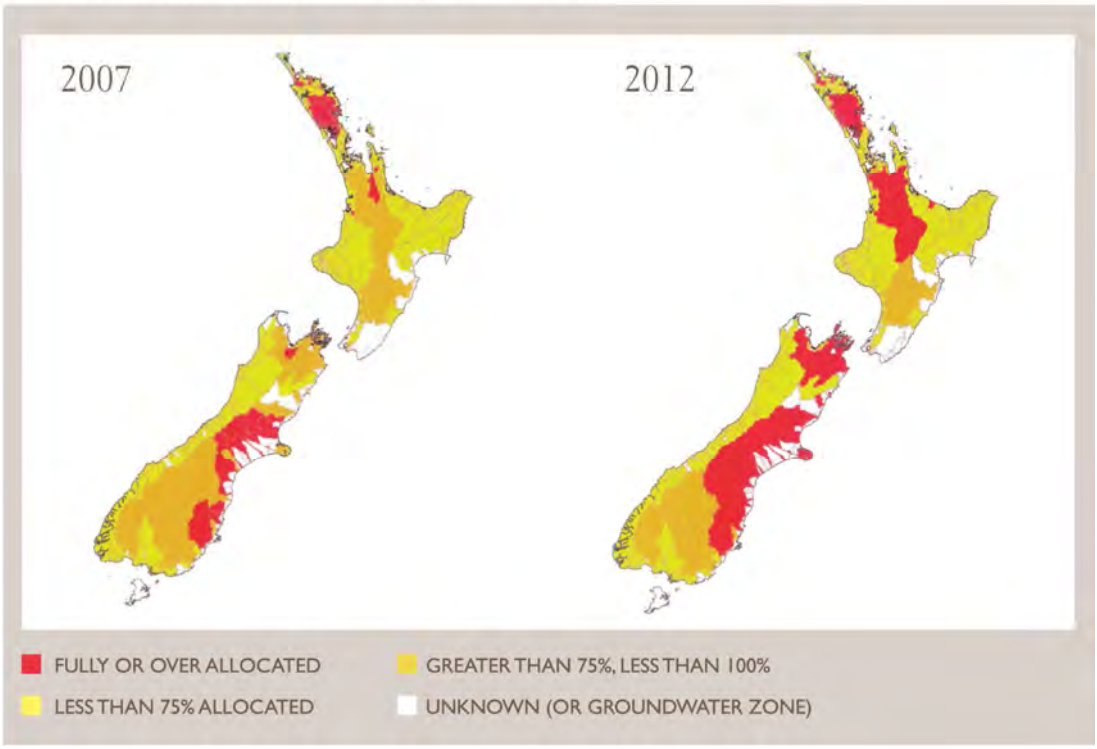
New Zealand is comparatively well off in terms of its sustainable energy supplies: a very high proportion of our electricity needs, for instance, is supplied through renewable sources. But there are issues too. The proportion of renewable energy has been declining in recent years and our carbon dioxide emissions from fossil fuel combustion against GDP ranks us above the average for G7 nations.



Likewise, New Zealand's relatively plentiful water resources could become a significant economic advantage in coming decades – demand for food, or "virtual water", is likely to increase. New Zealand is better off than many parts of the world. But, as noted in the 2007 State of the Environment Report our water resources are coming under pressure (both in quality and quantity).

Surface water allocations 2007 - 2012 by major catchment boundaries, percentage of water allocated

Source: NZBCSD, A Best Use Solution for New Zealand's Water Problems, 2008.



Auckland is our only international city, ranking around the 300th largest city in the world. It does have some of the problems that many cities have – transportation for instance. To be competitive in the future, Auckland may need to focus more on sustainable development because many other cities in the developed world are looking at ways of both enhancing liveability and at the same time reducing carbon emissions.

Consumers (or more correctly, the way supermarket buyers are anticipating consumer behaviour) are becoming more concerned about sustainability. Consumer issues like food miles and eating local could have a profound influence on New Zealand's trade prospects. Tourism and agriculture are very important for the New Zealand economy. Both are subject to international trends. New Zealand cannot help but be affected by what happens in global supply chains, whether as suppliers of raw ingredients or finished manufactured items. In certain areas, New Zealand has some very smart and nimble players, although these tend to be at the niche end of the spectrum.

In terms of where New Zealand business is in regards to sustainability, the picture is mixed. Some companies are leading edge but many are still very much in response mode. Also, New Zealand is not at the forefront of developing partnerships between business, government and science in the sustainability area.

2.7 How the NZ science system may respond

A more sustainable energy future would require the science system to:

- be well connected to overseas energy science activity
- have a strong base in New Zealand to ensure local conditions are well understood, and
- be multi-disciplinary to enable the environmental, social and economic aspects of developing a range of energy sources to be considered and allowed for.

To enable a more sustainable future, our science system in the water and food production area would need to:

- have more inventory capability, e.g. understanding water and soil resources at a fine scale
- be more multi-disciplinary and transdisciplinary in some areas
- be more effectively targeted to the needs of water managers
- have strong predictive capabilities, and
- develop the capability to better understand effective governance arrangements, particularly in the water allocation area.

The choices Auckland makes (e.g. if it positions itself as a state of the art "transition" city with strong links to other regional cities) will influence the kind of urban science New Zealand develops. If Auckland chose to focus strongly on developing in a more sustainable way, a considerable science and research effort would be needed to support decisions leading to more sustainable outcomes in a range of areas, such as energy supplies, transport, and ways of encouraging and supporting more sustainable industry and economic activity.

Successful marketing of niche, high-value New Zealand products and services requires a good understanding of the wealthy and discriminating consumers who can afford to buy these products. This requires multi-faceted, multi-disciplinary research founded in the social sciences, linking this to science that is developing new products and improved ways of producing existing goods and services.

Increasingly, New Zealand companies may need to work more collaboratively with other suppliers to meet the sustainability standards of major retail chains. New Zealand firms intending to supply products in this kind of marketplace need to become, in effect, strategic partners in these brand-controlled supply chains. It is likely that the science system will be called upon to help provide information on the sustainability aspects of products and ingredients. In turn this would require:

- More research to support life cycle assessment (LCA) and fully verifiable and traceable supply chains, and
- Increased science capability around social and environmental reporting so that products' "credence attributes" can be justified.

A strong New Zealand "clean and green" image remains an important element of our national branding and is likely to be important into the future. Science has an important role in providing information supporting this brand, identifying risks to it and finding ways to manage those risks.

Given that changes in New Zealanders' behaviour will be needed if sustainable development is an increased focus, policy and behavioural research is needed so that government (central and local) and industry can know which policies are likely to work, and which are not.

Government will need to keep a close watching brief on initiatives by other governments, such as:

- eco-taxation
- mandatory performance labelling
- minimum performance standards
- development of mandatory product stewardship-type measures, and
- public procurement by governments increasingly insisting on ecolabels and verification.

This information will need to be linked into the science system to help ensure science programmes are factoring government-driven international market trends into new product development.

Overall, it is likely that science in New Zealand will increasingly need to factor in an environmentally and carbon constrained world of the future. This factoring is likely to occur in virtually all aspects of research. A broad, flexible and adaptable science sector is needed, one that can turn its hand to issues quickly, to enable New Zealand to minimise risks and maximise opportunities. The science system will need to combine a wider range of disciplines than may have been the case in the past, working together in innovative ways. It needs an effective scanning component, and it needs to be well connected with industry and the government sectors. All three sectors need good connections with each other to help New Zealand thrive in an increasingly uncertain and resource-constrained future.

3. Summary: convergences, possibilities, interdependencies and trends to watch

The following is a high level assessment of some of the most important trends we have observed in this project.

3.1 Convergence of trends

What has emerged prominently from this work is the strong convergence towards sustainability in all the areas we looked at: consumer trends, business trends, trends in government interventions, investment trends and science trends. What varies is the timing of these trends. At one end of the spectrum, leading businesses are moving quickly to develop more environmentally sustainable practices, such as reducing carbon emissions. At the other end of the spectrum, a survey of investment fund managers indicates they rank environmental sustainability as a low priority issue, although the survey indicates they will rank it as a very important factor in 10 to 15 years time. Consumers, government intervention trends and trends in science activity lie between the leading elements of the business sector and the majority of the investment sector.

In developed countries governments, consumers (as represented by retailers), business and science are all likely to increasingly work together to develop more sustainable societies. A consequence for New Zealand is that sustainability requirements are likely to be put on supply chains which will impact on New Zealand businesses wanting to participate in these supply chains.

Innovation is seen by both government and industry as being critical to achieving a more sustainable future. We are seeing evidence of government and industry working together more to develop ways to drive "eco-innovation". New Zealand does not appear as advanced in this area as some other countries.

3.2 Drivers of trends

Two main drivers are influencing trends towards sustainability: climate change and energy. Industry, governments and consumers are becoming concerned about the long-term impacts of climate change, including economic and social instability. Industry is also concerned about regulation in the short term.

We are also seeing concern about energy supplies and energy security are becoming a key driver. Some companies, such as Du Pont, are investigating non-fossil fuel feedstocks for industrial processes. Governments are becoming increasingly concerned about dwindling energy supplies, particularly liquid fossil fuels.

3.3 Technical bottlenecks: energy is critical

Generally the development of technology is a bottleneck to a more sustainable future. In many areas, for instance, the energy-related technology to enable a more sustainable future is not yet available. Electric cars with the range of petrol cars and commercial-scale carbon capture and storage from coal or gas-fired power stations are examples of technology under development but yet to come into fruition.

Research and development effort in a range of areas is ramping up and technology to significantly reduce greenhouse gas emissions in key areas (such as road transport) may become commercially available within 10 to 20 years, possibly sooner. However, the time lag between technology development and having commercially viable products available in the market place means that it is highly likely that greenhouse gas concentrations in the atmosphere will continue to rise for some decades.

High volume food production systems that are not heavily reliant on fossil fuels is another technical bottleneck. The so-called “green revolution” (that substantially increased food production over the last century or so) is reliant on cheap fossil fuel energy sources. If this bottleneck cannot be addressed, food production costs are likely to rise if fossil fuel prices rise.

3.4 Interdependencies: climate change, food and energy

Modern society, food production and rates of climate change are dependent on energy consumption and production patterns. A more sustainable future is critically dependent on the development of more sustainable energy technologies.

Some important interdependencies:

- Climate change impacts could be minimised if effective and efficient ways of producing electricity without creating greenhouse gas emissions can be found, and if alternatives to fossil fuels for transport can be developed.
- Food production could be affected by the development and widespread adoption of new energy technologies. Firstly, greenhouse gas emissions would reduce, thereby lessening climate change impacts on food production. Secondly, fossil fuel prices would not increase so rapidly. This means that prices for fossil fuel-based fertilizers would not rise so fast either, in turn probably meaning that food price increases would not be so large.

3.5 Possibilities of "surprise"

An underlying assumption of both business and government is that there will be a transition to a more sustainable future and it will tend to be orderly. However, another possibility is that society will be in for "surprises" that could significantly stretch the social fabric in a number of countries around the world. For example, if climate change occurs more quickly than currently predicted and it occurs in such a way that there are significant impacts on food production, then food crises could occur within 20 years. Political stability in a number of countries around the world could be threatened as a result.

Another possibility is that other crises divert focus from environmental sustainability. For example, the current global financial crisis could mean that globally there is a reduced focus on environmental sustainability across government, industry and consumers.

3.6 Legislative and non-legislative trends

Governments in developed countries around the world are developing stronger sustainability legislative frameworks. Also of increasing importance is the trend in retailers setting sustainability requirements on supply chains. It is likely that within the next few years retail and supply chain sustainability requirements will become important sustainability drivers for many export sectors along with legislative frameworks in New Zealand or in other jurisdictions. For example, we see evidence of supermarkets and large ingredients buyers, such as Nestlé, becoming increasingly interested in the sustainability aspects of dairy farming in New Zealand.

3.7 Decision points for New Zealand

Different sectors of the New Zealand economy may face decision points about meeting sustainability requirements set in other markets. To ensure their place in world markets, the wine and kiwifruit industries, for example, have made decisions to have a strong focus on sustainability. An entirely plausible future scenario could be that international food companies like Nestlé (a major buyer of New Zealand dairy products), will place sustainability demands on New Zealand products, because global supermarket chains have put their sustainability requirements on the food companies. In turn, some New Zealand industry sectors might need to

make decisions about whether and how to respond to these demands. Choosing not to meet them could mean loss of opportunity to export to wealthier markets.

Some sectors could come into conflict on sustainability issues, with some possibly seeking higher levels of sustainability more quickly than others in response to market opportunities. If these conflicts do start to occur, it may lead to a debate about where New Zealand positions itself overall. For example, does New Zealand supply wealthier countries with food produced to the higher sustainability standards that they are likely to demand, or does it supply products to poorer countries with likely lower sustainability standards? This decision may be far reaching – a lower sustainability path, for instance, may be difficult to reverse due to a loss of markets and the costs of repairing environmental degradation.

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4. Keeping a watching brief on key trends

The following are some important trends to keep an eye on:

Energy and climate change

- Global carbon emissions figures – as an indicator of the speed of climate change
- Data on key global energy supplies and demand – as an indicator of if/when prices may change and shortages occur
- Trends in uptake of alternative sources of energy – as an indicator of the extent to which it is likely that changes to greenhouse gas emissions will occur and therefore climate change

Water and food production

- Prevalence of drought/extreme weather events impacting on food production globally and global food stocks (e.g. grain and dairy inventories) – given these were at historically low levels in mid-2008 – to help understand food price trends

Urban development

- Leading developments in sustainable urban design ("transition cites") to help inform urban research and development in New Zealand, and look for trends that could apply globally

Consumer trends

- Global moves towards or away from "supermarketisation" to help track where future demands for product characteristics/credence attributes will come from and to track alternatives to supermarkets (e.g. direct purchase over the internet, farmers markets, buying local etc)
- Retailer moves towards sustainability (in supply chain partners, credence attributes, carbon and water foot-printing, how the LOHAS market develops, etc) as flags for our own exporters and in terms of understanding what aspects of production science might be asked to provide information on

Business

- What the big mainstream companies are saying, and more importantly, doing, in terms of sustainability – as a measure of how seriously they view sustainability, and how they could, potentially, set the rules of the game for New Zealand in export markets, which in turn could impact on food production in New Zealand

Investment

- The degree to which sustainability is being factored into investment fund criteria, particular mainstream funds and where sustainability investments are focused to understand risks and opportunities for New Zealand

Government initiatives

- Government trends in sustainability policy initiatives – especially in areas around specific targets regarding emissions control, a price on carbon, product standards and the like, to help anticipate future trade issues
- The ways in which government is working together with the business sector and science and ways in which this area is developing, i.e. trends in "eco-innovation" to help inform views on how New Zealand might evolve the relationship between industry, government and the science sector

Science

- Trends in science towards trans-disciplinary ways of thinking to help inform science policy in New Zealand

Appendix

Reports that MoRST commissioned (available on the MoRST website):

- C Saunders, 2008, *Consumer sustainability trends in key overseas markets*, Lincoln University.
- Knowledge Matrix Ltd, 2008, *Sustainability and the Investment Community.*
- E Goldberg, 2008, *Environmental regulation and government initiatives in selected jurisdictions.*
- C Cronin, 2008, *Transdisciplinary Research*, Environmental Science and Research Ltd.
- C Gray, 2008, *Sustainability Lessons from Global Shapers*.
- P Morten, 2007, *Approaches to energy innovation in Northern Europe*.
- K Delaney, 2007, *Gateways to Science, Sustainability and the Future.*

Workshops that MoRST held as part of this project (notes are available on the MoRST website):

- Water and Food Production
- Energy
- Urbanisation
- Sustainability, Science and Business.

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