Green Buildings & Green Business Parks
Striving for Sustainability through Design & Operations

September 2007
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Prepared for

Priority One
In association with Environment Bay of Plenty

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EXECUTIVE SUMMARY

The purpose of this report is to build a case for – and promote – green buildings and green business parks. The intended audience is the various stakeholders and partners that have an influence on the form of commercial facilities in the Bay of Plenty.

The report is intended as a guide or primer, aiming to:

• educate about the various elements and features of building/park design
• detail the benefits and costs involved
• outline obstacles to progress and note how they can be overcome
• provide some practical and relevant examples, and
• suggest roles for the various stakeholders in order to achieve success.

The report is detailed with references provided for the various statistics and sources quoted. Two short summaries, capturing the key points outlined here, are available on request from Priority One (and included on the website for download).

The general structure of the report is as follows:

• Part 1 – In Context offers some background on sustainable development, reviews the local commitment to sustainability and how green design and building responds to this, notes some specific opportunities for action and details the contents and format of the report.

• Part 2 – Green Buildings provides an overview and summary of costs, benefits and building characteristics. It also gives a short history of the green building movement and details a few relevant examples. This section demonstrates the value of green buildings to the full range of partners in the process, from developers and property owners to building occupants and the community.

• Part 3 – Green Business Parks ~ In Theory covers the concept of industrial ecology and reviews early efforts in developing eco-industrial parks. In addition to eco-industrial ‘networking’, this section addresses site design, green buildings and other opportunities for cooperation amongst park residents.

• Part 4 – Green Business Parks ~ In Practice provides six case study examples of parks varying in size, structure and operating focus. This review serves to show the broad range of opportunities available. It’s a matter of choosing the best and most appropriate best practices from other places as a guide to development in the Bay of Plenty.

• Part 5 – Making It Happen ~ Implementation in the Bay of Plenty draws on the research, reports and case studies detailed in Parts 2, 3 and 4 to offer guidance for on the ground efforts here at home. It provides four more brief case studies – local examples of innovation – along with steps to success checklists and suggestions for the role to be played by key partners in the development process.

A green building incorporates design, construction, and operational practices that significantly reduce or eliminate the negative impacts of development on the environment and occupants.

In “Building the Green Way” in the June 2006 issue of the Harvard Business Review, Charles Lockwood wrote, “Green is not simply getting more respect; it is rapidly becoming a necessity as corporations – as well as home builders, retailers, health care institutions, governments, and others – push green buildings fully into the mainstream over the next five to ten years”.

Lockwood attributes the shift to green to three main factors:

• the creation of reliable building-rating systems for new construction and renovations
• increasing availability and falling prices for green building materials, mechanical systems and furnishings, and
• hundreds of studies proving the financial advantages of green buildings compared to more traditional construction.

Green Value: Green buildings, growing value is one of these studies – an independent effort of The Registered Institute of Chartered Surveyors. It combined an extensive review of the academic and industry literature and interviews with developers, owners and occupiers of green office, industrial, retail, and educational buildings in Canada, the U.S. and the UK.

The study suggests that the environmental benefits of green buildings and the fact that they are healthier places to work are now widely accepted. Their research added to this, demonstrating that green buildings also improve asset value noting that they can:
• secure tenants more quickly
• command higher prices or rents
• enjoy lower tenant turnover
• cost less to operate and maintain in most cases
• improve business productivity for occupants, and
• attract grants, subsidies and other inducements to do with environmental stewardship.

A green business park is a real estate enterprise developed and managed to strive for high environmental, economic, and social benefits as well as business excellence.

Green business parks (also variously called sustainable business parks or eco-industrial parks) have sometimes been described as ‘applied industrial ecology’ where closely-located businesses cooperate to minimise resource use and reduce waste. Ernest Lowe has said the purpose of this cooperation is to:
• preserve the ecological viability of natural systems
• ensure acceptable quality of life for people, and
• maintain the economic viability of systems for industry, trade and commerce.

As green business parks evolved, other cooperative efforts of resident businesses have been realised, including in purchasing, transportation, marketing, information systems, human resources, and environment, health and safety actions. These have led to operating efficiencies and cost reductions.

Beyond the businesses directly involved, communities that promote and develop green business parks also stand to benefit. As a point of competitive advantage, a green business park has the potential to attract (and retain) innovative businesses, leading to more jobs and a larger tax base.

Green business parks, by their nature, help to protect quality of life in the community. Through sensitive design, infrastructure needs can be more modest and the potential impact of such things as traffic congestion and air and water quality can be efficiently addressed. Green business parks can reduce or end what is often thought of as a ‘conflict’ between the economy and the environment.

There are many opportunities for green building and green business park development in the Bay of Plenty. Success will come through innovation and key partners working together – in the interest of business and the broader community.

Submitted 28 September 2007 by

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1 In Context

“Eventually, the world will no longer be divided by the ideologies of ‘left’ and
‘right’, but by those who accept ecological limits and those who don’t”.
– Wolfgang Sachs, Wuppertal Institute

The built environment has a profound effect on the natural environment. Buildings and
business parks play a significant part in this – both in the natural resources required for their
construction and in their ongoing impact in operations.

With the tremendous growth in the western Bay of Plenty occurring now and projected to
continue in the coming decades, new commercial buildings and business/industrial parks will
be needed to house the growing companies – and growing number of companies – that will
drive the economy of the sub-region.

There is a strong case for taking sustainability into account in the design and operation of
commercial buildings and facilities. It is imperative that we employ the best technologies
available and learn from the experiences of others as we strive to ensure the Bay retains the
features that make it such a special place to live, work and play.

1.1 Purpose of the Report

The original intent was to build a case for and promote the value of ‘sustainable business
parks’ to developers of commercial and industrial land in the Bay of Plenty. Early research,
however, showed that the report needed to do – and should do – much more than this.

First, it was apparent that not much can be done in the way of sustainability in a business
park overall unless the individual buildings and facilities making up the park also encompass
sustainable design.

Second, it was clear that while developers have much to gain by striving for sustainability in
the business parks they create, there are others who must contribute to the effort and many
stand to benefit from it as well. There are crucial roles for a variety of stakeholders if success
is to be achieved.

Third, it was evident that the many economic, environmental, and social benefits that result
from the sensitive design of new buildings and design and operation of new business parks
can also be realised when older buildings are renovated or retrofitted and if closely located
existing businesses take advantage of eco-industrial networking opportunities.

All of this has helped to shape the format and contents of the report as noted in Section 1.4.

In the research literature, the term sustainable business park is common as is eco-industrial
park. For the purposes of this report, the term green business park has been adopted as
the descriptor for consistency with the now common term green building, which is used to
describe a building that encompasses sustainability features. (See Figure 1 for more on
‘sustainability’.)

It is recognised that ‘green’ has political connotations in New Zealand and even negative
connotations in some circles. Nevertheless, ‘green building’ is a well-accepted term
internationally and one adopted by the New Zealand Green Building Council and associate
councils around the world. ‘Green business park’ is a natural extension of this – addressing
development issues at the site level, just as green building does at the section level.
Definitions are provided in subsequent parts of the report (and in the Glossary), but the following are useful to note here:

A **green building** incorporates design, construction, and operational practices that significantly reduce or eliminate the negative impacts of development on the environment and occupants.

A **green business park** is a real estate enterprise developed and managed to strive for high environmental, economic, and social benefits as well as business excellence.

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**Figure 1**

‘Sustainability 101’

| Definitions abound for **sustainable development** and **sustainability**. The terms are sometimes misused and misunderstood, but two definitions have stood the test of time and are now commonly accepted – together capturing what sustainable development is all about. |
|---|---|
| The first is from the 1987 World Commission on Environment and Development publication, *Our Common Future*. It states: |
| **Sustainable development** is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. |
| A second, complementary, definition is from the 1991 World Conservation Union publication, *Caring for the Earth*. It notes: |
| **Sustainable development** means improving the quality of life while living within the carrying capacity of supporting ecosystems. |
| A key part of the first definition – which implies social, economic, and environmental components – is use of the term ‘needs’ not ‘wants’. The key concept in the second definition (which focuses on the essential environmental component) is ‘carrying capacity’ – the idea of limits as expressed in the opening quote by Wolfgang Sachs. |
| Economist, Herman Daly, also considers limits. He differentiates growth (which is about quantity) which cannot be sustainable in our finite world and development (which embraces the idea of quality). |
| To motivate us to take action, others have made it more personal. Paul Hawken has said, “Sustainability, ensuring the future of life on earth, is an infinite game, the endless expression of generosity on behalf of all”. Another nice description (source unknown) is that sustainability is about the way we would operate if we knew we were going to live forever. |

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This report is intended as a guide or primer on green buildings and green business parks. It aims to:

- educate about the various elements and features of building/park design
- detail the benefits and costs involved
- outline obstacles to progress and note how they can be overcome
- provide practical examples relevant to development in the Bay of Plenty, and
- suggest roles for the various stakeholders in order to achieve success.

The report is detailed with references for the statistics provided and sources quoted. Two short summaries have been prepared – one on *Green Buildings*, the other on *Green Business Parks* – capturing the key points in this longer report. These summaries are available on request from Priority One (and included on the website).
1.2 Responding to Local Commitments

Taking a ‘green’ approach to commercial building and industrial land development is a practical response to the stated commitment of local councils and organisations to sustainability. It’s a great way to put important ideas into action.

**SmartGrowth** – the cooperative effort of Environment Bay of Plenty, Tauranga City Council and Western Bay of Plenty District Council, with support from Tangata Whenua and community groups – embraces sustainability. The 50-Year Plan booklet says, “Management of urban and rural development in a sustainable manner is one of the most fundamental challenges facing the western Bay”.

The SmartGrowth Update 2006 notes that “protection of the natural and cultural environment of the western Bay of Plenty is a cornerstone of the strategy” and for sustainable economic development “business practices in all sectors will need to reduce their ‘draw’ on natural resources and minimise waste output to the environment”.

The complementary SmartEconomy strategy has sustainability embedded in it as well. ‘Sustainable business practices’ is one of eight high-level 10-year outcomes to be monitored, and sustainability is noted as one of four current and emerging issues. (Water quality and availability is another, so it’s really one of three as this falls under the broader umbrella of sustainability.) Key issues noted are the best use of resources and increased recognition of the economic implications of climate change.

The Councils are further committed to sustainability in their own activities.

**Environment Bay of Plenty** states that their “work guides and supports the sustainable development of the Bay of Plenty. We want to make sure our region grows and develops in a way that keeps its values safe for future generations”.

**Tauranga City Council** addresses building and site design in key planning documents. ‘Principle 7- Make efficient use of energy and resources’ in Great City, Great Design: Urban Design Strategy for Tauranga (July 2006) lists planned actions under the title, “What will we do?”. These actions include identifying and supporting initiatives to:

- source renewable energy forms
- advance sustainable building and site design, and
- increase the energy efficiency and environmental health of buildings.

The Draft City Centre Strategy (July 2007) lists as one ‘Principle’ of the project that “environmental sustainability is a key driver of design of buildings and the City Centre environment”. One stated objective is “to ensure that new buildings and redevelopments are based on Environmentally Sustainable Design (ESD) principles”. With reference to ESD, the Strategy notes, “Tauranga, and the Council in particular, has the opportunity to lead by example in this area”.

The **Western Bay of Plenty District Council** is similarly involved. The Council notes: “While it is not difficult to attract new residents to the Western Bay, the challenge lies in ensuring employment and business opportunities grow at a similar rate, the environment is not adversely affected, and the lifestyle values that attract people to the area are not compromised”.

The Council’s Economic Strategy addresses this, with outcomes including:

- Council plans support the development of strategies for sustainable economic development, and
- responsible environmental practices are encouraged.

Urban design elements are considered in development of industrial land sites around the District and a comprehensive built environment strategy is now in preparation.
Key organisations are behind local sustainability efforts as well. For example …

The *Tauranga Chamber of Commerce Enterprise Magazine* lead editorial in the August 2007 issue was titled “Sustainability is the Way to the Future”. It noted that “the ideal time to make many environmentally-friendly choices is when you first buy or rent a facility, remodel your premises, expand your fleet, or replace equipment, as many of the costs would be incurred anyway”. It concluded with: “Sustainability is not a fad – it’s a necessity and the sooner we all embrace it, the better off we all shall be”.

The *Sustainable Business Network* (SBN) promotes the holistic approach to sustainable development practice for businesses. This encompasses environmental quality, social equity and economic prosperity. SBN BOP is already active in promoting green building design and practice in the Bay and will continue to offer leadership and support in this area, working closely with the New Zealand Green Building Council.

### 1.3 Seizing Local Opportunities

Green buildings already have a presence in the Bay. Those incorporating green design features include the Tauranga City library branch at Papamoa, Baywave TECT Aquatic & Leisure Centre, and the FIL New Zealand head office and manufacturing plant in Mount Maunganui. (FIL’s facility is a particularly relevant example given it bridges the office/industrial elements covered in this report.)

Current opportunities to pursue green building innovations include the planned waterfront museum, the sports and exhibition centre intended for Baypark, and the Strand City site in Devonport Road recently tendered by Council for commercial development (which includes ESD principles in the design brief). Development of any vacant sites and redevelopment of property in the CBD – by Council or by private developers – could follow suit.

Development of business land throughout the western Bay provides a multitude of green business park opportunities. The Smart Growth Strategy includes a business land staging plan covering a significant regional business park at Rangituki, commercial sites at Papamoa East (Wairakei) and Tauriko, and smaller developments in Te Puna Station Road, in Omokoroa, and in Marshall Road, Katikati. All of these could gain from the benefits of site design, green buildings and (eco-industrial) networking opportunities for park residents.

Development of commercial and industrial property in the Eastern Bay and in Rotorua could follow the same course. Whakatane and Kawerau District Councils have been cooperating to explore strategies for industrial land. Available land includes some 24ha in Mill Road, Whakatane and about 10ha each in Edgecumbe and Kawerau. Any redevelopment or retrofits of existing commercial facilities are further opportunities for green design innovations.

Rotorua District Council’s *Rotorua Growth Model* (2005) indicates approximately 60ha of vacant industrial-zoned land and additional commercial land available for development. New building or renovations offer the same opportunities to ‘go green’ here as they do elsewhere in the Bay. A particular opportunity would be in hotel/accommodation facilities as a part of efforts to get involved in the Green Globe New Zealand network and programmes.

In the high growth western Bay area, Priority One is working on three projects with tremendous potential to incorporate green design from the outset: Harbour Central Marine Precinct, an AgriFoods manufacturing park and an ICT technology park.

Harbour Central is a potential purpose-built, export-focused marine cluster with haul-out infrastructure on a 3.5ha waterfront site owned by Tauranga City Council siding on Mirrielees and Cross Roads in Sulphur Point.

Sites have been explored for the development of an AgriFoods (food processing, horticulture and nutraceuticals) export and sustainability focused park. The concept includes an
innovation centre delivering tertiary education programmes as well as R&D capability targeting the needs of food/nutraceutical manufacturers.

The Information & Communications Technology Park could house a number of the region’s existing internationally-recognised ICT businesses and even attract national and international businesses looking to relocate or establish a New Zealand/local presence. (Relevant to this last point is a UK survey cited in Part 3 of the report showing that hi-tech firms there preferred to locate in business parks with a natural look and pleasant environment.)

The many benefits detailed in subsequent sections of the report will accrue to developers, building/park owners and occupants, and the broader community if green design is integral to development. Each building or business park will be planned and built only once, so it’s crucial to get it right. This will ensure the environmental impact is minimised and the economic and social benefits maximised over the life of the facilities.

1.4 Format of the Report

Following this introduction, the report is divided into four parts as described below. It concludes with a reference list and three appendices for those seeking more detailed information.

Part 2 provides a review of green buildings. There is a wealth of excellent studies and reports on the topic and this section attempts to summarise and highlight the key points. It includes a brief history of the movement and notes green building characteristics, benefits and costs. A few examples – chosen for their relevance to the Bay of Plenty – conclude the section. Appendix A lists helpful sources and resources pertaining to green buildings, notably the New Zealand Green Building Council. Interested readers are encouraged to check out their website (www.nzgbc.org.nz) for the resources listed there and information on membership opportunities.

Part 3 looks at the theory of green business parks. It addresses the concept of industrial ecology and early efforts in developing eco-industrial parks. These parks focus on opportunities for energy ‘cascading’, water reuse and by-product exchanges (to reduce waste). The role of site design, green buildings, and other opportunities for cooperation amongst park residents broaden the scope for green business parks. Appendix B supports Part 3, noting source information on helpful resources cited in the text.

Part 4 gets into green business parks in practice. It provides six case study examples of parks, chosen due to their differences in size, structure and operating focus, thus demonstrating the wide range of opportunities available. This part also notes some of the obstacles to developing green business parks, factors for success and the key role to be played by developers. Appendix C notes references for the case studies covered in Part 4 plus some additional sources, notably Eco-Industrial Solutions Ltd (www.ecoindustrial.ca) for its variety of international examples.

Part 5 draws on the details provided in Parts 2 to 4 to offer a ‘roadmap’ for implementing green building/business park design and operations in the Bay of Plenty (including a suggested role for different stakeholders). The theory outlined and the examples drawn from different settings serve as a guide for the mix of factors that need to come into play here to drive success.

This report draws on relevant information from a wide variety of sources as noted in the References list. In addition to the New Zealand Green Building Council mentioned above, the Canada Green Building Council has been particularly helpful in providing some key documents for review. Their support is appreciated.

In the area of eco-industrial/green business parks, the names of four people kept popping up in the reference literature. These were Marian Chertow, Edward Cohen-Rosenthal, Raymond Côté and Ernest Lowe – all based in North America, three with university affiliations and one
a private consultant. Their early involvement in studying, encouraging and evaluating eco-
efficiency in the industrial setting has been instrumental in progress to date. Edward Cohen-
Rosenthal, who passed away in 2002, edited and contributed to a key resource, entitled Eco-
Industrial Strategies: Unleashing Synergy Between Economic Development and the
Environment, which is referenced extensively here.

The body of this report includes only a sampling of best practice examples. The Reference
list, Appendix A and Appendix B note the sources of many others for further consideration.

1.5 Partners for Progress

It's clear from the research that many parties stand to gain whenever green buildings or
green business parks are pursued over more traditional approaches. Similarly, getting them
in place, on the ground, will require the efforts of many.

Striving for sustainability is a big task. Protecting the natural environment and helping it to
regenerate wherever possible is work for everyone. David Brower, founder of the Sierra Club
and long-time advocate for environmental justice, likened the Earth to a spaceship, saying
"There are no passengers, only crew".

As ‘crew’ and partners in building green in the Bay of Plenty, there is a role for all of us –
land owners; developers and investors; building, landscape, and environmental
professionals; building owners and occupiers; Councils and economic development
agencies; business groups and the community.
2 Green Buildings

*The building block for green business parks*

“We shape our buildings, and afterwards our buildings shape us”.
– Winston Churchill

Business parks can address sustainability at the *site* level, while ‘green buildings’ address it at the *section* level. A *green* business park will remain elusive unless its component parts – the various buildings and facilities comprising it – also encompass sustainable design.

This section provides a brief but essential review of green *buildings* before getting into the theory and practice of green business parks. It includes a short history of the green building movement along with a summary of green building characteristics, benefits and costs. It concludes with brief descriptions of a few relevant examples.

2.1 Green Building Basics

The first step is to have a clear understanding of what is meant by a ‘green building’. It is then worth answering the question: Why bother building green? The keen interest in green buildings – and the growth in the number of adherents amongst architects, engineers, planners, developers and building owners and occupiers – suggests this is no passing fad but a new norm for the future.

2.1.1 By Definition

Environmentally Sustainable Development (ESD) recognises the need to integrate short- and long-term economic, social, and environmental aspects into the management of all our activities including the building environment.

As for *sustainable* buildings, there are a number of overlapping or near synonymous terms used to describe them, including energy-efficient building, environmental building, eco-building, high-performance building and green building. *Green building* is the term adopted by key organisations and the one that will be used throughout this report.

‘Green building’ definitions held by these various organisations confirm there are many facets to it and that it encompasses a long-term – and broad – view of things.

The Organisation for Economic Cooperation and Development, for example, defines green buildings as “those buildings that have minimum adverse impacts on the built and natural environment, in terms of the buildings themselves, their immediate surroundings and the broader regional and global settings” (OECD, 2003).

Our own New Zealand Green Building Council notes similarly that the purpose of a green building is “to reduce the adverse human impacts on the natural environment, while improving our quality of life and economic well-being” (Fullbrook et al, 2005).

Green Building Council Australia defines a green building as one that “incorporates design, construction and operational practices that significantly reduce or eliminate the negative impacts of development on the environment and occupants” (GBCA, 2006).

Finally, McGraw Hill Construction (2006) in its *Green Building Smart Market Report* also takes a pragmatic approach, noting that green building refers to “the careful design, construction, operation and reuse or removal of the built environment in an environmentally, energy-efficient and sustainable manner”.

Green buildings accomplish these various ends by incorporating characteristics as outlined in Section 2.2 below.

### 2.1.2 Rationale

Building construction – no matter how it is done – has significant impact on the natural environment.

David Orr (2006) alludes to this in *Design on the Edge: The Making of a High-Performance Building*, a book describing the planning, design and construction of the Adam Joseph Lewis Centre, on the campus of Oberlin College in Ohio. The Lewis Centre houses the College’s environmental studies programme and is acknowledged as the first substantially green building on a college campus in the United States. Planning for it began in 1995, with completion in 2000.

Orr notes that participants in design planning sessions agreed to three principles. The first was “to aim for a building and landscape that would cause no ugliness, human or ecological, somewhere else or at some other time. That standard required that the building be judged relative to its upstream effects at wells, mines, forests, and factories where the materials originate, and by its effects downstream on climate, biological diversity, and human and ecological health”.

This is an admirable goal given that, globally, buildings and construction activity consume about 30% of the planet’s raw materials and 20% of land use (NZGBC, 2007). In New Zealand, commercial buildings account for about 8% of our annual energy consumption and 5% of our CO₂ emissions (EECA, 2007).

The draw on these resources is only predicted to grow. By one estimate, as many buildings will be constructed worldwide in the next 50 years as over the last 5,000. Since green buildings have a smaller ‘environmental footprint’ than more traditional buildings, it makes sense to have more of them. (RICS, 2005)

Many additional benefits of green buildings are noted in Section 2.3.

### 2.1.3 A Short History

The green building movement is promoted and supported by the World Green Building Council and its affiliates around the world. Member countries are Australia, Canada, India, Japan, Mexico, Taiwan, United States, United Arab Emirates and, as of 2006, New Zealand. Green Building Councils are currently emerging in Brazil, Chile, Greece, Guatemala, Israel and the United Kingdom. Another 30 countries are actively exploring formation of a Green Building Council.

The World Green Building Council aims to be the key global not-for-profit organisation working to transform the property industry toward sustainability. Member Councils in the various countries take their own approach, but adapt and build on the efforts of one another.

**In the United States**, the Green Building Council (USGBC) was established in 1993 by some of the largest companies in the building design and construction industry together with leaders from the environmental and non-profit community. Their mission was “to promote buildings that are environmentally responsible, profitable and healthy places to live and work” (McGraw Hill, 2006).

USGBC created the LEED (Leadership in Energy & Environmental Design) rating system in 1999 based on points awarded for meeting specific performance criteria. Buildings can be certified at one of four rating levels – Certified, Silver, Gold or Platinum. Initially, the LEED rating focused on new construction and major renovations. It has since been expanded to include existing building operations, commercial interiors, core and shell projects, homes and neighbourhood developments.
LEED certified projects in the U.S. have grown from less than 10 in 2000 to over 1,000 by 2007. In 2000, there were 425 USGBC member companies. This has grown to more than 10,000 today.

**In Canada**, the Green Building Council (CaGBC) was incorporated in 2002. Initially, buildings were certified using the U.S. LEED rating system. CaGBC subsequently obtained exclusive rights to LEED in Canada, introducing LEED Canada in 2004.

There are currently 65 LEED certified projects in Canada – with 46 of them at the Silver or Gold level. Facilities range in size and purpose, from transfer stations, firehalls and bank branches to university science buildings, distribution centres and technology parks.

CaGBC notes that while LEED is the most popular rating system in Canada, certified buildings represent only a portion of the green buildings in the country. Other green building projects have been undertaken or are underway that are not seeking LEED certification (including renovations of existing buildings).

Current CaGBC membership stands at nearly 1,500.

**In Australia**, the Green Building Council (GBCA) was formed in 2003. The Green Star rating system was launched in 2003, with release of the first version of its Office Design rating tool. Rating involves the following criteria categories: management, site selection and ecology, land use, materials, indoor environment quality, energy, water, transport, emissions and innovation.

Adding to the initial Office Design, rating tools now include Office as Built, Office Interiors and Office Asset. The rating scale is one to six stars, with four through six stars receiving official certification. Brindella Business Park – a three-story commercial building at Canberra International Airport – was the first Green Star certified building in the country, achieving a 5 Star rating on completion in 2004.

In 2005, the South Australian Government announced that all new offices built or leased by the government must achieve 5 Star Office Design Certified Rating and all new government office fit-outs must achieve a 4 Star Office Interiors rating. Also in 2005, the Victoria Government’s Office Accommodation Guidelines stipulated that all new offices leased or built by the government require a 4 Star Office Design rating, with the same 4 Star requirement for all government fit-outs.

Membership growth in GBCA mirrors that in other countries, with a current membership base of 310 and 900 Green Star Accredited Professionals. There are now 26 Green Star certified buildings (v eight buildings in 2006) and 138 Green Star registered buildings (v 36 a year ago).

**In New Zealand**, the Green Building Council (NZGBC) was formed in 2005, with membership in the World Green Building Council secured in 2006 as noted above. NZGBC’s vision is to transform the built environment to reduce the impact of development and use.

From the outset, key areas of focus for the Council have been:

- **Rating system** – to establish nationally accepted, internationally aligned, sustainability rating systems for buildings in New Zealand.
- **Education** – to create demand for education around sustainable building issues and to facilitate delivery of that education, and
- **Information** – to provide, more generally, information and advocacy for the improved environmental performance of buildings.

Similar to Canada’s approach in adapting the U.S. LEED rating system, the NZGBC has fashioned the Green Star NZ rating system after Australia’s Green Star programme, with variations to address the particular circumstances in New Zealand. The Green Star NZ suite will feature rating tools for all phases of development, from design and construction to fit-out.
and operation. Tools cover a variety of building types, including office, retail, education, health, industrial and residential.

Green Star NZ will assess building projects against eight environmental impact categories as shown in the accompanying figure.

![Figure 2: Green Star NZ Category Ratings (by %)](chart)

Geographical location and energy efficiency targets are also taken into consideration before a rating of four, five, or six stars may be awarded. Along with offering formal certification of a building project’s environmental performance, rating tools can be used as a design guide to track and improve performance.

NZGBC membership has grown rapidly since the Council was formed – with 180 active member companies/organisations by August 2007. The Council’s Board of Directors reflects the interests of the entire building and construction industry. Board members include commercial property developers, investors and owners, owner occupiers, major corporate tenants and retailers, building contractors, building product manufacturers and distributors, architects and engineers, and property and construction professionals.

### 2.2 Features

For some people, green buildings conjure up the image of composting toilets and trees on the roof. While on-site waste disposal and a ‘green roof’ (i.e. an elevated and reinforced surface covered with a thin layer of soil and vegetation) are possible components of a sustainable building, there are many potential features that will help make the building a high-performance one. Innovation and creativity will surely lead to brighter shades of green, but thoughtful planning and best use of current technology can go a long way to ‘greening’ a building.

Green Building Council Australia (2006) notes that in green buildings there should be strategies for addressing:

- energy efficiency and greenhouse gas emission abatement
- water conservation
- waste avoidance, reuse and recycling
- pollution prevention – noise, water, air, soil and light
- enhanced biodiversity, reduced natural resource consumption
- productive and healthier environments, and
- complementary sustainable transportation options.

Various reports and case studies describe green building features in different ways, but they are nicely categorised under the six headings in Figure 3. All buildings obviously cannot include each of these features, but the extensive list gives some sense of the possibilities.
### Figure 3
Sample Green Building Features

<table>
<thead>
<tr>
<th><strong>Location</strong></th>
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<tbody>
<tr>
<td>- Avoid fragile landscapes</td>
<td></td>
</tr>
<tr>
<td>- Revitalisation of brownfield sites</td>
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<tr>
<td>- Accessible to public transportation</td>
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<thead>
<tr>
<th><strong>Site</strong></th>
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<tbody>
<tr>
<td>- Low impact on local ecology, retention of mature vegetation</td>
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<tr>
<td>- Use trees and plants for shading</td>
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<tr>
<td>- Native plantings/low-water-use landscaping</td>
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<tr>
<td>- If irrigation, water-efficient systems with drip feeders and automatic timers</td>
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<tr>
<td>- Stormwater management via holding ponds, natural contouring, rain gardens, porous paving, etc.</td>
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</tr>
<tr>
<td>- Increased green space (i.e. small building footprint, minimal surface parking)</td>
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<tr>
<td>- Optimal siting of building (re: solar gain in winter and shading in summer)</td>
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<thead>
<tr>
<th><strong>Building Exterior</strong></th>
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<tbody>
<tr>
<td>- Highly-efficient building envelope (e.g. thermal mass for temperature control)</td>
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<tr>
<td>- Sustainably-sourced timber (e.g. Forest Stewardship Council)</td>
<td></td>
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<tr>
<td>- High-efficiency glazing (solar control or insulating or both)</td>
<td></td>
</tr>
<tr>
<td>- Best practice insulation (including underfloor)</td>
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</tr>
<tr>
<td>- Large roof overhang and window louvers (to control temperature and glare)</td>
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<tr>
<td>- Windows, skylights and light shelves to increase natural light penetration into the space</td>
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<tr>
<td>- Efficient, targeted exterior lighting to minimising light pollution (consider solar)</td>
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<tr>
<td>- Green roofs to enhance biodiversity and slow rainwater run-off</td>
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<tr>
<th><strong>Building Interior &amp; Fit-Out</strong></th>
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<tbody>
<tr>
<td>- Minimal materials (e.g. exposed structural materials)</td>
<td></td>
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<tr>
<td>- Mixed mode natural and mechanical ventilation</td>
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<tr>
<td>- Occupant (local) controlled heating, cooling and ventilation</td>
<td></td>
</tr>
<tr>
<td>- Heat pump heating and cooling</td>
<td></td>
</tr>
<tr>
<td>- Motion sensors and timers to control artificial lighting</td>
<td></td>
</tr>
<tr>
<td>- Low Volatile Organic Compound (VOC) content in carpets, adhesives and sealants</td>
<td></td>
</tr>
<tr>
<td>- Environmental Choice products, including paints, flooring and laminates</td>
<td></td>
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<tr>
<td>- ‘Floating’ floors (i.e. no glues or adhesives)</td>
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<tr>
<td>- Water-saving fixtures (e.g. tap, toilets, showers, low pressure hot water)</td>
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<tr>
<td>- Highly-efficient appliances (e.g. office equipment, fridges)</td>
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<tr>
<td>- Exhaust risers for printing/photocopying areas</td>
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<tr>
<td>- Flexible layouts (e.g. movable walls, raised floors)</td>
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</tr>
<tr>
<td>- Access to long-distance views, provision of visual connection to the outdoors</td>
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</tr>
<tr>
<td>- Furniture with recycled content and highly recyclable at end of useful life</td>
<td></td>
</tr>
<tr>
<td>- Lease floor coverings, furniture, etc. v purchase (re: producer responsibility)</td>
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<tr>
<th><strong>Other Attributes</strong></th>
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<tbody>
<tr>
<td>- Reuse of existing facades and structures (if available)</td>
<td></td>
</tr>
<tr>
<td>- Use of local materials, use of recycled materials (e.g. concrete and steel)</td>
<td></td>
</tr>
<tr>
<td>- Materials with low environmental embodied effect</td>
<td></td>
</tr>
<tr>
<td>- Minimal/no use of PVC materials</td>
<td></td>
</tr>
<tr>
<td>- Construction waste diversion based on source separation</td>
<td></td>
</tr>
<tr>
<td>- HVAC systems that limit use of ozone depletion substances</td>
<td></td>
</tr>
<tr>
<td>- Rainwater collection and use (e.g. landscape irrigation, toilet flushing)</td>
<td></td>
</tr>
<tr>
<td>- Solar water heating or use heat pumps</td>
<td></td>
</tr>
<tr>
<td>- Alternative energy systems (e.g. photovoltaics, wind turbines)</td>
<td></td>
</tr>
<tr>
<td>- Purchase energy from a ‘green’ provider</td>
<td></td>
</tr>
<tr>
<td>- Secure area for bicycle storage, plus showers and lockers</td>
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<thead>
<tr>
<th><strong>Building Management System</strong></th>
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<tbody>
<tr>
<td>- Automatic control of blinds, louvers and opening windows with manual occupant override</td>
<td></td>
</tr>
<tr>
<td>- Automatic control of plant and systems</td>
<td></td>
</tr>
<tr>
<td>- Ability to measure and optimise system performance over time</td>
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</tr>
<tr>
<td>- Provide a <em>Building Users’ Guide</em> to occupants</td>
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These various features come with costs, but there are attendant benefits as well. These are covered in the next section.
2.3 Costs … and Benefits

Charles Lockwood (2006), writing in the *Harvard Business Review*, said, “Just five or six years ago, the term ‘green building’ evoked visions of tie-dyed, granola-munching denizens walking around barefoot on straw mats as wind chimes tinkled near open windows. Today, the term suggests lower overhead costs, greater employee productivity, less absenteeism and stronger employee attraction and retention”.

He goes on to say, “Green is not simply getting more respect; it is rapidly becoming a necessity as corporations – as well as home builders, retailers, health care institutions, governments and others – push green buildings fully into the mainstream over the next five to ten years”.

Lockwood attributes the shift to green to three main factors:

• the creation of reliable building-rating systems for new construction and renovations
• increasing availability and falling prices for green building materials, mechanical systems and furnishings, and
• hundreds of (U.S. and international) studies proving the financial advantages of green buildings compared to more traditional construction.

Green buildings compete well with standard buildings on a construction cost basis, but it is less and less common to evaluate them solely on these terms. Whole-of-life costs and benefits – economic, environmental and social – all need to be weighed up in decision making.

A number of reports and studies assess and review these important issues. Three reports, supported by national Green Building Councils, provide strong evidence for building green. These are:

*The Value Case for Sustainable Building in New Zealand* (2005)
*A Business Case for Green Buildings in Canada* (2005), and

Each of these reports emphasise different aspects of the case for green buildings. All three draw and build on other analyses and studies such as the following:

*Costing Green: A Comprehensive Cost Database and Budgeting Methodology* (2004), by Lisa Fay Matthiessen and Peter Morris of Davis Langdon
*Green Value: Green buildings, growing assets* (2005), published by The Royal Institute of Chartered Surveyors (RICS)

Appendix A provides more information on these documents and indicates where they can be found. Readers are encouraged to review the original documents for the wealth of information they contain. The following sections note some of the key points they make.

2.3.1 Presenting the Case

The *Value Case for Sustainable Building in New Zealand* (Fullbrook, 2005) provides detailed case studies of five buildings: a university office/classroom complex, hospital, secondary school, community library and a government office.
Indicative cost/benefits are provided for each one. Data includes benchmark building capital cost, building capital cost given its ESD characteristics and annual energy and water cost savings (all in $/m^2). It also notes the simple payback period (in years) and the 20-year net present value for ESD measures (in $/m^2). A residual land value calculation is also provided (comparing a conventional 10,000m^2 commercial office and a similar-sized green building). The analysis is based on the concept of ‘worth’, which properly reflects the benefits of green buildings in terms of:

- corporate tenant identification with environmental issues
- improved rental values
- better technical performance, and
- improvements in productivity and other building occupant advantages.

Based on the data and calculations in the report, the value case for sustainable building is as follows:

- For owner occupiers, a 20-year whole-of-life cost view indicates the marginal cost increase of green building is likely to be repaid between five and six times by operating cost savings alone.
- For tenants, the probable 20-year rental premium for green buildings is likely to be repaid by a factor of approximately three from operating cost savings alone.
- For owner occupiers, developers and investors, a residual land value analysis shows a green office building may have a true worth of nearly 40% more than a conventional building.

The case studies show that to achieve the above investment returns, the difference in capital cost of sustainable buildings compared to conventional good quality buildings varies from 15% less to 11.5% more, with sustainable features initially costing an average of 2-6% more. The report notes this is in the range experienced in other countries – citing green buildings costing a premium of 2-4% in Australia, 1-7% in the U.S. and 10% in the U.K.

Energy costs for the case study buildings in the report are 50-65% below those for similar conventional buildings. Significant rises in energy costs and, to a lesser extent, water costs will thus make green buildings increasingly appealing. Other potential user charges such as carbon taxes will make green buildings even more attractive in the years to come.

A Business Case for Green Buildings in Canada (Lucuik, 2005) considers a variety of benefits of green buildings, looks at the economics of green building and discusses risks, challenges and barriers to further adoption of green building practices in construction.

Climate change impact warrants special attention in this report. It notes that a full building life cycle analysis (LCA) approach can be used to model the typical production and potential reductions of greenhouse gas emissions related to buildings. LCA quantifies the environmental effects of the building materials, its operation and its end-of-life outcome.

Significant amounts of fossil fuels will be used in the production and transport of building materials to the site. There will be similar energy requirements for deconstructing buildings at the end of their useful life. Add to this any fossil fuel use in operations, and this report suggests that global climate change contribution associated with a conventional inefficient building can be reduced by more than 70% when both material and energy use effects are minimised using an LCA approach.

This Business Case notes that green buildings offer a wide range of benefits to a number of building industry stakeholders. The matrix in Figure 4, drawn from the Canadian report, shows how these benefits might apply to different stakeholder groups.
Much is also made of occupant comfort and health – and their spill over effect on productivity – in the Canadian report. Green buildings typically incorporate superior air quality, abundant natural light, access to good views whenever possible, and noise control. Comfortable air temperature and indoor air quality are particularly important as generally indicated by building occupant surveys.

Lucuik suggests that, since payroll costs contribute a significant portion of a company’s annual expenses, any productivity gains attributable to a green building should be included in a life cycle cost analysis (especially for owner occupied buildings). His review of the literature cites one large U.S. study concluding that improvements to indoor environment common in green buildings could reduce health care costs and work losses from communicable respiratory diseases (by 9-20%), from reduced allergies and asthma (by 18-25%) and from non-specific health and discomfort effects (by 20-50%).

A database of studies developed by the Center for Building Performance at Carnegie Mellon University in the U.S. addressed the impact on individual productivity of increased occupant control of:

- temperature – 13 studies, productivity increases 0.48-11% (average 1.8%)
- ventilation – seven studies, productivity increases 0.2-3 % (average 1.2%), and
- lighting – eight studies, productivity increases 3-15% (average 7.1%).

Assessing these and other studies cited in the Business Case, Lucuik says, “There is a strong indication that occupant productivity is greater, and that salary costs are reduced, in
green buildings compared to conventional buildings”. He notes that the magnitude of this difference is not clear, but that it would be reasonable to assume a productivity gain of between 2 and 10% when shifting from an average building to a green building that incorporates high quality natural light, exceptional ventilation and, possibly, user controls.

The Dollars and Sense of Green Buildings (GBCA, 2006), Australia’s equivalent of the two studies cited above, includes 13 case studies and an extensive section on the benefits of building green. Topics covered include operating costs, return on asset, property values and marketability. It considers the benefits from the point of view of developers, investors, tenants and the community. Much of the benefits data and information is drawn from the studies referenced in the next section.

2.3.2 Studies in Support

A number of studies have focused on the capital cost of green buildings.

The Costs and Financial Benefits of Green Buildings (Kats, 2003) includes a comprehensive literature review and analysis of 33 green buildings across the U.S. The analysis provides a comparison of the real constructed cost of the green buildings with a cost estimate based on a similar non-green building design.

The green buildings consisted of eight LEED certified ones, 18 LEED Silver, six LEED Gold and one LEED Platinum. The cost premium for the certified buildings was less than 1%, about 2% for Silver and Gold buildings and just over 6% for the Platinum building. A similar study a few years earlier put the cost premium of green buildings at 5-15%. This change attests to the increased availability and lower cost of green building materials, mechanical systems and furnishings as cited by Lockwood above.

Kats summarises the financial benefits to include lower energy, waste disposal, and water costs, lower environmental and emissions costs, lower maintenance costs and savings from increased productivity and health. These benefits range from being fairly predictable (energy, waste, and water savings) to relatively unpredictable and varying (productivity/health benefits). Some examples of the ranges for these latter benefits were noted in the previous section.

Costing Green: A Comprehensive Cost Database and Budgeting Methodology (Mattheissen, 2004) was prepared by Davis Langdon, a cost consulting company. It examined 138 buildings across the U.S. strictly from the standpoint of construction costs. Of the buildings studied, 45 were LEED-seeking and labelled green, while the remaining 93 were defined as conventional.

In a comparison of the projects, the green buildings were found scattered throughout the range of costs for all buildings studied, with no apparent pattern to the distribution – i.e. there was no statistically-significant difference between the LEED buildings and non-LEED buildings.

Their cost analysis of similar buildings led to four main conclusions:

- There is a very large variation in costs of buildings, even within the same building programme type (i.e. the purpose of the building).
- Cost differences between buildings are due primarily to programme type.
- There are low cost and high cost green buildings.
- There are low cost and high cost non-green buildings.

They conclude that many projects achieve sustainable design within their initial budget or with very little supplemental funding. Those most successful in staying within budgets have clear goals from the outset and integrate green elements into the project at a very early stage. Projects where green elements are ‘add-ons’ experience greater budget difficulties.

Green Value: Green buildings, growing value (RICS, 2005) was an independent study carried out by The Registered Institute of Chartered Surveyors. It combined an extensive
review of the academic and industry literature and interviews with developers, owners and occupiers of green office, industrial, retail, residential, and educational buildings in Canada, the U.S. and the UK.

The study suggests that the environmental benefits of green buildings and the fact that they are healthier places to work are now widely accepted. Their research adds to this, demonstrating that green buildings also improve asset value. Green buildings can:

- secure tenants more quickly
- command higher prices or rents
- enjoy lower tenant turnover
- cost less to operate and maintain in most cases
- improve business productivity for occupants, and
- attract grants, subsidies and other inducements to do with environmental stewardship (e.g. increasing energy efficiency and lessening greenhouse gas emissions).

*Green Value* notes, however, that comparatively few green buildings have been completed and they still represent a very small portion of the commercial building stock. Many green developments have been completed too recently to offer conclusive evidence or to have undergone post-occupancy analysis. Thus, the extent of green value is still difficult to quantify.

Further efforts to demonstrate the linkage between green buildings and asset value will come from better agreement on what constitutes ‘value’. RICS suggests there is still a gap in understanding and knowledge between the green industry and the financial industry. As this gap closes with the increasing use of more holistic valuations methods, there will be a better understanding that the benefits of green buildings are there to be gained by developers, owners and tenants alike.

*Green Building Smart Market Report* (McGraw Hill Construction, 2006) is based on a survey of architects, engineers, contractors and building owners in the U.S. It inquired as to their involvement, habits and perceptions about green buildings.

When asked to predict the impact of completed green building projects, respondents reported the following:

- operating costs – average expected decrease 8-9% across the industry
- building values – average increase expected about 7.5%
- return on investment – on average, expected to improve 6.6%
- occupancy ratio – occupancy expected to increase by 3.5%
- rent – expected to rise by 3% on average.

The Report noted that green building comprised approximately 2% of the new U.S. non-residential construction market in 2004. Based on their research findings, they predict that by 2010 between 5 and 10% of new non-residential construction starts will be designed using green building principles.

*Future-Proofing New Zealand’s Commercial Property for a Sustainable Tomorrow* (Myers and Bannon, 2006), a Jones Lang Lasalle report, builds on the studies cited above and provides a New Zealand context for the issues considered.

The report reminds us that New Zealand is currently ranked fifth in the world in greenhouse gas emissions and that a good portion of our CO₂ emissions are generated by commercial buildings. Water use in commercial buildings and solid waste generation (particularly paper) are other issues that need greater attention. In the years to come, the cost of water and energy will no doubt increase as will landfill charges. Add to this the likelihood of carbon emission taxes, and sustainability features in new and existing buildings is one way of future-proofing against these costs.

Installation of many green building features can pay off quickly. The Jones Lang Lasalle report provides examples of seven initiatives relating to heating and lighting which have a simple payback period ranging from 1.25 to 4.72 years (with an average of 3.21). Design and
installation is one thing, but the report confirms that “once operational, improved property and facilities management is required to maximise cost savings and sustainability goals”.

The report summarises current green building projects in Wellington and notes that, with Central Government occupying 40% of the commercial office space, its sustainability requirements will strongly influence the direction of the green building market. There will no doubt be a ripple effect – to other levels of government, institutions and the private sector and to other regions of the country – as the case for green buildings grows.

2.4 Examples

The sources noted in Appendix A include a wide variety of green building case studies. A few examples from the extensive lists are included here to demonstrate the application of green building principles to buildings varying in size and intent. They show a spectrum of facilities that would ‘fit’ in the Bay of Plenty generally and in business parks as they develop in the region.

The examples include:
- a small manufacturing company
- a bank branch (representative of general office/customer service facilities)
- distribution centres
- a library and service centre (community complex)
- a retail store (including offices), and
- an academic building (including offices and laboratories, similar purpose as science/R&D facilities).

The original Information varies considerably in detail and style. The summaries included here draw on these, with no attempt to standardise the format.

**Bordo International Pty Ltd** is a small Australian firm based in Scoresby VIC supplying high quality industrial cutting tools and accessories. The contractor for their new office facility implemented a comprehensive environmental management plan leading to, among other things, 60% of construction waste by weight being reused or recycled and 30% recycled content in concrete used.

Green initiatives in the facility include:
- a narrow floor plate affording abundant natural light and views
- external shading and internal blinds to eliminate glare
- low VOC paints and carpets throughout
- zero ozone-depleting potential of refrigerants
- solar hot water system for service areas
- waterless urinals and 3/6 dual flush toilets
- operable windows
- 50% fewer car park spaces than allowed by planning controls
- secure bicycle facilities and showers.

The building has achieved a 5 Star Green Star – Office Design Certified rating and is predicted to achieve a 68% reduction in energy consumption. The simple payback period for the green initiatives is 3.7 to 7.8 years. (World GBC, 2007)

**PNC Financial Services Group**’s head office in Pittsburgh, Pennsylvania at 65,000m² is one of the world’s largest certified green buildings and winner of over 20 awards. Building on this, PNC has now constructed several of more than 200 planned green bank branches. Construction time is 45 days less than its earlier traditional branches, with the buildings coming in $100,000 below the cost of a competitor’s new standard branches. Citing a recently completed 365m² LEED-certified branch, day-lighting is estimated to save 7% of energy costs, with total energy costs 40-50% less than a typical branch. (McGraw Hill Construction, 2006; Lockwood, 2006)
**Canpar**, one of Canada's leading parcel delivery firms, is actively increasing energy efficiency and reducing environmental impact of their business practices. Their new distribution centre on a brownfield site in western Toronto is large (at 17,000 m$^2$), but indicative of the kinds of things that can be done with a 'big box' type of structure. Much of the building houses automated parcel sorting equipment, with truck loading docks along two sides of the building.

Green features include:

- 95% landfill diversion rates of waste materials from the construction site to recycling or salvage
- demolition of old factory foundations provided 31,000 m$^2$ of concrete which was crushed and reused as fill
- buildings materials had 23% recycled content and 55% regional content
- a building shell with high insulation levels in walls and roof and high performance windows (low E-coating and argon gas fill)
- 70% reduction in use of municipal water via water-saving fixtures and rainwater harvested from the large warehouse roof (used for irrigation and flushing of toilets and urinals)
- energy cost performance 29% better than Model National Energy Code for Buildings.

LEED Canada certification and significant ongoing operating cost reductions were achieved at a built cost premium of $32/m$^2$ over a similar building without the green features. (CaGBC, 2007a)

**Verifone** renovated its worldwide distribution headquarters for its telephone credit card verification systems in Costa Mesa, California several years ago. Green features included skylights for daylighting, a high-efficiency mechanical system, building materials with minimal VOCs and ergonomic office systems. Benefits attributed to the change and improvements include a 59% reduction in energy consumption, 47% decrease in employee absenteeism and a 5% increase in productivity. Payback period for their green investment was less than one year. (USGBC, 2002)

**South Christchurch Library and Service Centre**, a 2,400 m$^2$ building, houses a community library, education centre and the local Council service centre and advocacy team. It was designed to be sensitive to the residential character of the area and serves as a focal point for the lower Cashmere community.

The **Value Case for Sustainable Building in New Zealand** (Fullbrook, 2005) includes a detailed case study of this facility under the headings: concept, site, energy, water, waste, materials, transport and process. Some of its more interesting features include:

- a saw-tooth roof form that breaks the building into four distinct blocks and allows daylight and ventilation throughout the facility
- durable external surfaces requiring no applied surface finishes (stone, glass and aluminium), plus materials with a high recycled content
- optimised wall-to-window ratios and strategic placement of thermal mass determined by 3D energy modelling
- low-energy T5 light fittings on shared ballasts linked to daylight sensors
- water-saving fixtures throughout and a water-filled moat around the building to collect and hold rainwater for the toilet cisterns.
- bicycle stands for public and staff, plus staff shower and locker facilities to encourage cycle use.

A number of changes to the normal procurement process were instrumental in the environmental success of the project. These included:

- a design brief requiring that ecologically sustainable development (ESD) be a priority of the design, and
- a realistic but demanding energy brief and a separate energy budget to pay for low-energy strategies with approved payback periods.
A considerable number of environmentally-preferable materials and technologies incorporated in the building have no direct payback, but were accomplished for less than 1% of the total construction costs. The ESD building premium (additional cost) is estimated at 4.9%, with annual energy cost savings estimated at $7.50m\(^2\). (There are currently no water-cost savings due to Christchurch City’s method of charging, though this could change in the future). Simply payback for the green features is 14.67 years (with a 20-year NPV for ESD measures of $32/m\(^2\)).

**Mountain Equipment Co-op** (MEC), a retail co-operative, is Canada’s largest supplier of outdoor equipment. It sells its products via the internet and a phone/mail order service, as well as through retail stores across Canada. MEC is committed to social and environmental leadership and it has been building progressively greener buildings over the past decade. (CaGBC, 2007b)

Their store and offices in Winnipeg, Manitoba are in a three-story, 2,810m\(^2\) building completed in 2004 in a part of downtown targeted for revitalisation by the city. Key innovative features of the project included an integrated design and construction management process, aggressive deconstruction and materials re-use, and energy efficiency in operations – some 69% better than a nationally-recognised benchmark.

Their water management strategy combines several technologies. Composting toilets have replaced flush toilets. (‘Compost tea’ from the toilets is used to fertilise the green roof.) Stormwater from the roof is collected in tanks and used to irrigate the roof via a solar photovoltaic (PV) powered pump, with the flow being proportional to the solar heat gain on the roof (thus reducing the air-conditioning load). Combined, these technologies provide over 72% water savings and there is no sewage discharge from the building (and thus no infrastructure changes required by the city to service the building).

The **Adam Joseph Lewis Center**, mentioned at the beginning of Section 2.1.2, is at Oberlin College in Ohio. It’s a two story, 1,260m\(^2\) structure, of passive solar design, built with durable and recycled materials and wood with Forest Stewardship Council certification. The grounds include student-maintained gardens, an orchard, and a pond and wetland to filter stormwater and runoff. (Orr, 2007; Green Buildings BC, 2007)

With its array of green features, the Lewis Centre remains best known for three things – its energy, wastewater, and building-monitoring systems:

- **Energy** – In addition to the building positioning for passive solar energy, use of concrete floors, exposed interior masonry and an earth berm to the second floor on the north side of the building to moderate temperature extremes, there is a 370m\(^2\) photovoltaic array on the Centre’s roof and that of a nearby car park. The building uses about 80% less energy than comparable ‘non green’ buildings, with more than half of it coming from the solar PV system.

- **Wastewater** – The ‘Living Machine’, as it is called, sits in a glass-enclosed lab area at a corner of the entrance atrium. Wastewater circulates through a biological system similar to ponds and marshes housed in several tanks, with bacteria, algae, micro-organisms, trees, plants, snails and fish naturally purifying and filtering water enough to be used as non-potable greywater in the building. The system is powered by the sun and used as a research and teaching tool for students in the environmental studies programme.

- **Building-monitoring** – Over 150 sensors, collecting data on resource and energy flows throughout the building and landscape, give ongoing feedback for improving environmental performance. Awareness and education are tied in via computer display of the data in the Centre’s atrium.

The Lewis Center has won a number of awards, including ones from the American Institute of Architects and the National Convention of Associated General Contractors. It has been described by the U.S. Department of Energy as one of 30 “milestone” buildings of the twentieth century.
Commenting on the design, David Orr (2006) said, “We intended to create not just a place for classes, but rather a building that would help to redefine the relationship between humankind and the environment – one that would expand our sense of ecological possibilities”.

2.5 In Summary

By all accounts, the future is bright for green buildings in New Zealand and elsewhere. For a possible modest premium in capital costs, a whole range of potential benefits arise (as summarised in Table 1). The benefits cover economic, social, and environmental factors, with building developers, owners and occupants all standing to gain in the process.

<table>
<thead>
<tr>
<th>Initial</th>
<th>Health &amp; Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streamlined consents and approvals</td>
<td>Enhanced comfort</td>
</tr>
<tr>
<td>Lower material use</td>
<td>Improved health</td>
</tr>
<tr>
<td>Savings in construction waste disposal</td>
<td>Reduced absenteeism</td>
</tr>
<tr>
<td>Savings via smaller mechanical systems</td>
<td>Improved productivity</td>
</tr>
<tr>
<td>Qualify for financial incentives</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower energy and water costs</td>
<td>Reduced resource extraction impacts</td>
</tr>
<tr>
<td>Greater durability, fewer repairs</td>
<td>Reduced global warming impacts</td>
</tr>
<tr>
<td>Reduced cleaning and maintenance</td>
<td>Reduced toxic emissions</td>
</tr>
<tr>
<td>Reduced waste generation</td>
<td>Minimise ozone depletion impacts</td>
</tr>
<tr>
<td></td>
<td>Lower air/water pollution impacts</td>
</tr>
<tr>
<td></td>
<td>Protection of biodiversity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Economic</th>
<th>Community &amp; Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketability – more rapid lease out</td>
<td>Lessens demand on municipal services</td>
</tr>
<tr>
<td>Lower tenant turnover</td>
<td>Reduced stormwater runoff and erosion</td>
</tr>
<tr>
<td>Rent premium</td>
<td>Reduced automobile use</td>
</tr>
<tr>
<td>Enhanced employee recruiting</td>
<td>Support for companies committed to sustainable business</td>
</tr>
<tr>
<td>Reduced employee turnover</td>
<td>Corporate image in the business and broader community</td>
</tr>
<tr>
<td>Increased asset value</td>
<td></td>
</tr>
<tr>
<td>Future-proofing against costs</td>
<td></td>
</tr>
<tr>
<td>Protect v building obsolescence</td>
<td></td>
</tr>
</tbody>
</table>

* Table/format adapted from BuildingGreen.com

Building green responds to a number of imperatives for New Zealand in the twenty-first century, including a drive toward sustainability (even carbon neutrality), lessening our impact on the local environment and ensuring we deserve and protect our ‘clean, green’ image.

The New Zealand Green Building Council confirms that there are key steps and processes for successful implementation – design, build and commissioning – of green buildings. These are considered in the final section of the report, following a look at the theory and practice of green business parks in the next two sections.
3 Green Business Parks ... *In theory*

“Eco-industrial answers don’t arrive wrapped up neatly in a kit with instructions on how to glue it together”.

– Edward Cohen-Rosenthal
Cornell Work & Environment Initiative

Green business parks are a natural and logical extension of green buildings. They can address sustainability via design and layout of the land site as well as through the ongoing operation of businesses located there.

This section provides some background to the development of ‘green’ business parks. Their beginnings and evolution are considered first, followed by a look at strategies for developing them, their main elements and their benefits.

3.1 Evolution of the Green Business Park

Current day green business parks have their roots in industrial ecology. In fact, the early parks were called eco-industrial parks (EIPs) and their functioning has been described as “applied industrial ecology”. The networking of industries close by one another in Kalundberg, Denmark is the first and often-cited example of industrial ecology in practice. There have been variations on the theme as EIPS have developed over the years. A brief review of the evolution of green business parks follows.

3.1.1 Industrial Ecology

Traditional industrial activity could be described as ‘man controlling nature’. It generally took a linear approach, with raw materials used to produce desired goods and waste of various sorts generated in the process. In earlier times, with lower population levels and seemingly endless resources for raw materials (and ‘sinks’ for the wastes), the problems caused by this approach were not readily evident.

In the final decades of the twentieth century, implications of the linear approach were becoming apparent. Issues such as air, land and water pollution, soil erosion, hazardous waste, landfill sites filling up and climate change had to be addressed. This pushed businesses to look at ways to get off the linear path. In the process, it spawned the idea of industrial ecology.

This approach involves trying to ‘mimic nature’ – follow a circular path, or ‘close the loop’ as it is sometimes described. There is no such thing as ‘waste’ in nature. Plant and animal debris and remains become the nutrients for growth and the future in an endless – and sustainable – cycle.

Frosch and Gallopoulos (1989) introduced the concept of industrial ecology in an article in *Scientific American*. They defined an industrial ecosystem as one in which “the consumption of energy and materials is optimised, waste generation is minimised, and the effluents of the process serve as the raw material for another process”.

*Industrial symbiosis* is a complementary term that came into use around the same time. Manahan (1999) described industrial symbiosis as a “highly inter-dependent relationship between firms, exchanging materials and energy in a mutually-advantageous manner, each contributing to the welfare of the other”. Chertow (2007) has defined it to include “physical exchanges of materials, energy, water and by-products among diversified clusters of firms”.

Chertow (2004) suggests that industrial ecology can operate at three different levels:
• At the level of the firm, it encompasses design for the environment, pollution prevention, cleaner production, eco-efficiency and green accounting.
• Across firms, it involves industrial symbiosis, life-cycle analysis and industrial sector initiatives, and
• At the regional/global level, it includes materials and energy flow studies (industrial metabolism) and dematerialisation and decarbonisation.

Gibbs (2007) confirms the key concept in industrial ecology is that processes and industries are seen as interacting systems rather than comprising isolated components in a system of linear flows. He goes on to say, “This provides a basis for thinking about ways to connect different waste-producing processes, plants or industries into an operating web that minimises the total amount of industrial material that goes to disposal sinks or is lost in intermediate processes”.

Architect William McDonough (2002) captured the idea nicely, saying we want to turn a ‘take-make-waste’ or ‘cradle-to-grave’ economic model into a ‘borrow-use-return’ or ‘cradle-to-cradle’ approach.

As a working definition, Lowe (2001) says that industrial ecology is an approach to managing human activity on a sustainable basis by:
• seeking the integration of human systems into natural systems
• minimising energy and materials usage, and
• minimising the ecological impact of human activity to levels natural systems can sustain.

Its objectives are:
• preserving the ecological viability of natural systems
• ensuring acceptable quality of life for people, and
• maintaining the economic viability of systems for industry, trade and commerce.

These various objectives and processes have contributed to the development of eco-industrial parks – applying industrial ecology across firms.

### 3.1.2 Eco-Industrial Parks

The EIP concept was formalised around 1993 by a loose collaboration of three groups in the U.S. and Canada. Contributors were: Indigo Development, a consultancy in North Carolina; a team of people in the Faculty of Management at Dalhousie University in Nova Scotia; and staff at Cornell University’s Work and Environment Initiative.

In 1994 the U.S. Environmental Protection Agency contracted the Research Triangle Institute (also in North Carolina) and Indigo to flesh out the eco-industrial park idea and carry out a case study. By late 1997, there were reportedly 17 projects in the U.S. calling themselves eco-industrial parks and two had recruited their first tenants. Indigo Development indicates that by 2005 communities in Europe, Asia, Africa, South America and the U.S. had initiated EIPs or other eco-industrial development planning processes.

The (U.S.) President’s Council on Sustainable Development has provided the now well-accepted definition of an EIP as follows…

*An eco-industrial park is a community of businesses that co-operate with each other and with the local community to efficiently share resources (information, materials, water, energy, infrastructure and natural habitat), leading to economic gains, gains in environmental quality and equitable enhancement of human resources for the business and local community.*

Cohen-Rosenthal (2003) notes that eco-industrial parks offer a discrete parcel of land where companies locate for maximum resource efficiency and that they differ in structure and function from traditional business parks.
Table 2 – adapted from the Côté and Cohen-Rosenthal (1998) article in *Journal of Cleaner Production* – compares the traditional approach with EIPs.

### Table 2
**Traditional Industrial Parks v EIPs**

<table>
<thead>
<tr>
<th>Compared to a traditional industrial park, an EIP would …</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define the community of interests and involve that community in the design of the park.</td>
</tr>
<tr>
<td>Reduce its environmental impact through substitution of toxic materials, absorption of carbon dioxide, material exchanges and integrated treatment of wastes.</td>
</tr>
<tr>
<td>Maximise energy efficiency via facility design and construction, co-generation and (energy) cascading.</td>
</tr>
<tr>
<td>Conserve materials through facility design and construction, reuse, recovery and recycling.</td>
</tr>
<tr>
<td>Link companies with suppliers and customers in the wider community in which the complex is situated.</td>
</tr>
<tr>
<td>Strive to continually improve environmental performance of the individual businesses and the community as a whole.</td>
</tr>
<tr>
<td>Have a regulatory system which permits some flexibility while encouraging companies to meet performance goals.</td>
</tr>
<tr>
<td>Use economic instruments which discourage waste and pollution.</td>
</tr>
<tr>
<td>Employ an information management system which facilitates the flow of energy and materials within a more or less closed-loop.</td>
</tr>
<tr>
<td>Train and educate managers and workers about new strategies, technologies and tools to improve the system.</td>
</tr>
<tr>
<td>Orient marketing to attract companies which fill niches and complement other businesses.</td>
</tr>
</tbody>
</table>


Ayres (1995) suggests that an industrial ‘ecosystem’ (EIP) would involve at least one major firm exporting raw or processed materials, connected to one or more firms capable of utilising significant portions of the waste streams of the ‘anchor’ industries. These, in turn, would be linked to several ‘satellite’ businesses converting wastes into useable products.

Lowe and Warren (1996) note that an EIP may include many of these features, but that the crucial feature is the interactions amongst the businesses and between the businesses and the natural environment.

Finally, Lowe (2001) confirms the multi-faceted nature of EIPs, noting that they require the integration of engineering, architecture, urban planning, real estate development, landscape design and ecology, economic development, information systems design and business management.

### 3.1.3 Kalundborg – The First Example

The example of Kalundborg is one of industrial symbiosis – involving a number of closely located industries and the city itself – and, therefore, not specifically an EIP. However, it is an excellent example of applied industrial ecology, thus relevant to EIPs.
The UNEP (2001) case study notes that Kalundborg is often quoted in the literature “because it is simple enough to allow the idea of an industrial ecosystem to be appreciated, yet sufficiently sophisticated to give a feeling for the enormous potential of this approach”. Efforts in Kalundborg began in 1961 with a project to use surface water to reduce the draw on limited groundwater resources. The initial collaboration saw the city build a pipeline from a nearby lake to a new refinery with the work financed by the refinery’s owner. From this initial effort, various other collaborative projects have occurred and the number of participating partners has increased. Hence, the industrial symbiosis evident here has been ‘self-organised’ over a number of years – not pre-planned from scratch.

In addition to several smaller companies participating as recipients of materials or energy, the ‘ecosystem’ consists of six main partners:

- a (coal-fired) power station producing electricity
- an oil refinery
- a biotechnology company producing insulin and industrial enzymes
- a company manufacturing plasterboard for the building industry
- a soil remediation operation, and
- the City of Kalundborg.

The various partnerships, providing economic and environmental benefits, have included:

- purified wastewater and used cooling water from the oil refinery to supply the power station
- steam from the power station supplied to the refinery and biotech company for heating of their processes
- excess refinery gas treated to remove sulphur and sold as a raw material for the manufacture of sulphuric acid
- clean gas from the refinery supplied to the power station and plasterboard plant as an energy source
- the power station’s install of a desulfurisation unit to remove sulphur from its flue gases allowing the production of calcium sulphate (gypsum), the main ingredient in the production of plasterboard
- purchase of this synthetic ‘waste’ gypsum by the plasterboard firm replacing the natural gypsum it had to source from Spain
- used bio-mass (containing nitrogen, phosphorus and potassium) from synthetic processes at the biotech firm used as fertiliser by local farming communities, and
- residual heat from the power station serving the city’s residential district heating system.

All of the above exchanges have been arranged contractually between the two partners involved. Exchanges adopted are those that have been assessed and deemed financially worthwhile. Eighteen such projects costing a total of $75 million are estimated to have saved $160 million. The payback time for the projects has been less than five years on average.

While the synergies were adopted for economic reasons, the environmental benefits have been significant. These include reductions (in tonnes/year unless noted otherwise) of:

- resources used – coal 15,000, oil 45,000 (barrels)
- waste emissions – carbon dioxide 175,000, sulphur dioxide 10,200

Additional benefits include reduced water use of 600,000 m$^3$/year and use of (former) wastes – sulphur 4,500, calcium sulphate (gypsum) 90,000 and fly ash for cement 130,000 (all figures in tonnes/year).

Critics of Kalundborg as an example of eco-industrial networking or as a model for EIP development say that it’s not very ‘eco’ (given the types of industries participating) and that it involves a few heavy industries, thus limiting its application. To this, the founders of the Kalundborg system readily say that it is the relationships they formed that are a key to its success, not necessarily the pipes. (Cohen-Rosenthal, 2003)
3.1.4 Subsequent Developments

Eco-industrial parks, as noted above, focus on resource efficiency via energy and water cascading and waste minimisation through by-product exchanges amongst nearby businesses. Purists in the industrial ecology field contend these sorts of interconnections must exist if the complex is to be accurately labelled an EIP.

But there are many other design features – and operating activities – of business parks that contribute to sustainability. The term ‘sustainable business park’ has often been used to label developments that incorporate these broader features.

As noted in Part 1 of the report, the term ‘green business park’ (GBP) has been adopted for our purposes to denote the same thing. To repeat the definition …

*A green business park is a real estate enterprise developed and managed to strive for high environmental, economic, and social benefits as well as business excellence.*

Table 3, developed in its original form by the Cornell University Work & Environmental Initiative, includes a wide range of possible network opportunities in a green business park.

<table>
<thead>
<tr>
<th>Cooperation Area</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>Common buying, customer supplier relations, by-product connections, creating new material markets</td>
</tr>
<tr>
<td>Energy</td>
<td>Green buildings, energy auditing, cogeneration, alternative fuels</td>
</tr>
<tr>
<td>Production Processes</td>
<td>Pollution prevention, scrap reduction and reuse, production design, common subcontractors, common equipment, technology sharing and integration</td>
</tr>
<tr>
<td>Transportation</td>
<td>Shared commuting, shared shipping, common vehicle maintenance, alternative packaging, intra-park transportation, integrated logistics</td>
</tr>
<tr>
<td>Marketing</td>
<td>Green labelling, accessing green markets, joint promotions (e.g. advertising, trade shows), joint ventures, recruiting new value-added companies</td>
</tr>
<tr>
<td>Information Systems</td>
<td>Internal communication systems, external information exchange, monitoring systems, computer compatibility, joint system for park management</td>
</tr>
<tr>
<td>Human Resources</td>
<td>Recruiting, wellness programs, joint benefit packages, common needs (payroll, maintenance, security), training, flexible employee assignment</td>
</tr>
<tr>
<td>Environment, Health and Safety</td>
<td>Accident prevention, emergency response, waste minimisation, shared environmental information systems, joint regulatory permitting</td>
</tr>
<tr>
<td>Quality of Life and Community Connections</td>
<td>Integrating work and recreation, cooperative education opportunities, volunteer and community programs</td>
</tr>
</tbody>
</table>

Source: Cornell University Work & Environmental Initiative website
Many of the features listed under Materials, Energy and Production Processes in the table are consistent with EIP developments. Other features under Transportation, Marketing, Human Resources, and Environment, Health & Safety, for example, show the richness of opportunities for green business park developments.

Strategies for developing GBPs and their many possible elements are considered in greater detail in the next section. Examples of operating parks appear in Part 3 of the report.

For now, it is simply worth noting that successful development of a GBP begins with an open attitude and approach. Edward Cohen-Rosenthal, in his book *Eco-Industrial Strategies* (2003) notes that good things evolve from applying three basic principles:

- Always ask how to achieve business and environmental excellence in the same breath.
- Always look for mutually-beneficial connections with and among businesses, materials, energy, natural systems, markets and the local community.
- Think systemically, experiment locally.

Green business parks can be developed in urban or rural areas. They could include a range of heavy industries, a mixture of business types or a focus on one industry sector. They can be developed with varying degrees of public sector support and community involvement. Every situation is different and needs to be assessed on its own merits.

### 3.2 Development Approaches & Park Elements

Various strategies and approaches have been followed in developing business parks striving for sustainability. This is covered briefly in the first section here, followed by a look at the range of elements that can help ‘green’ a business park.

#### 3.2.1 Strategies & Approaches

In the early development of eco-industrial parks, a number of models were proposed with different starting points – ranging from bare land through to redevelopment of a fully-functioning industrial park. These models are summarised in Table 4 based on information from Chertow (1999) and Lowe (1999). The table notes the approach taken and the likely stakeholders involved.

<table>
<thead>
<tr>
<th>Type of Model</th>
<th>Approach</th>
<th>Initiators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex-Nihilo</td>
<td>Designing an EIP on a greenfield and “out of nothing”</td>
<td>Public entity, Developer</td>
</tr>
<tr>
<td>Anchor Tenant</td>
<td>Identifying an existing/interested “core-company” and designing the EIP, complementing the “anchor” with a network of businesses to supply materials/use by-products</td>
<td>Public entity, Developer, Company</td>
</tr>
<tr>
<td>Business Stream</td>
<td>Attracting a number of tenants in order to develop a certain area and then facilitate network linkages</td>
<td>Developer</td>
</tr>
<tr>
<td>Stream</td>
<td>Analysing different material/resource flows in an existing industrial system and creating an EIP by networking the users of complementing streams</td>
<td>Public entity, Developer, Companies</td>
</tr>
<tr>
<td>Business Stream</td>
<td>A combination of the above two models: analysing flows in an existing system, networking users and attracting additionally needed businesses to an available development area</td>
<td>Public entity, Developer, Companies</td>
</tr>
<tr>
<td>Redeveloping</td>
<td>Analysing material and energy flows, communication gaps/possibilities of collaboration in a fully-established industrial park, enhancing environmental performance, presenting possibilities of improvement and facilitating communication</td>
<td>Public entity, Companies, Park mgmt</td>
</tr>
</tbody>
</table>
Regardless of the starting point, development of EIPs – and green business parks generally – must be viewed as a continuum which takes place in different overlapping steps beginning with environmental performance addressed at the company level. (Fleig, 2000)

Five scenarios have been suggested by the Research Triangle Institute (2000) as follows:

• **Baseline** – settling in of initial park members/residents
• **Pollution prevention (P2)** – members implement their own pollution prevention measures
• **P2 + industrial symbiosis** – members develop symbiotic relationships with other members (and potentially with remote partners)
• **New members** – new symbiotic relationships develop as a result of new members locating in the park
• **Co-location and joint services** – formerly remote partners locate within the park and the park provides environmental support services.

The scenarios will unfold differently in various settings, but the main point is that – from a strong base of sensitive site design and green buildings – the functioning of green business parks can evolve and grow over time.

To make the park as green as possible, various goals, targets or standards can be set. An example of this is the PALME eco-label for industrial parks in France. PALME (for ‘Programme d’actions labelise pour la maitrise de l’environnement’) goes beyond the cycles, webs and networks of EIPs, establishing a range of actions and steps required to earn the label. Some of the key elements are listed in Table 5.

<table>
<thead>
<tr>
<th>Table 5</th>
<th>Some Elements of the PALME Label for Industrial Parks in France*</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Prepare a site development plan, and have available the relevant regulations and guidelines.</td>
<td></td>
</tr>
<tr>
<td>• Prepare an initial baseline “State of Environment” report for the site.</td>
<td></td>
</tr>
<tr>
<td>• Establish a landscaping plan and architectural requirements for buildings.</td>
<td></td>
</tr>
<tr>
<td>• Ensure compliance with (environmental) regulations and by-laws and adherence to operational guidelines.</td>
<td></td>
</tr>
<tr>
<td>• Establish and implement a plan for natural flora and fauna to maintain or re-establish the ecological balance of the site.</td>
<td></td>
</tr>
<tr>
<td>• Implement a public awareness and information programme concerning the natural environment and conservation.</td>
<td></td>
</tr>
<tr>
<td>• Establish an advisory service for clean technologies.</td>
<td></td>
</tr>
<tr>
<td>• Develop and implement a “clean construction site” programme.</td>
<td></td>
</tr>
<tr>
<td>• Establish a plan for solid waste management.</td>
<td></td>
</tr>
<tr>
<td>• Establish a plan for industrial wastes and effluents.</td>
<td></td>
</tr>
<tr>
<td>• Establish a plan for management of rainwater and surface run-off and construction of any necessary installations.</td>
<td></td>
</tr>
<tr>
<td>• Advise enterprises on noise reduction measures and materials for buildings and machinery.</td>
<td></td>
</tr>
<tr>
<td>• Monitor site air quality and noise.</td>
<td></td>
</tr>
<tr>
<td>• Establish an energy management plan for the site.</td>
<td></td>
</tr>
<tr>
<td>• Investigate alternative energy sources.</td>
<td></td>
</tr>
<tr>
<td>• Establish a liaison mechanism with relevant local authorities.</td>
<td></td>
</tr>
<tr>
<td>• Establish a monitoring and co-ordination unit for the above.</td>
<td></td>
</tr>
</tbody>
</table>

This series of requirements to earn the PALME label in France can serve as a useful checklist for developing green business parks regardless of location.

### 3.2.2 Infrastructure Elements

A number of sources provide helpful information on park infrastructure, including the Research Triangle Institute (2000), Lowe (1998, 2000 and 2001) and Mitchell (2002). (Appendix B provides details on these sources.) While some of the infrastructure options are complex (particularly those relating to energy) and perhaps more than will be implemented in many business parks, it is important to document the possibilities. All options can then be considered in the development of any particular site.

Design of green business parks differs from traditional industrial parks since an important goal is to integrate options that will minimise environmental impact of the infrastructure – and the operations they support – while meeting technical, financial, and logistical requirements of the companies involved. The park must also be designed with enough flexibility that the infrastructure will not become obsolete as the park evolves.

Table 6 outlines some important design strategies set out in the early years of eco-industrial parks, but they apply equally to the more broadly conceived green business parks. (The table references green building design and park management activities in addition to infrastructure issues.)

### Table 6
**Strategies for Designing Eco-Industrial Parks**

<table>
<thead>
<tr>
<th>Strategies for Designing Eco-Industrial Parks*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Integration into Natural Systems</strong></td>
</tr>
<tr>
<td>• Minimise local environmental impacts by integrating the EIP into the local landscape, hydrologic setting and ecosystem.</td>
</tr>
<tr>
<td>• Minimise contributions to global environmental impacts, e.g. greenhouse gas emissions.</td>
</tr>
<tr>
<td><strong>Construction/Rehabilitation</strong></td>
</tr>
<tr>
<td>• New construction, or rehabilitation of existing buildings, follows best environmental practices in materials selection and building technology. These include recycling or reuse of materials and consideration of life-cycle environmental implications of materials and technologies.</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
</tr>
<tr>
<td>• Maximise energy efficiency through facility design or rehabilitation, co-generation, energy cascading and other means.</td>
</tr>
<tr>
<td>• Achieve higher efficiency through inter-plant energy flows.</td>
</tr>
<tr>
<td>• Use renewable sources extensively.</td>
</tr>
<tr>
<td><strong>Water</strong></td>
</tr>
<tr>
<td>• Design water flows to conserve resources and reduce pollution through strategies similar to those described for energy and materials.</td>
</tr>
<tr>
<td><strong>Materials Flows &amp; ‘Waste’ Management</strong></td>
</tr>
<tr>
<td>• Emphasise pollution prevention, especially with toxic substances.</td>
</tr>
<tr>
<td>• Ensure maximum re-use and recycling of materials among EIP businesses.</td>
</tr>
<tr>
<td>• Reduce toxic materials risks though integrated site-level waste treatment.</td>
</tr>
<tr>
<td>• Link the EIP to companies in the surrounding region as consumers and generators of usable by-products via resource exchanges and recycling networks.</td>
</tr>
</tbody>
</table>
In addition to standard park service, recruitment, and maintenance functions, park management should:

- Maintain the mix of companies needed to best use each others’ by-products as companies change.
- Support improvement in environmental performance for individual companies and the park as a whole.
- Operate a site-wide information system that supports inter-company communications, informs members of local environmental conditions and provides feedback on EIP performance.

* Adapted from Lowe et al. 1998.

‘Integration into natural systems’ in the table implies careful and sensitive site design and development. ‘Construction/rehabilitation’ relates to the individual buildings/facilities in the park, which is addressed in detail in Part 2 of the report.

The remaining options in the table cover key infrastructure issues, such as energy, water and materials/waste. Consideration of these during the design phase will ensure that the needs of tenant firms are met in a cost-effective manner. Savings are possible – in capital costs and in operating costs over time.

**Energy.** Efficient energy use can be a major strategy for cutting costs and reducing the environmental impact of individual facilities and the park as a whole. This could involve cogeneration, waste heat recovery and district heating and cooling.

*Cogeneration,* also known as combined heat and power (CHP), is the simultaneous production of power (electrical or mechanical) and heat from the same fuel or energy. Cogeneration facilities produce electricity and use the ‘waste’ heat to generate steam for water heating, space heating or other thermal needs. This creates a series of material and energy flows for exchange – with the cogeneration plant able to provide electricity, steam and demineralised water to various manufacturing processes. A major benefit of cogeneration is that it produces a given amount of electric power and process heat with less fuel – some sources say by as much as 30 to 50% less – than it takes to produce the two separately.

*District heating and cooling* is also possible (as in the Kalundborg ‘ecosystem’) with residual energy from industrial processes used to meet the space heating, domestic hot water and cooling needs of residential and commercial customers. In district energy systems thermal energy, in the form of hot water, steam or chilled water, is distributed by underground pipes from central plants to individual buildings. Energy is extracted at the buildings, with return pipes bringing water back to the plants to be heated or cooled again.

These are all forms of *energy cascading* which improve efficiency and reduce costs and emissions. Beyond this, as technologies improve and prices come down, some sites may even get to partial- or self-sufficiency with concentrating solar power (CSP) or micro-wind technology, for example. Small systems relying on renewable energy ought to be explored in every situation to determine viability.

**Water.** Objectives for the water system infrastructure should be to minimise demand on external water supplies, promote efficient use of water within the park, encourage water reuse through water cascading and wastewater management, and manage stormwater in an ecologically ‘friendly’ manner.

*Water-use efficiency* can be addressed by individual tenants via water-saving technologies and practices for ‘service’ water (in basins, toilets, showers, etc.) and proper management of water used in processing/operations. Regular water audits can lead to efficiencies in process water use (including in cooling towers).
Recycled water can serve different water needs as long as it is adequately treated to ensure water quality appropriate for the use. While water is often thought of in two categories (potable and non-potable), several grades of water could be provided in a green business park, depending on the needs of firms involved and the economics of reuse. Tiers of water reuse include:

- ultra-pure water (for use in making semi-conductor chips, for example)
- de-ionised water (for use in biological or pharmaceutical processes)
- drinking water (for kitchens, cafeterias, water fountains, etc.)
- wash water (e.g. to clean delivery trucks and buildings) and
- irrigation water (for lawns and gardens).

Reuse within any one facility can take a number of forms based on the tier structure above. A simple one is the reuse of greywater (from sinks and showers) for toilet flushing or garden irrigation. In terms of reuse from one facility to another, closely-located buildings will reduce the cost of the infrastructure required, but each situation would have to be assessed on its own merits.

Wastewater management. The amount of actual wastewater will be reduced if water-use efficiency and reuse options noted above are taken seriously. The ‘Living Machine’ approach to wastewater treatment (see information on page 19) can be considered and might even be built to serve a number of tenants in a park, thus realising some economies of scale.

Stormwater management goals should be to improve water quality and to reduce the risk of local and downstream erosion and flooding. Ideal management practices would see peak run-off flow rates no greater than run-off rates before site development.

Stormwater systems provide opportunities for innovation and environmentally-sensitive design. Storage mechanisms can include lakes, ponds, rain tanks and even rooftops. Lakes or ponds can serve as settling basins for run-off particulate matter and as site amenities. Collected roof rainwater can serve landscape irrigation and other on-site applications, thus reducing the amount of water going straight to the storm drains.

Green roofs – introduced in Part 2 – can absorb water that would otherwise go direct to storm drains. As noted, green roofs also provide energy-efficiency benefits and help mitigate heat island effects. Surface contouring (natural swales) and porous pavement (in low-traffic or overflow parking areas, for example) are additional ways to reduce stormwater run-off. Taken together, these more natural ways of dealing with stormwater can reduce costs if fewer underground storm sewers need to be installed.

In terms of outdoor/discretionary use of water, native plantings (and water-efficient landscaping) throughout the park can minimise or eliminate the need for irrigation.

Finally, fire protection also needs to be considered in designing the water system to ensure sufficient flow rate in the event of an emergency.

Materials In traditional industrial parks, firms typically manage solid waste materials on their own. In green business parks, many companies view wastes as potential products to be reused within the park or marketed to someone else. To assist with this, the park infrastructure may include a common area for by-products being shifted amongst tenants and for shipments to external customers. It may also have some joint facilities for housing residual (and hazardous) waste as well as common providers for these services.

Transportation. The roading and parking infrastructure of a business park can be substantial. It must be capable of dealing with the movement of goods and people within – and to and from – the park. Various cooperative efforts, such as warehousing (including cool stores), shipping, parking facilities and a common vehicle maintenance depot can all help to reduce the transportation ‘footprint’. So can adequate provision of public transportation and facilities for walking and cycling.
Information. High-quality telecommunication services, including broadband or wireless internet and facilities for video conferencing, are essential elements of a green business park – to attract and properly serve tenants. Good systems for communication within the park are also important to facilitate materials exchanges and other beneficial cooperative efforts as outlined in the next section.

Innovative developers see significant leaps being made, especially with cogeneration and water reuse (via membrane bioreactor recycled water technology). This could give green business parks the ability to be partially or totally independent of conventional trunk infrastructure (especially electricity, water and wastewater). This will be dependent on scale and cost of the technology, but is certainly getting closer as development contributions for the provision of – and connection to – conventional infrastructure continues to increase.

3.2.3 Other Complementary Elements

Table 3 in Section 3.1.4 notes the wide range of elements that make up a green business park and lend themselves to networking and cooperation. While some of them are in the core EIP areas of energy, water and materials exchange, many other opportunities exist as well. A brief description of some of these key elements from Table 3 follows.

Transportation. Beyond the infrastructure elements noted above, cooperative efforts can include shared commuting/car pooling and integrated logistics and transportation (goods shipment) planning.

Marketing. Depending on the make-up of park tenants, there may be opportunities for joint promotions, including advertising and attendance at trade shows, plus other cooperative ventures.

Human resources and office management. Cooperative efforts could result in a central café/dining area, fitness centre/wellness programme, and child care services. There can be joint efforts for staff training and even staff sharing/flexible employee assignments. Companies can also work together to address common needs such as purchasing, payroll, maintenance and security.

Environment, health and safety. Shared accident prevention and emergency response capacity and training will serve employees well and could make it easier to meet needed standards and regulations at lower costs.

Social and community connections. Working together, businesses in the park could make a more significant contribution to community programmes through employee volunteer efforts.

Some of these initiatives individual firms simply couldn’t tackle on their own – or certainly not with the efficiency (and cost-effectiveness) possible when pursued with others. This helps to confirm the point made earlier that each element of an EIP – or green business park – adds value, but together they form a whole greater than the sum of the parts. These are all integral benefits of green business parks, discussed in greater detail in the next section.

3.3 Benefits

Lowe (2001) states succinctly the appeal of industrial ecology and the green approach to business park development, saying, “Developers and communities that create eco-industrial parks seek to build a foundation for industrial development that is more competitive, more efficient and cleaner than traditional industrial parks or regions. In addition new business niches will be opened for recruitment or incubation of new companies that strengthen the local economy”.

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Cohen-Rosenthal (2003), in the introduction to *Eco-Industrial Strategies: Unleashing Synergy Between Economic Development and the Environment*, speaks passionately when he says:

“Eco-industrial development presents an archway to a better future. For business, it offers new avenues for profitable companies. For communities, it leads to more rooted businesses, good jobs and a cleaner environment. For local and global ecosystems, it promises a lighter load on the environment. In some ways, eco-industrialism is the sunny side of the street from doom-and-gloom environmental scenarios. It seeks to uplift, not to commiserate; to connect rather than dismantle. Eco-industrialism doesn’t solve all environmental or business challenges but instead deploys a systemic scan at multiple levels to find and re-find best possible solutions.”

In other work, Cohen-Rosenthal (2001) developed a pragmatic list of the benefits of eco-industrial/green business parks. These are covered in Table 7.

<table>
<thead>
<tr>
<th>... for Business</th>
<th>... for Communities</th>
<th>... for the Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced operating costs (energy, water, materials)</td>
<td>Expanded local business opportunities</td>
<td>Protection of the local environment via site design</td>
</tr>
<tr>
<td>Reduced disposal costs</td>
<td>Recruitment of higher quality companies</td>
<td>Reduced use of resource materials in construction</td>
</tr>
<tr>
<td>Income from sale of by-products</td>
<td>Good jobs, larger tax base</td>
<td>Efficient energy use in operations? reduced emissions</td>
</tr>
<tr>
<td>Improved environmental performance</td>
<td>Partnership with businesses</td>
<td>Efficient water use? protection of freshwater resources</td>
</tr>
<tr>
<td>Business efficiencies</td>
<td>Minimise impact on infrastructure</td>
<td>Sensitive stormwater management? reduced risk of erosion and flooding</td>
</tr>
<tr>
<td>New initiatives possible</td>
<td>Enhanced quality of life in areas near the development</td>
<td>Efficient movement of people and goods? lower emissions and congestion</td>
</tr>
<tr>
<td>Positive impact on employee health and productivity</td>
<td>Generally improved environment and landscape</td>
<td>By-product exchange and reuse? lower draw on natural resources and less waste to landfill</td>
</tr>
<tr>
<td>Enhanced corporate image</td>
<td>Community pride</td>
<td>Provision of reserves, tracks, etc.</td>
</tr>
</tbody>
</table>

* Adapted from Cohen-Rosenthal (2001)

Further discussion of the benefits of green business parks is included in the following sections under the headings:

- Business efficiency and profitability
- Community stability and amenity
- Environmental stewardship, and
- As a real estate development.
This information builds on the extensive outline of benefits of green buildings in Part 2 of the report. The benefits to green business park tenants come from the potential synergies and cooperative efforts made possible by the close association of participating businesses.

### 3.3.1 Business Efficiency & Profitability

The benefits to businesses in the Kalundborg ecosystem (described in Section 3.1.3) are significant. As noted in the case study, 18 by-product exchanges between participating companies had a net benefit (savings compared to costs) of some $85 million up to the time of the analysis.

In a similar assessment, Chertow (2006) reports major savings by companies in the Campbell Industrial Park in Hawaii via inter-firm sharing. The park houses large industries – a cogeneration plant, two oil refineries, a cement plant, a quarry and a recycling company. The networking also involves the City Board of Water Supply and the wastewater treatment plant (WWTP) run by Veolia.

In all there are eight players, with seven materials involved in exchange. Sample economic benefits (after the initial investment) include an annual net gain of:

- $1.73 million to the power plant via avoided cost for landfill
- up to $1 million to the cement company (cost saving of cement and sand substituted by fly ash)
- $250,000 to the quarry in revenue from the power plant for taking fly ash, and
- $100,000 revenue to the WWTP from sales of treated water to the cogeneration plant.

While the above examples show benefits to large industries in significant by-product exchanges, simpler transactions (or cooperative efforts) can reap important benefits as well. CEIN (2003), for example, reports that Mobil in a U.S. park sells styrene to a recycler for 50 cents a gallon where previously it had to pay $1.00/gallon for disposal.

The same source notes that eight firms in a business park in Sarnia, Ontario (housing firms in the same industry) cooperate on emergency response efforts leading to better overall capacity at 35% less cost. In another arrangement, 14 companies have collaborated with the local polytech in the development of new courses. Companies report this has led to a better supply of well-trained staff, higher productivity amongst workers and an improved safety record. It has also created opportunities to involve co-op students in their businesses and resulted in lower overall training costs.

Section 3.2.3 described a range of elements that can come together in a green business park and with each of these benefits can accrue. Benefits can be in the form of operational efficiencies and direct cost savings. They can come through key areas such as employee morale, productivity and retention (as covered in more detail in Part 2). And they come in the form of ‘intangibles’ like enhanced corporate image for being involved in a venture with a true commitment to sustainability.

### 3.3.2 Community Strength & Amenity

Beyond the businesses directly involved, communities that promote and develop green business parks stand to benefit as well. As a point of competitive advantage, a green business park has the potential to attract (and retain) innovative businesses, leading to both more jobs and a larger tax base.

Green business parks, by their nature, help to protect quality of life in the community. Through sensitive design, infrastructure needs will be more modest and the potential impact of such things as traffic congestion and air and water quality can be properly addressed. Green business parks can reduce or end what is often thought of as a ‘conflict’ between the economy and the environment. Quite simply, green business parks can be easy neighbours to live with.
3.3.3 Environmental Stewardship

Direct environmental benefits from inter-firm sharing are clear and unequivocal. The Kalundborg example (in Section 3.1.3) shows annual reductions in resource use and waste emissions into the tens of thousands of tonnes per year – 175,000 tonnes of CO₂ emissions alone.

The economic benefits cited in Section 3.3.1 for the industrial park in Hawaii (Chertow, 2004) resulted from actions that brought direct environmental benefits as well. Exchange arrangements between firms have led, for example, to annual CO₂ emissions reduction of some 2,800 tonnes (from avoided cement production), 3,500 tonnes of avoided virgin sand extraction and a landfill space saving of more than 51,000 cubic metres.

Every time resources or materials are used instead of going to waste – or used more than once before being discarded or needing treatment – the environment benefits.

The environment benefits from the outset when industrial park development incorporates some of the infrastructure elements detailed in Section 3.1.2. It also benefits when complementary elements (noted in Section 3.1.3) are used to good effect in day-to-day operations.

It’s evident from all of this that ‘going green’ in business park development has multiple benefits – economic, community (social) and environmental. These are the pillars of sustainability and any one step or action has a ripple effect with benefits sometime resulting in all three areas.

3.3.4 Real Estate Enterprise

Developers (and investors) are not left out of the benefits equation when a green approach to business park development is followed. In Part 2 of the report, green buildings are proposed as essential building blocks for green business parks. The potential benefits of green buildings as detailed there are significant – from less time to secure tenants, lower turnover and higher rents to better return on investment and higher building values.

Beyond green design of the buildings making up a business park, there are issues relating to the site itself and to how businesses within the park interact and cooperate.

Maintaining and enhancing natural features of the overall site are important. A major tenant in the Crewe Business Park (described in Part 4 of the report) indicated that attention to the ecology of the site in its design and protection of its natural amenities were major reasons for their choosing to locate there – they were looking for the right ‘environment’. (An Ipsos MORI survey cited in the Crewe case study provided conclusive evidence that hi-tech firms in the UK prefer to locate in business parks with a natural look. Fully 86% of 3,000 companies interviewed considered the crucial factor in any decision to relocate to be a pleasant environment within a business park context.)

Leaving more of the site in an undeveloped state has other advantages. For example, the Innovista Industrial Park (also described in the Part 4) has reduced roading infrastructure from 12% to 7% of the total area via design measures and planned eco-industrial networking activities. This 58% reduction is in line with Cohen-Rosenthal’s (2003b) estimate of a 66% reduction in asphalt requirements in his Quantum Connection Eco-Park prototype. Similarly, a reduction in stormwater infrastructure is possible if site features such as swales and wetlands are employed to good advantage.

Both of these design elements can reduce the developer’s capital cost and bring benefits to businesses located in the park and the surrounding community. The bottom line? Added value at lower cost.

In terms of park operations, eco-industrial networking and other cooperative efforts of firms (described in Sections 3.2.2 and 3.2.3) can reduce their costs, improve efficiencies and
enhance their stature. There is value in all of these outcomes, which will be shared by the innovative developer providing the necessary facilities and features that allow them to happen.

Section 4.2.2 notes some actions developers need to take in order to capitalise on these opportunities. Cohen-Rosenthal (2003b) suggests it starts with a ‘mind set’ with developers “moving beyond selling space to providing functionality, flexibility and service to the client”.

Being proactive can help. As Cohen-Rosenthal notes, “By taking an eco-industrial approach to development and communicating benefits effectively, the time it takes to win approval from the community and various permitting agencies can be dramatically reduced – turning NIMBY (‘not in my back yard’) into enthusiasm for well-designed, community and environmentally conscious development. This has real financial implications in terms of time to market and cash requirements but also makes life easier for the developer and the potential tenants”.

These are all steps in the right direction. The idea of ‘future proofing’ New Zealand’s commercial property via green building features was introduced in Part 2. With the increasing concern for the environment and government efforts around sustainability, the same can be said for business parks. Going green is really about building the business parks of the future – today.
4 Green Business Parks ... In practice

“*The building industry has a key role to play in the creation of a sustainable society... What makes the need for change in the building sector so urgent is that buildings last a long time. Once a structure is completed, it is harder and less economical to reduce its energy and water use and to improve its air quality than it is to design from scratch for efficiency and health*”.
– Worldwatch Institute

Green business parks put the theory of industrial ecology and the principles of sustainability into practice. They can vary widely in design and operations, but all of them deliver environmental, economic, and social benefits – in varying degrees – to the resident businesses and the communities in which they are located.

This section provides some ‘on the ground’ examples of green business parks in different locations, including the United Kingdom, North America and Asia. These brief ‘case studies’ are followed by a review of factors that can work for or against going green when developing new business parks or initiating eco-industrial efforts in established areas.

4.1 Examples

These green business park examples have been chosen to demonstrate the variety of approaches possible – and the range of benefits that can result. Some of the key features and issues covered in the examples are as follows:

- **Crewe Business Park** (UK) – Ecological policy, protection of natural features of the site, support/expertise of a local environmental trust, ‘environment’ as a key reason for businesses locating there.

- **Burnside Industrial Park** (Eastern Canada) – Strong municipal government support, standards and covenants governing park development, catering to SMEs, Eco-Efficiency Centre clearinghouse and business support, by-product exchange (recover, rental, remanufacture, repair, recycle and reuse), major corporate partners/supporters, funding from several levels of government.

- **Devens Community Development** (USA) – Site reclamation, joint state-local effort, financial incentives for building green, by-product exchange with surrounding region, EcoStar environmental achievement and branding programme.

- **Naroda Industrial Estate** (India) – Active association of resident businesses, baseline audits, and co-operative efforts leading to technology innovation, product recycling/reuse, reduced waste to landfill, environmental protection, and job creation.

- **Tilbury Industrial Area** and **Innovista Industrial Park** (Western Canada) – For Tilbury, potential reductions in the use of natural gas, electricity and water, plus lower wastewater generation (with significant resultant cost savings). For Innovista, ‘eco-industrial’ zoning and development guidelines for a greenfield site, reduced road requirement via planning and shared services, natural and constructed wetlands for stormwater management, wildlife protection and retention of on-site recreational trails, and grants and low-interest loans from government sources.

Source information on the case study examples is included in Appendix C.

4.1.1 Crewe Business Park

Crewe Business Park is situated in the Crewe and Nantwich Borough (population 114,000) in the North West of England. It is central to the transport infrastructure of the area, near the M6 motorway, the main train station in Crewe and the Manchester Airport.
The 27-hectare park site is owned by the Crewe and Nantwich Borough and the Cheshire County Council, with sections for businesses provided on a long-term lease basis. From its inception in 1987, development of the park has been governed by a strong ecological policy that protects the natural features of the site.

This approach was partly a response to business parks “of the high-density pagodas and clipped lawns variety” which the Crewe Business Park marketing team found when looking at other developments in the area while Crewe was in the planning stages.

The park’s ecological policy was established with support of the Cheshire Conservation Trust (a local affiliate of the Royal Society of Nature Conservation). The Trust was asked to assess the ecological interest of the site and make suggestions for management of it to enhance the landscape and benefit wildlife.

Natural features of the property include a brook, ponds, a species-rich grassland and an ancient hedgerow. These have been enhanced with the planting of thousands of native shrubs and trees, native aquatic plants on the edges of ponds, and wildflowers.

The park’s ecological policy has proven its worth. Businesses in the park support the conservation and wildlife plan, and many have created landscape features on their own sections. Swagelok UK – a firm distributing precision industrial vacuum products – singled out the “environment” as a major reason for locating its European headquarters on a 4ha section. A private developer took up another 4ha and erected purpose-built units for tenants including Genus, a division of the country’s Milk Marketing Board.

Europa Scientific has also established its headquarters in the park. The firm produces instruments to trace such things as acid rain and fertiliser run-off used by research scientists around the world. Europa Scientific indicates it is “at home” here because of the park’s unique ecological policy. They say it’s a fitting place for a business such as theirs and one where they are proud to welcome clients and visitors. Other major companies represented in the park include Barclays, Air Products and Focus DIY.

The Crewe Business Park is evidence that a hi-tech site can be developed in harmony with wildlife and its natural habitats. It has been recognised with a number of awards, including a Millennium Marque for Environmental Excellence in 2000, one of just two business parks in the United Kingdom to receive this.

4.1.2 Burnside Industrial Park

Burnside Industrial Park is in the Halifax Regional Municipality (population 384,000) in Nova Scotia, Canada. The park covers 1,200 hectares (about 80% currently developed) and is home to some 1,300 businesses with a combined 17,000 employees. It is serviced by road, rail and sea.

The park was established in the early 1970s. The municipal government is responsible for the park. It sets the standards and enforces bylaws, provides roading, water, and sewer infrastructure, and sells land to developers. Electricity, gas and telecommunication services are provided by the private sector.

Burnside caters mainly for light manufacturing, distribution and commercial activities. One section is designated as a ‘business park’ and includes computer, health, and technology companies. Another section has attracted a number of large trucking companies and their maintenance depots. The great majority of businesses are SMEs, employing anywhere from a few up to 50 people.

The Halifax Regional Municipality provides a strong support base for activities in the park. The municipality’s solid waste management system is considered one of the most sophisticated in Canada. In addition, it is a member of the Partners for Climate Protection, a programme of the Federation of Canadian Municipalities with a goal of reducing greenhouse gas emissions to 20% below 1990 levels.
In the early 1990s, researchers from Dalhousie University’s Faculty of Management got involved to examine and help develop eco-industrial initiatives at Burnside. This was supported by increasingly strong development standards for the park. The stated objectives of the standards and covenants applying to the park’s development are:

- to protect property values and enhance the investment of businesses located in the park by providing a well-planned and well-maintained development
- to create an attractive and efficient business environment through sound land-use, planning and environmental management standards, and
- to ensure harmonious relationships among uses.

In 1998, an Eco-Efficiency Centre was established in the park, with Dalhousie University and Nova Scotia Power Inc. (the province’s electricity utility) as the major partners. Funding support for the first three years of the Centre’s operations was provided by Canada’s three levels of government (federal, provincial and local).

The Centre is described as an information clearinghouse and networking mechanism. Companies in the park are encouraged to join the Centre’s ‘Eco-Business Program’ which sees them adopting an environmental code and setting waste reduction and conservation goals. The Centre conducts reviews to help companies find energy, water, and materials conservation opportunities.

The Centre provides further support, including:

- eco-efficiency fact sheets on a wide range of topics
- educational signage
- access to resources/expertise and to library and Internet searches
- a website, a quarterly newsletter, and ‘The Burnside Ecosystem’ column in Burnside News, the park’s monthly newspaper
- a ‘Greening Your Business’ starter kit, and
- various educational and promotional activities.

The Burnside industrial ecosystem has developed over the years, with a range of firms now serving as ‘scavenger’ and ‘decomposer species’ within the boundaries of the park. Examples of these activities (and items) include:

- Recover – fine paper, glass bottles, metals, batteries and chemicals
- Rental – construction and communications equipment, tools and uniforms
- Remanufacturing – toner cartridges, furniture, tire retreading and automotive parts
- Repair – electronic equipment, furniture, cars and trucks
- Recycling – solvents, paint and waste oil, and
- Reuse – packaging, tools and building materials.

Businesses are also connected to several resource exchange programmes beyond the boundaries of the park. These include a province-wide (online) waste exchange, a computer hardware recycling programme, a chemical exchange managed by Dalhousie, and a food recovery programme through a local food bank.

As the remainder of the park is developed, the covenants noted above will ensure aesthetic and environmental protection. Covenants apply to architecture, landscaping, signage, protection of natural areas (in particular streams, lakes and wetlands) and a requirement for buffer zones of undisturbed habitat or appropriate green spaces around all watercourses.

4.1.3 Devens Community Development

Devens is located in North Central, Massachusetts, in the United States. The total area is some 1,870ha (covering the former Fort Devens army base closed in 1991), with about 725ha slated for development. The remainder includes open space lands, an award-winning “sustainable certified” golf course and land added to the Oxbow National Wildlife Refuge. Due to its previous use, it was listed as a U.S. Superfund Site with extensive clean-up and reclamation required as a part of the development process.
The site was turned over to the state in 1996. It is owned by MassDevelopment, with the Devens Enterprise Commission (DEC) serving as the permitting and regulatory authority. A unique feature of the redevelopment is the one-stop permitting process via DEC’s unified development permit. New projects are permitted within 75 days and the entire Devens project has been pre-permitted through the Massachusetts Environmental Policy Act.

To encourage the reuse and renovation of existing buildings, a 21-day approval period is provided. For new and renovated buildings, DEC encourages businesses to pursue green building design by offering a grant of up to 15% of the permitting fee (up to $10,000) for any building achieving certification under the U.S. Green Building Council’s LEED scheme.

In 2000, DEC examined ways to further sustainability efforts through eco-industrial networking initiatives. The following were identified as important elements: one or more ‘anchor’ tenants; minor retrofitting of existing infrastructure; strong informal ties between plant managers in the park, and more effective by-product exchange arrangements.

A survey of businesses found the major material flows were corrugated cardboard, paper, plastic, metal scrap and chips, wooden pallets, and machine oil. These materials were being purchased, produced, consumed, used in processing, recycled or discarded. Assessment of four towns in reasonable proximity to the park found there were more than 50 manufacturing businesses – with three-quarters of them producing products from plastic, paper, wood or metal – providing opportunities to broaden and extend the exchange connections.

DEC has also conducted educational sessions about industrial ecology and eco-industrial development, leading to the establishment in 2005 of EcoStar – an environmental achievement and branding programme.

DEC notes that EcoStar was created to:

- strengthen the eco-industrial park concept
- provide businesses with technical assistance
- strengthen communications networks, and
- create linkages among firms, and between the community and firms.

The programme recognises businesses that achieve a certain number of core and optional standards. Businesses that are certified can tie the EcoStar logo to their products and services. By 2006, fully one-quarter of the 80-plus businesses at Devens were members of the EcoStar programme.

Beneficial efforts include: the use of waste oil from Parker-Hannifin Corporation (a manufacturer of motion and control technologies and system) to heat a greenhouse and bioprocessing waste from Novo Nordisk for fertiliser in landscaping. The development’s Public Works Department has found new ways to nurture turf on the sandy terrain of the area’s sports fields. It is producing topsoil made up of decomposed wood chips, yard waste, gelatin and other biosolids that absorb and retain water, in the process reducing water use by 80% and fertiliser costs by 65%.

A 2004 report card on progress noted some significant achievements. These included public and private investments of $118 million and $435 million respectively; 75 businesses established and 3,000 jobs created with a combined $130 million annual payroll. A good example of a successful public-private partnership, Devens was recognised for its efforts with a State of Massachusetts Sustainable Development Award in 2005.

4.1.4 Sites in Asia

Lowe (2003) reports on a number of eco-industrial initiatives in Asian developing countries, including in Thailand, the Philippines, Indonesia and India. He notes that in new developments there are opportunities to ‘leapfrog’ earlier errors of developed countries through application of industrial ecology from the outset.
The **Naroda Industrial Estate** in Gujerat, India – an older estate, established in 1967 – provides a number of useful insights. The estate covers 365ha, hosting about 900 companies providing jobs to 35,000 people. Industry clusters range from ceramics, chemical/paint/dyestuffs and engineering fabricators to wood/wooden articles, textiles manufacturing and food products.

Most companies in the estate are members of the Naroda Industries Association (NIA). The association has a number of active committees, addressing such things as energy, water supply, legal issues and programmes. The association runs a charitable trust hospital and the Naroda Industrial Co-operative Bank provides financing to many of the small businesses in the park.

In 1999, the Gujarat Industrial Development Corporation and the Confederation of Indian Industry provided initial support for research into eco-industrial networking opportunities in the estate. The first step was a baseline survey of NIA members, looking at material, water and energy use. Out of this came a number of networking/reuse projects, including:

- Four companies cooperating to have their chemical gypsum by-product used in the production of concrete. They established a drying area to handle their combined output and recycle 300 tonnes a month that would otherwise have gone to landfill.
- Five companies working together to collect spent acid (H$_2$SO$_4$) to produce ferrous sulphate (FeSO$_4$). Four firms provide the by-product; the fifth has the necessary technology to do the processing. The by-product is provided for recycling at half the usual disposal fee, and new jobs have been created by the processing operator.
- Fifteen firms in the ceramic industry have found ways to work together to ensure purity of their input materials and jointly develop a testing laboratory.

Other cooperative efforts serving NIA members are a common effluent treatment plant and solid waste site and the Naroda Enviro Networking Centre.

### 4.1.5 Other Developments

Two more recent developments in Western Canada add to the body of information supporting the green business park approach. One involves planning efforts for eco-industrial networking in an established industrial area; the other is development of an EIP from scratch on a greenfield site. (Eco-Industrial Solutions, 2007)

The **Tilbury Industrial Area** is in Delta in the Greater Vancouver Regional District (GVRD), British Columbia. It comprises about 830ha and is home to some 620 businesses in sectors ranging from cement and metal manufacturers to wholesalers and distributors.

Looking for ways to reduce infrastructure demand and costs and improve environmental quality, GVRD Policy and Planning Division retained consultants to examine the potential benefits of eco-industrial networking. Following an initial assessment of six industrial areas, Tilbury was chosen for an in-depth review. The study showed the potential for significant material, energy and financial savings, including:

- 26% reduction in natural gas consumption (savings $2.4 million annually)
- 37% reduction in electricity consumption (saving $4 million annually)
- 25% reduction in both potable water use and wastewater generation
- 25% reduction in truck trips (= 200,000 trips/year)
- elimination of 15,000 tonnes CO$_2$ emissions per year.

A workshop for resident businesses presented the eco-industrial networking opportunities and noted the environmental importance of such an effort. (Tilbury is flanked on one side by the Fraser River, important for salmon spawning, and on the other side by Burns Bog, a unique and globally significant wetlands ecosystem.)

The Fraser Basin Council has become involved in support of the initiative and ongoing efforts include strategic planning and gaining support from additional businesses.
In Hinton, Alberta, a town of 10,000 located 280 km west of Edmonton, a detailed planning process has led to development of **Innovista Industrial Park**, with sections in Phase 1 of the project now available. Billed as a place “Where the Future Works”, Innovista is the first greenfield eco-industrial park development in Canada.

Total park size is 44ha, with developments of 12, 8.5 and 7 hectares planned in three phases. Each phase of development will include a cluster of sections/buildings with natural areas and green space separating them.

Some of the key features of the park are:
- multiple section sizes to allow for a mix of companies (to facilitate synergies)
- reduced roadways through careful planning and the promotion of shared services such as shipping and parking (7% of developed area v a typical 12%)
- infrastructure and utility corridor design that improves performance and facilitates energy, materials, and wastewater synergies
- natural and constructed wetlands for stormwater management
- protection of a significant portion of the site, with retention of wildlife corridors and existing recreational trails.

A special “eco-industrial” zoning designation has been developed for the park. Innovista is intended as an area that will demonstrate innovation and high levels of environmental and economic performance. To assist with this, the town has created a Green Design Professionals Roster of engineers, architects and project managers conversant with the zoning and development guidelines to assist businesses with their facility design and planning.

The $14 million project has already received a $3.3 million grant and $2.2 million low-interest loan from the Federation of Canadian Municipalities to help pay for it.

### 4.2 Obstacles & Opportunities

The examples in the previous section demonstrate a variety of approaches to green business park development. The unique features of each park and local circumstances would dictate the kinds of challenges faced for development and operations.

Lowe (2000) in his *Fieldbook for the Development of Eco-Industrial Parks* identifies a range of possible challenges for different stakeholders in the process of developing an EIP/green business park. These are listed in Table 8 on the next page.

Some of the challenges are due to the evolutionary stage the EIP/green business park approach. This is still a young discipline. Innovation is necessary given that in many respects these sorts of developments are ‘breaking new ground’. They also require a special partnership of the various stakeholders involved in – and affected by – the development.

Obviously, not every challenge will occur in every situation, but it is a good checklist of the sorts of obstacles that may have to be overcome for successful implementation.

Building on this, TNO (2002) notes a number of factors that can stand in the way of green business parks succeeding. Their list includes: little insight on the part of participants as to the potential benefits and tension between short-term interests (developers, businesses) and long-term interests (governments, communities).
### Table 8
Challenges to Eco-Industrial Park Development

<table>
<thead>
<tr>
<th>Challenges for Communities</th>
<th>Challenges for Potential Resident Businesses</th>
<th>Challenges for the Regulatory Community</th>
<th>Challenges for Developers, Designers and Builders</th>
<th>Challenges for Park Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building local support</td>
<td>• Estimating EIP benefits and costs</td>
<td>• Streamlining zoning, permitting, and other development regulations</td>
<td>• Choosing a site that will maximise EIP benefits</td>
<td>• Managing the design and development process</td>
</tr>
<tr>
<td>• Setting EIP performance objectives for the park</td>
<td>• Determining the right mix of EIP partners</td>
<td>• Adding flexibility to environmental regulations</td>
<td>• Designing infrastructure that incorporates the specialised needs of EIP members</td>
<td>• Recruiting companies for the park</td>
</tr>
<tr>
<td>• Determining the appropriate park ownership strategy</td>
<td>• Finding appropriate technologies</td>
<td>• Developing appropriate technology, promoting technology transfer and providing technical training</td>
<td>• Designing facilities that provide flexibility to allow the EIP to grow and evolve</td>
<td>• Maintaining relationships between companies</td>
</tr>
<tr>
<td>• Developing EIP financing strategies</td>
<td>• Reducing regulatory uncertainty and liability</td>
<td>• Encouraging the exchange of information among EIPs</td>
<td>• Designing buildings that maximise the efficiency of energy and materials</td>
<td></td>
</tr>
<tr>
<td>• Reducing administrative red tape</td>
<td></td>
<td></td>
<td>• Using constructions practices that are consistent with the EIP vision</td>
<td></td>
</tr>
</tbody>
</table>

* Adapted from Lowe (2001)

The whole issue of resource sharing (energy, water, etc.) and by-product exchange (production inputs) is something that resident companies cannot take lightly and can present risks for participants.

Heeres (2004) notes that, in the establishment of exchange relationships, a company could encounter five different kinds of barriers:

- **Technical** – where an exchange is technically unfeasible
- **Economic** – where an exchange might be economically unsound or risky
- **Informational** – the right people do not have the needed information at the right time
- **Organisational** – the intended exchange might not fit the current corporate organisational structure
- **Regulatory/legal** – based on local/national environmental laws and regulations.

Most of these barriers can be overcome if parks are designed and operated in a manner appropriate for the resident businesses and for the community.

The issue of whether a by-product exchange might be economically unsound or risky – for example, a company sourcing ‘waste’ from a neighbour as a raw material for their own production risking loss of this if the supplying company relocates – deserves special mention. Cohen-Rosenthal (2003b) reminds that exchanges are voluntary arrangements between parties most often done on a contractual basis. Nothing is mandatory. As Cohen-
Rosenthal says, “Eco-industrial networking creates its own value-added connections. Participants form those that make sense, demur from those that don’t, and create specific processes between themselves which mine, extract and use productively what is possible”.

4.2.1 Factors for Success

Participation of a number of stakeholders will be important for successful development of any EIP/green business park. Heeres (2004) lists the following as important participants:

- public sector representatives (appropriate levels of government)
- representatives of local companies and potential future tenants
- industry and financial leaders in the community
- practitioners with the full complement of skills needed for the project (e.g. ecology, architecture, engineering and environmental management)
- local Chamber of Commerce
- labour representatives and educational institutions
- community and environmental organisations.

The active participation of potential resident businesses from the initial planning stage has been cited as an important success factor. Once the park is in operation, a formal association of resident businesses can help create the open communication necessary to foster relationships amongst the firms. As Mitchell (2002) points out, material and energy exchanges benefit from close proximity of facilities, but the ‘mental distance’ between firms must also be short.

In general, Lowe (2000) suggests a number of conditions that will help to meet the challenges to green business park success:

- Potential resident businesses must carefully consider the park design options that will maximise their opportunities to benefit from the involvement.
- In supporting park development, government agencies must balance the public interest with industries’ needs.
- Park designers must incorporate design options that balance economic and environmental performance.

Lowe notes that regardless of who owns the park, public-private cooperation is essential. This will help to ensure full benefits for the community as well as for the businesses involved.

4.2.2 Development Leadership

Smith (2003) in his chapter, “The Developer’s Role” in Eco-Industrial Strategies: Unleashing Synergy Between Economic Development and the Environment, says, “Real estate organisations have been one of the last stakeholders to strongly embrace eco-industrial design”. He attributes this to three main reasons:

- The industry has little familiarity with the topic and what it entails.
- Much of the ‘risk’ of sustainable design occurs in the development role, such as its market value and any potential time and cost increases, and the industry avoids adding risk and processes to its already volatile circumstances.
- The primary benefit is perceived to be the inclusion of process participants outside the developer’s role, and thus there is no expected gain under current topic views.

This rationale was offered several years ago but, with the quantum move forward in green building design and construction since then, the developer’s stance of ‘holding back’ can no longer be justified.

Nevertheless, addressing environmental issues is still seen by many as leading only to additional costs. Smith argues that developers need to understand the broader benefits of sustainable (resource-efficient) business and its manifestation in the eco-industrial paradigm. He says that developers – who are at the hub of the process – can step beyond the role of ‘space provider’ into a new role of synthesiser of participants, resources, information and capital.
Smith says, “To assess eco-industrial development opportunities and to implement them effectively, the developer needs to expand interaction ‘upstream’ towards regional economic development, environmental planning and infrastructure planning – as well as ‘downstream’, with greater interaction with businesses in their operations and in real estate management. This is essentially ‘drawing a bigger circle’ around the existing relationships in the industry”.

A practical approach to this is to focus on what Smith calls ‘resource engineering’. In his consulting work in sustainable real estate development, he promote the establishment of a resource engineer position within development firms, with responsibilities for integration of sustainable business methods. Specifically, responsibilities would include:

- education
- formation linkages (with suppliers, customers, government, other businesses, etc.)
- consideration of energy, water, waste and other aspects of sustainability.

He reckons that such a position would pay for itself within a year and generate favourable returns from savings obtained from medium and large projects. An independent position such as this within the real estate development firm needn’t be permanent. It could be eliminated once sustainability is fully understood and truly integrated into the organisation.

Several of the resources listed in Appendix B will be particularly helpful for developers looking for information and advice in this area.
5 Making it Happen
Implementation in the Bay of Plenty

"Aside from language, our desire to build is perhaps the most distinctive thing about humans. Building for us, clever apes, is not just a nesting instinct but the way by which we manifest our ideas and values. The act of building is a form of language that puts us on public display".

– David W Orr, Oberlin College

The intent of the report to this point has been to build a case for green buildings and green business parks and to describe the approaches taken in various settings. It has considered the costs and benefits of ‘going green’ and detailed green design features.

This final section focuses on ‘making it happen’ in the Bay of Plenty. It starts with brief descriptions of model buildings and innovative approaches already evident here. To make it happen on a broader scale, it will be important to do more of the same and build on their example. The report concludes with two checklists for success and some suggestions for the role of key stakeholders.

5.1 Local Models

The case study examples in Parts 2 and 4 of the report document a variety of experiences overseas (plus one building in New Zealand). They were chosen to demonstrate a range of features and approaches relevant to development in the Bay of Plenty, but not to imply we’re short of good examples here at home.

There are some exemplary green buildings in New Zealand, certainly including Meridian Energy’s office in Wellington and the Landcare Research facility on the Tamaki Campus of the University of Auckland. As for business parks, Highbrook in Tamaki East includes many features we’d do well to emulate in our efforts in the Bay, including environmentally-sensitive design of the overall site.

Two recently completed local facilities (Baywave and the Papamoa Library), a retrofit of an older building in the planning stages at the time of writing (Energy Options) and another in the final stages of construction (FiL New Zealand) are fine examples of green design innovation in our own backyard. They are described briefly here as further evidence of what’s possible when sustainability is taken to heart.

Baywave TECT Aquatic & Leisure Centre, completed in 2005, incorporates a number of energy saving and sustainability features driven by Tauranga City Council’s project objectives. A key feature is the use of geothermal bore water to provide most of the heating needs (with re-injection of the water used fundamental to environmental sustainability).

- a ventilation system incorporating run-around coil heat recovery, variable speed fan motor drives and a mixed mode where opening windows are used to introduce outside air over the summer
- a gym displacement ventilation system to allow the area to be maintained at optimum temperature and ventilation rates with minimum energy consumption, and
- power factor correction at the main switchboard to maximise electrical efficiency.

The building design maximises daylight, thus reducing the need for artificial lighting (which includes control systems so lights are only on when needed).

Papamoa Library & Community Centre in Gravatt Road was completed in June 2006. A little over half of its 1,750m² provides for library facilities, with the remainder in community
meeting space and service/reception areas. Council’s design brief called for a low-energy facility. Key sustainability features include:

- East-West orientation to minimise solar gain
- insulated concrete exterior panels, tiled concrete floor and pre-cast internal panels to moderate temperature fluctuations
- large roof overhang and no western windows
- naturally ventilated with microprocessor-controlled window openers based on wind speed and direction, precipitation and air temperature
- high efficiency glazing and high levels of insulation
- “intelligent lighting” on sensors to maximise use of natural light and T5 lighting (providing high light levels with low heat output)
- “roof lanterns” to get natural light deep into the library space
- in-floor heating via water pipes and a heat pump

The facility also includes solar hot water heating and two 5000-litre tanks to harvest roof rainwater for toilet flushing. Stormwater discharge is managed on-site via swales and natural gardens.

Preliminary follow-up assessment shows projected electricity consumption is well within the lowest range for a building of its type in EECA’s Energy Consumption Index. Annual electricity cost savings projections are in the range of $13,000 compared to typical energy use in a building of comparable size and up to $24,000 compared to a high-consumption facility.

Energy Options is retrofitting an office, showroom and workshop space in a 1960s concrete-block building, recently purchased by its parent organisation Eastern Bay Energy Trust, in Richardson Street, Whakatane. As a company that does energy audits and sells and installs quality energy-efficiency products in a range of facilities, it’s a chance for them to truly ‘practice what they preach’.

The 500m$^2$ space will be totally renovated to include:
- full insulation in walls and ceilings
- double-glazed windows
- fit out using environmentally-friendly paints, flooring, carpets, etc.
- rainwater collection for toilet flushing, and
- solar hot water heating.

Once settled into the facility, they intend exploring opportunities for solar heating and cooling.

The plan includes a ‘show and tell’ showroom with stairs to the roof so clients can examine the solar panels. A final unique feature of the building is three interior (open to the sky) atriums which provide extensive natural light throughout the single-story structure. These range in size from 2.5m x 2.5m to 2.5 m x 8.5m. The intention is to place the rain tank in one of the atriums and there is even talk of a vegetable garden in another one (and, of course, a worm bin to complete the cycle).

Fil New Zealand is known for its innovation and high standards in delivering animal health and hygiene products to dairy farmers throughout the country and internationally. This same commitment has been applied to the design of their new company headquarters and manufacturing plant in Portside Drive, Mount Maunganui.

Three years in planning, their new purpose-built facility is arguably New Zealand’s most eco-effective industrial building and even at the forefront internationally. Company directors and managers led the design process, working with local architects and structural engineers. They have created a facility with massive reductions in energy and water requirements compared to ‘standard’ buildings and with attention to solid waste management and roading requirements.
The office area comprises 665m$^2$ with the manufacturing floor and mezzanine covering just under 3,800m$^2$. Features leading to energy use some 80% less than in traditional buildings of a similar size include the following:

**In the office area ...**
- an atrium for natural light and ventilation
- concrete slab floors on both levels bringing reduced cooling demand
- fibreglass wall and roof thermal and acoustic insulation
- reverse cycle regenerative heat pumps (that move heat from warm to cool areas and vice versa)
- solar water heating
- double glazing and window louvers
- compact fluorescent lighting on motion sensors and solar tubes to capture natural light
- light-coloured décor to prevent solar gain.

**In the factory and stores area:**
- Alsynite Topglass cool extreme roofing (with underlying insulation)
- Indal highbay T5 lighting system (on sensors)
- process heating met via heat recovery and a waste oil boiler recovering heat content from a product that would otherwise be disposed of in a liquid waste system
- gravity filling system for manufactured product.

Reduction in water from city supply is even more dramatic – fully 95% below quantities used at their previous site. Two 30,000 litre tanks capture rainwater from the factory roof which is then filtered to provide process water. Condensate from the heating/ventilation system will irrigate the atrium gardens. (Service water for toilet, sinks, etc., in the office comes from Council supply.) FiL examined Niwa historical rainfall records and are confident the system will provide more than their full requirements year round. The system, in turn, reduces stormwater leaving the site by close to 50%.

The same care has gone into solid waste management and transportation planning. Segregation of waste materials at source is accompanied by recycling and reuse of packaging wherever possible. Delivery of raw materials and pick-up of finished products are done at opposite ends of the plant via a one way road around the site. This streamlines the movement of vehicles and completely eliminates any congestion on the street in front. FiL was also able to reduce car park space to 65% below normal Council requirements, based in part on provision of bicycle parking and showers/service area for employees. Finally, there is space held for a future ‘engine room’ when solar and photovoltaics are more economical as an energy source.

FiL’s ‘green’ facility has been built at a 10% premium over a ‘standard’ building – well within the cost range noted in Part 2. Considering only direct operating costs (energy, water, solid waste, etc.), the company anticipates a typical 20-year payback period. Beyond this, they are looking at a productivity gain of 30% based on improved operating flow in manufacturing accommodated by the new design and the enhanced working conditions in both office and plant (these latter benefits of green buildings were also covered in Part 2).

FiL is aiming to raise export sales (currently 15%) to 50% of the company’s total in five years. In a world where more and more international markets are looking at the sustainability credentials of their suppliers, FiL’s green commitment will stand it in good stead.

While many would be consumed by the cost-benefit details of such a project, FiL’s general manager summed up their approach quite simply: “You get one chance in a lifetime to design a new building, and we were going to do it right”.

This FiL example – with its office and manufacturing components – is particularly relevant when considering design in the broader business park setting.
5.2 Steps to Success

With respect to **green buildings** the *Value Case for Sustainable Building in New Zealand*, referenced in detail in Part 2 of the report, provides an excellent checklist for the planning and design process. Table 9 includes a list of recommendations drawn from that report.

**Table 9**
Checklist for Green Building Design & Operations

<table>
<thead>
<tr>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consider sustainable building strategies in the initial briefing of the project.</td>
</tr>
<tr>
<td>Visit sustainable buildings of a similar nature during the development of the brief.</td>
</tr>
<tr>
<td>Select a professional team with a concern for and understanding of sustainable building.</td>
</tr>
<tr>
<td>Encourage an integrated and co-operative design approach.</td>
</tr>
<tr>
<td>Adopt measurement tools throughout the design and construction phases and for the first years of operation.</td>
</tr>
<tr>
<td>Include a suitable budget and allowances for sustainable building.</td>
</tr>
<tr>
<td>Ensure cost advice is on the basis of whole-of-life costs and not just capital costs.</td>
</tr>
<tr>
<td>Investigate external funding available for implementing sustainable building strategies.</td>
</tr>
<tr>
<td>Communicate and market the sustainable building message to all parties including building occupants and users.</td>
</tr>
<tr>
<td>Fine-tune and evaluate the building in use and optimise its continued sustainability.</td>
</tr>
</tbody>
</table>

* Adapted from Fullbrook et al. *Value Case for Sustainable Building in New Zealand*. MfE 2005

Relative to the third last point in the table, there is potential funding support for taking action. EECA, for example, may cost share design auditing and modelling energy-saving strategies for commercial buildings. It also has a low-cost finance scheme for territorial and regional authorities and public agencies for energy-saving technologies implemented in their facilities. (Some jurisdictions offer other incentives. Waitakere City Council, for example, waives the building consent fee if a solar hot-water system is installed.)

Following on from the checklist above, it’s crucial to ensure there is a sensitive approach to development of the building site. This includes how the building fits with any surrounding buildings and the landscape since this contributes to overall urban design which is an important community amenity.

Steps to success for **green business parks** are more complicated, partly because of the potential number of stakeholders and partners involved. There are also more elements to consider in design and operations. These are:

- the natural features and functional layout of the overall site
- green elements of the individual buildings/facilities
- potential eco-industrial networking opportunities of businesses resident in the park
- other possible cooperative efforts of park residents.

Options available under the last two points above are detailed in Sections 3.2.2 and 3.2.3.

Steps for successful implementation of green business parks are noted in Table 10 on the next page.
Table 10
Checklist for Green Business Park Design & Operations

- Consider the ecological characteristics of the site with respect to functional use and protection of natural features.
- Involve the full range of building and landscape professionals – all with a passion for sustainable design – to cover the many facets of development.
- Involve potential park residents in discussions from the outset to explore networking and cooperative opportunities.
- Let the potential networking/co-operative opportunities inform design and layout of the park (e.g. roading, shared facilities).
- Explore energy, water, and waste management opportunities at the site level (e.g. micro wind technology, natural buffers for stormwater control).
- Promote benefits of the green design approach to the community to gain early support.
- Promote the park to complementary businesses to maximise eco-efficiency and sustainability benefits when operating.
- Establish an association of park businesses once it is operational to enhance communication and increase cooperation.
- Strive for public-private cooperation regardless of who owns the park.

Overseas examples show that local authorities play a key (gatekeeper) role in progressing green development in buildings and business parks in their jurisdictions. They do this by creating an environment that encourages and rewards environmentally sustainable design (ESD). Certain policies and incentives work to good effect. Instituting similar approaches in the Bay of Plenty makes good sense. To create a more favourable environment for green buildings and green business parks …

Central government can:
- continue to strengthen policy and legislation that supports sustainable development of the built environment and sustainable business practices generally
- provide grants and/or low-interest loans for facilities and developments that meet certain green design criteria.

Regional government can:
- review resource consent procedures pertaining to land development to ensure applications with strong green ESD features receive appropriate support (e.g. ease of processing, favourable fees)
- as an investment in the region’s sustainability, offer grants or low-interest loans for facilities/developments that meet appropriate green design standards.

Local governments can:
- ensure green design principles are adequately provided for within the planning framework
- review and update codes of practice for engineering works to make sure they embrace ESD
- streamline (and speed) the approval process for applications incorporating ESD
- make sure building impact and development contribution fees take into account the environmental and infrastructure benefits that green buildings and green business parks provide.

Coordination with various government agencies such as Transit New Zealand will be important as well. Green design of business parks can reduce both roading and parking.
space requirements, for example, which is consistent with Transit New Zealand’s quest for sustainable approaches to transportation infrastructure.

Environmental organisations and groups – Department of Conservation, Royal Forest and Bird Protection Society and others – should be natural allies for the green building/business park movement and should be engaged early in discussions.

Finally, Maori involvement and input from the outset is crucial. The environmental sensitivity inherent in green design is a natural ‘fit’ with Tangata Whenua values and gives effect to the practice of kaitaikitanga.

These steps and actions would build on any current policies that include ESD in Council-owned facilities and in design briefs for commercial tenders. It is recognised that policy changes would be necessary for the financial incentives proposed above. To avoid delay in action, it would be important to assure (and inform) developers and businesses constructing their own facilities that funding payments would be retroactive to the time consultation begins on the policies. (The same incentives should be available for facility retrofits and renovations.)

Landowners, developers and property investors take risks in construction projects and the above mentioned changes could encourage more projects to go green. International experience confirms the key role developers play in the process and provides guidance to help the building industry move further in the direction of sustainability.

Where necessary, it will be helpful for developers to:
- gain further understanding of urgent sustainability issues and the role building and construction can play in addressing them
- put more emphasis on whole-of-life costs (v capital costs) in development decisions – recognising the value inherent in green facilities as documented throughout this report
- consider creating a ‘resource engineer’ or ‘sustainability facilitator’ function as a part of the design process – to serve as a champion for innovative green initiatives until such time as sustainability is integral to operations.

Finally, business and community organisations can offer encouragement and support as we move to ‘green’ business and the facilities they occupy to carry on their essential role of providing good jobs and a secure economic base for the Bay of Plenty – now and into the future.
References


Branz.co.nz See “level – the authority on sustainability building” (www.level.org.nz)

BuildingGreen.com, www.buildinggreen.com

Canada Green Building Council, www.cabgc.org


Frosch, R A and N Gallopoulos (1989) “Strategies for Manufacturing”, Scientific American, 9, 144-52.


Green Building Council Australia, www.gbca.org


Green Building Pages, www.greenbuildingpages.com


Green Globe New Zealand, www.greenglobenz.com


International Initiatives for a Sustainable Built Environment (iiSBE), www.iisbe.org


Rocky Mountain Institute, www.rmi.org


Tauranga City Council (2004) *Tauranga Tomorrow – catch the wave: Community Outcomes*.


Tauranga City Council (2007) *Draft City Centre Strategy*.

The Natural Step New Zealand, www.tns.org.nz

The Royal Institute of Chartered Surveyors [RICS] (2005) *Green Value – Green buildings, growing assets*. (See Appendix A for source information)


William McDonough + Partners, www.mcdonoughpartners.com


Glossary

Concentrating solar power (CSP) plants produce electric power by converting the sun’s energy into high-temperature heat using various mirror configurations. The heat is then channelled through a convention generator converting it to electricity.

Cogeneration is the simultaneous production of electricity and heat from the same source. Cogeneration facilities produce electricity and use the ‘waste’ heat to generate steam for water heating, space heating or other thermal needs.

Eco-industrial park (EIP) is a community of businesses that co-operate with each other and with the local community to efficiently share resources (information, materials, water, energy, infrastructure and natural habitat), leading to economic gains, gains in environmental quality, and equitable enhancement of human resources for the business and local community.

Energy cascading is the using of residual heat in liquids or steam from a primary process to provide heating or cooling to a later process.

Environmentally sustainable development (ESD) recognises the need to integrate short- and long-term economic, social, and environmental aspects into the management of human activities including the building environment. In the building environment, it is also referred to as environmentally sustainable design. Some definitions replace ‘environmentally’ with ‘ecologically’. All are referenced as ESD.

Green building incorporates design, construction and operational practices that significantly reduce or eliminate the negative impacts of development on the environment and occupants.

Green business park (GBP) is a real estate enterprise developed and managed to strive for high environmental, economic, and social benefits as well as business excellence.

Industrial ecology is an approach to managing human activity on a sustainable basis by seeking the integration of human systems into natural systems, minimising energy and materials usage and minimising the ecological impact of human activity to levels natural systems can sustain.

Industrial ecosystem is a web or interlinking of businesses where the consumption of energy and materials is optimised, waste generation is minimised, and the effluents of one process serve as the raw material for another process.

Industrial symbiosis refers to the physical exchanges of materials, energy, water and by-products among diversified clusters of firms.

SME stands for small- and medium-size enterprises.

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (World Commission on Environment and Development 1987 definition)

Sustainable development means improving the quality of life while living within the carrying capacity of supporting ecosystems. (World Conservation 1991 definition)

Swales are vegetated areas which can be used in place of curbs, gutters and storm sewer systems to manage stormwater run-off. They can also temporarily hold small amounts of run-off and allow it to seep into the soil.

Volatile Organic Compounds (VOCs) are emitted as gases from certain liquids or solids. They include a variety of chemicals, some of which may have short- or long-term adverse health effects.
Appendix A

Green Buildings ~ Helpful Resources

New Zealand Green Building Council (www.nzgbc.org.nz)
Provides the report: Value Case for Sustainable Building in New Zealand, written by D Fullbright, Q Jackson and G Finlay, published by Ministry for the Environment in 2005. This report includes case studies of five green buildings in New Zealand. The website contains additional case studies, reports, information on the Green Star NZ rating system, back issues of the Council’s Futures newsletter, and other publications including two key documents cited in this report:
• Costing Green: A Comprehensive Cost Database and Budgeting Methodology
• Future-Proofing New Zealand’s Commercial Property for a Sustainable Tomorrow

Branz Ltd (www.branz.co.nz)
Includes the website “level – the authority on sustainable building” (www.level.org.nz)

Green Building Council Australia (www.gbcaus.org)
Provides the report: Dollars and Sense of Green Buildings 2006: Building the Case for Green Commercial Buildings in Australia. The website also contains information on the Green Star rating system and other resources, publications and links.

Canada Green Building Council (www.cagbc.org)
Provides information on the LEED Canada building certification system, green resources, links and an extensive library of case studies.

Priority One (www.priorityone.co.nz)
Includes a PDF copy of A Business Case for Green Buildings in Canada (courtesy of the Canada Green Building Council). It also includes PDF copies of this report and the summaries.

The Royal Institute of Chartered Surveyors (www.rics.org)
Includes the report: Green Value – Green buildings, growing assets, 11 detailed case studies, and summaries of both in PowerPoint slide format.

World Green Building Council (www.worldgbc.org)
Contains a copy of Charles Lockwood’s Harvard Business Review article “Building the Green Way” and a range of other information.

United States Green Building Council (www.usgbc.org)
Offers information on the LEED building certification system, a wide range of publications and an extensive list of green building links.

Green Buildings BC (www.greenbuildingsbc.com)
Provides a wide range of information, including case studies under the headings: Why Build Green? How to Build Green? and Resources.

Green Building Pages (www.greenbuildingpages.com)
Billed as a “sustainable building materials database and design tool for the environmentally and socially responsible designer, builder and client”. Includes a wide range of case studies.

BuildingGreen.com
For information on resources, the monthly Environmental Building News (EBN) subscription newsletters, and more than 180 case studies (including 80+ that are LEED certified).
Appendix B

Green Business Parks … In Theory

Helpful Resources

The References section includes a wide range of publications relating to green business parks. The following sources are particularly helpful:


Appendix C

Green Business Parks ... In Practice
Helpful Resources

Crewe Business Park
www.unepie.org/pc/ind-estates/casestudies/Crewe.htm

Burnside Industrial Park
www.unepie.org/pc/ind-estates/casestudies/Burnside.htm
http://eco-efficiency.management.dal.ca

Devens Community Development
www.devensec.com/sustain-award.html
www.devenssec.com/ecoreport.html
www.massdevelopment.com/re/devens.aspx

Naroda Industrial Estate

Tilbury Industrial Area
www.ecoindustrial.ca/projects/Tilbury_Eco-IndustrialPark.pdf

Innovista Industrial Park
www.eip.hinton.ca

Other

Eco-Industrial Solutions Ltd (www.ecoindustrial.ca) – Case studies, reports and publications on Canadian and International projects.


www. usc.edu/schools/sppd/research/NCEID/Websites.htm