

INDUSTRIALRESEARCH
LIMITED



Annual Report

2007



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developing our
community

Industrial Research Limited's main community of interest is with New Zealand's businesses and we work with major industry groups such as Business New Zealand and NZBio to ensure the industrial sector can take advantage of our research and development expertise.

IRL also has a responsibility to foster a new generation of scientists and works with the education community to give young scientists

work experience through summer internships and to raise the profile of science in general.

IRL recognises too, the significant contribution Māori enterprises make to the economy. As a world-class research provider, we see our role as helping these enterprises make the most of the opportunities presented by R&D to develop products from natural resources – including our native flora and fauna, aquaculture and fisheries – to come up with alternative energy options, and to develop smart technology for the forestry industry.



determining our
economy

Industrial Research Limited has a long history of working with businesses to produce products that meet consumer demand and processes that enhance productivity. These products and processes that evolve from scientific and technological research serve to foster innovation in New Zealand businesses and are the lifeblood of the country's economic development.

As a Crown Research Institute, IRL has a responsibility to ensure that the research programmes it delivers are not only matched to the nation's development priorities but also involve new areas of research that will lead to technologies and applications that form the basis of new industries of the future.

IRL's expertise in strategic research allows New Zealand businesses to increase their competitiveness in global markets while the publicly funded research undertaken feeds into innovative new products and processes that can be commercialised to ensure New Zealand's future economic growth.



investing in our
environment

Industrial Research Limited's core business is research and consultancy and the commercialisation of products and services from its scientific discoveries and inventions.

We are uniquely positioned to undertake research that will lead to new technologies that can contribute, nationally and internationally,

to environmental sustainability in our day-to-day lives and in our workplaces and industries.

One focus for IRL's work is research into technologies for the integrated supply and distribution of alternative sources of energy generation – an area of work that not only promises to deliver sound economic returns, but also recognises the wisdom and value of nurturing our environment for future generations.

Chairman's report



Preserving and enhancing New Zealand's investment in science through IRL has been a primary focus of the Board during 2006/07. New Zealand's industrial sector is a major contributor to GDP and IRL has a vital role to play in the development of industrial capability.

With this in mind, the financial result for the year does not make good reading; however, legacy issues contained in this result mask the significant progress made during the period to return IRL's operations to profitability. The after tax loss of \$5.7million contains a negative impact from discontinued operations of \$2.1million and write off of a deferred tax asset of \$2.7million required in terms of current accounting practice.

Central to considering IRL's future, is the achievement of close to budgeted result as highlighted in the *Statement of financial performance*. This result, when excluding the deferred tax write-off, shows that the company Board, management and staff are pulling together to turn the business around. We still have some way to go, but the trends are positive despite a severe reduction in operating revenue from royalties from BioPharm and from certain commercial activities.

The Board is not yet satisfied with IRL's position but is heartened by the underlying improvement being displayed. Operating costs have reduced dramatically during the year without affecting science capability, key revenue streams have been stabilised and IRL is projecting a more positive financial performance for the future after struggling for several years to achieve profitability.

Significant cost reductions resulted from the winding up of the operations of BioPharm during the year. During its time BioPharm made a significant contribution to the development of new antibody-linked drug conjugates for the treatment of cancer cells, as well as a significant contribution to IRL's revenue stream. However, the narrow customer

base for these operations was insufficient to support BioPharm following the loss of its major customer in an industry restructure, and attempts to sell the operation were unsuccessful. A key lesson from BioPharm is the need to take on commercial partners early to share the risk of commercialising R&D activities and to broaden market access.

Some important changes have been made to IRL's operations by the Chief Executive, Shaun Coffey, who has now been with us for a year. In particular, a new and smaller management team has been installed. It will take some months for this new team to settle into its work, yet already positive results are emerging.

The team is leading a major strategic realignment of the business with a principal focus on strengthening relationships with industry. Science can add significant value to industry and requires the underpinning of strong, engaged and trusting relationships through which learning and development can take place. These relationships also need to be enduring, because the type of value-added science needed by industry often requires a significant development timeframe to ensure a quality end result.

Periods of financial uncertainty can distract an organisation. However, despite financial pressures and restructuring in parts of the business, the science teams have kept their focus and have continued to produce a top-class product. External quality measures demonstrate a high level of customer satisfaction across a very wide range of government and industry engagements and across a broad diversity of projects. This report highlights just a few of these innovations and relationships.

The Board is pleased to note the positive support for its science activities demonstrated in the recent Foundation for Research Science and Technology bidding rounds. The shift away from contestable bidding to negotiated funding for long established core science teams is also welcomed as a step in the right direction.

I wish to thank my fellow directors for their ongoing support and commitment to IRL. Our

appreciation goes to retiring Board member, Richard Nottage, who has made an important contribution over the past seven years. We also welcome two new Board members – David Henry and Michael Ahie.

Our commendation and congratulations to Shaun Coffey, who has kept a steady focus throughout the year on what has been required, and this has much to do with why we can be optimistic about next year and the future.

Some of the best science comes from the serendipity effect. That is where science journeys into the unknown or searches for one thing and in so doing finds another. Sometimes it is the ability to take advantage of that serendipity that produces the findings that add real value or create new opportunities. At IRL we need to have the resources and the structure to meet the ongoing needs of the sector we serve, to support incremental developments of knowledge and to create the possibility of serendipitous discovery and new commercial activity. The Board believes it now has an organisation poised for a growth and development phase as a capable partner for industry and for all New Zealand.



Brian Rhoades
Chairman

Chief Executive's report



Investing in science is vital to New Zealand's capacity to respond and compete in the global market. Innovation from new technology is vital to growing our ability to trade in the "knowledge economy".

Among the myriad factors industry faces are two key elements – the impact of global economic forces and New Zealand's productivity.

Too often global economic forces are seen as negative, yet they almost always have a silver lining. Global warming, for example, can offer an extraordinary business and technological opportunity. The first country to seriously apply itself to developing solutions to climate change will reap unprecedented benefits. If we are to capitalise on such opportunities we need a higher level of engagement between science and industry than has been the norm here. Greater attention is needed in government and in boardrooms to the power of science.

Underlying New Zealand's capacity to innovate is our low productivity by OECD standards. Industry has done much to boost productivity over the last 30 years or more. However, improved productivity requires innovation across many sectors: in transportation, energy, and logistics; in the way government and local

government operate; and in the service sector. These sectors need to adopt new knowledge and technologies too.

Unfortunately, as a nation we under-invest in research and development (R&D). In recent years, direct industry investment in R&D has grown and that is a welcome trend. This year's Budget announcement of changes to the taxation treatment of R&D should spur that growth. That aside, the general trend is not promising, with government investment in research declining steadily since 1998.

In 2006 total gross expenditure on R&D (both public and private) in New Zealand was 1.17 percent of GDP compared with an OECD average of 2.21 percent.

The value of IRL

Industrial Research Limited (IRL) recognises it can be a catalyst for a more aggressive use of science in New Zealand's economic and industrial development. IRL provides cost effective R&D for industry by:

- delivering results within an agreed budget, to the specifications required and in a timely manner;
- deploying experienced professionals in multi-disciplinary teams to complete the project; and
- providing a complete management service that includes helping customers understand and define the problem or opportunity to be researched, and then facilitating the research solution.

During 2006/07 the company has engaged more widely with industry and industry groups to explore how best to provide this value to our customers. IRL has adopted a new strategy that requires us to go beyond just doing R&D to partnering with industry and individual firms to ensure effective application of the knowledge and technology that we generate.

IRL is unique among the Crown Research Institutes (CRIs). With expenditure of about \$60million out of the \$570million a year gross expenditure on R&D by CRIs, IRL alone serves the industrial and manufacturing sector, and is

the only CRI with a focus on urban-based industry as opposed to agricultural, regional or resource-based sectors. Our ability to fully impact is limited only by our available funds.

Purpose and corporate responsibility – the quadruple bottom line

In examining our value to New Zealand, IRL has reaffirmed its commitment as a CRI, owned by the people of New Zealand, to add value to the New Zealand economy and consequently to our quality of life. This fulfils our resource governance responsibility to ensure that the company's resources are deployed for the purpose for which they are intended.

Our vision for IRL is for a high-performing Crown entity working in partnership with the business community to transform manufacturing and industry in New Zealand. That vision also sees IRL having the infrastructure, the people and the commitment to deliver significant value to New Zealand.

We acknowledge our requirement to be financially sustainable, with a cost structure that supports engagement with industry, and a diversified revenue base that enables us to invest in our future capability needs.

IRL is also taking account of our social and environmental responsibilities because we aim to be an organisation that people want to work for, do business with, and recognise as an important part of the community.

Balanced development

If IRL is to achieve its full potential it must adopt a balanced set of priorities that will not just deliver short-term benefit to industry but that also support the future sustainability of our business. During the year we identified five strategic priorities that need to be addressed:

- delivering research solutions through more effective engagement with New Zealand industry;
- diversifying and growing our revenue bases;
- improving our operational effectiveness and the execution of strategy;

- planning and investing in our research capability over a longer time frame; and
- growing our research, development and application expertise and quality.

These priorities have figured strongly in our activities during the year and form the backbone of our future strategic plans. In the current funding system, and within the constraints of the CRI operating environment, there will always be a challenge to ensure that all five imperatives are addressed in a way that encourages short-term delivery without an erosion of medium to long-term capability.

Improving IRL's performance will call for a significant investment and there is an element of risk in developing our new industry engagement activities before these activities become self-sustaining. These risks, however, must be taken so that we can work with industry to develop innovative and relevant research solutions to their challenges, and develop appropriate and exciting responses to emerging market opportunities.

Science performance

Given the challenges to our funding base, IRL has focused attention on improving its scientific performance over the past year.

The company portfolio of achievement in science and technology is detailed later in this report. What this does not record is a much improved performance in both delivery of our research contracts and successes in bidding for new R&D.

Greater attention has been given to research milestones and the quality of reports during the year and this has resulted in a vast improvement in delivery. Contract performance with the Foundation for Research Science and Technology (FRST), for example, improved markedly.

In terms of new investment, IRL successfully secured new FRST investments totalling \$13.25million per annum. This represents a 15 percent increase on this year's maturing investment.

IRL can be proud of the effort of our scientists, engineers, technicians and business support staff responsible for those results. The quality of the science in IRL has a strong, and growing, reputation among clients.

Working with industry

Building on the 2006 study by Ernst and Young of industry connectedness, IRL has asked the question: "How can we best engage with industry to deliver improved value for New Zealand?". It became evident that we should focus more on the market as our basis of engagement and this has seen us moving away from being a collection of technology platforms. Instead, future strategy will focus on delivery through market channels such as specialty manufacturing, bio-manufacture, communications, energy, and engineering and infrastructure

Research shows that these sectors consider innovation is important. Sixty-five percent claim innovation activity but only 17 percent actually conduct R&D. Again these figures place New Zealand industry well below the benchmark OECD economies. Engagement, therefore, will not be easy but will continue to figure prominently in our strategy.

In the current year, IRL has been able to improve its position in the eyes of stakeholders through improved networking, key industry discussions, industry meetings, stakeholder workshops and other activities. We are now in a better position to respond to industry and community needs and to work directly with industry.

In the coming year we will be extending our relationship with industry with the objective to become the trusted R&D partner for business.

Financial performance

IRL commenced the year trading poorly and posted a significant loss for the first quarter. Through a combination of close management of revenue streams and expenditures, tighter procurement processes and better debtor management IRL was able to improve its relative cash flow position over the year. Expenditure reduction equivalent to \$1million per month was achieved for the year.

IRL BioPharm was closed in November 2006 after a period of poor trading. Of the 30 staff, 10 were redeployed within IRL and 20 took redundancies. In future, greater attention will be paid to exit strategies when equity investment opportunities are initiated, as well as ensuring adequate capital on start up, and

a fuller examination of the possibility to enter joint venture arrangements early in the process.

In other decisions, the non-trading holding company, Superlink Development Ltd, was closed and we are in the process of closing MPT-Matcor Pte Limited in Singapore. The sale of MPT Limited to Quest Reliability was successfully concluded during the year.

Improving management and operational arrangements

In addition to the careful examination of our purpose and our value to our customers, IRL has also taken measures to improve management systems, to simplify our R&D operations, and to address criticisms of excessive overhead processes and costs.

The number of General Management positions within the Executive has been reduced from seven to three and all operations have been organised into three groups – Science and Technology, Commercialisation and Business Development, and Corporate Support. New managers, experienced in the industrial R&D business have been appointed to lead these areas. Matrix management arrangements in research operations have been removed to reduce transaction time and costs. During 2007/08 IRL will continue the process of simplifying management structures so that we can focus more attention on revenue-generating R&D projects.

Significant progress has been made in shifting the ratio of overhead to operating costs from approximately 44:56 percent in 2005/06 to a target of 30:70 at the start of 2007/08.

Costs were reduced during the year through a range of measures aimed to improve fiscal discipline. Further reductions are expected in 2007/08 as we review purchasing and procurement systems.

Engaging and rewarding our people

IRL has many talented and dedicated people working for the company. Their active engagement in the work of the company is crucial for our success.

Each year we survey levels of staff satisfaction with IRL as an employer and with the work being conducted. The 2007 response rate was in the order of 60 percent of total employees, high enough within the normally acceptable margins of error and confidence limits to enable us to be sure that the data is representative of the IRL staff as a whole.

Whilst a detailed analysis is still to be completed, an initial review of the findings shows that the general trend of results, when compared with the 2006 survey, is positive (+2.3 percent) and in seven of the eight categories surveyed, there have been significant improvements in staff perceptions.

The most notable improvement is in the area of "Common Purpose" (+7.7 percent), reflecting the development and communication of a new and relevant strategy with a clear vision and purpose. IRL will build on this encouraging foundation in developing strategic capability over the next few years.

"Performance and Recognition" is the only survey area where there has been a decline in staff perceptions, but this has been small at -1.9 percent. Management and the Board are keen to see improvement in this area.

After several years of negotiations, a new remuneration system has been adopted by the company and will be fully operational by November 2007. This will see the total remuneration cost increase by 10 percent in 2007/08.

During the current year a salary increase of 3 percent was also awarded to staff.

These measures will enable IRL to return to more competitive salary conditions, and are a significant component of our efforts to maintain capability to do world-class science.

The future

Our people have worked diligently over the year to improve IRL's position. The task has not been easy but we have established a sound base on which to move forward. Everyone is to be congratulated for that achievement.

IRL still has much to do to fulfil its purpose as a crown enterprise, owned by New Zealanders, and working to add value to industry and the economy. Our principal opportunity lies in growing the quality, depth and focus of the way we engage with industry. This will be built on the improved performance already achieved in our work for FRST – a body that remains an important and valued partner.

IRL will also continue efforts to improve the science and technology system in New Zealand. The highly contestable system has some unhelpful elements. For example, government, industry and the communities have initiated labyrinthine processes of consultation and bidding for identification of R&D priorities

and for reporting and monitoring expenditures for innovation. These address a need for accountability and consultation, but do they represent efficient and effective leadership for the future?

There is little disagreement with the contention that New Zealand needs to lift its level of investment in R&D. Similarly, we need to make certain that our system and process, both within IRL and in the wider RST sector, are efficient and maximise the dollars going to research.

The purpose of IRL is best achieved through research solutions delivered to industry on time, to specification and on budget – solutions that create competitive advantages for industrial firms.

Shaun Coffey
Chief Executive

IRL overview



What is Industrial Research Limited

Industrial Research Limited (IRL) is a Crown Research Institute providing research, science and advanced technology support to industry to enhance their performance and add value to the New Zealand economy.

At our core is innovation based on scientific research. We work with industry in areas such as research and development, pilot-scale production, consultancy services, commercialisation of technology, testing and calibration, and sales and licensing.

We work with a range of industry, from a small company with a bright idea to some of the largest New Zealand companies needing research and development support to succeed in the highly competitive international marketplace. Clients are involved in diverse

areas of industry and manufacture, from pharmaceuticals to communications technology, food production to energy generation.

Working with partners is vital to our business, whether that be industry, investors or science collaborators, at home or overseas. The scientists, engineers and technicians at IRL apply their considerable skills and expertise to successfully take innovation to the market.

IRL's science capabilities include the broader areas of industrial processing, organic and inorganic chemistry, engineering, imaging and sensing technology, sustainable energy, materials research and performance, carbohydrate chemistry, communications and electronic technology, and applied mathematics and statistics.

How we work

As the only Crown Research Institute (CRI) mandated to support New Zealand industry, IRL is firmly industry focused. We strive to make a difference to individual companies which in turn supports economic transformation for the country as a whole.

The role of our research and development differs with each project. Our work may enable an existing company to remain competitive, or allow them to expand their productivity and grow market share. We can be leading the way with new technology that opens up opportunities to establish new industry at the cutting edge.

Our strong global science connections mean that distance does not mean isolation in the world of research and development. We are able to draw on international expertise to develop strong partnerships for New Zealand companies that enable them to compete confidently in the global marketplace.

Sustainability

IRL emphasises sustainability in the way it carries out its role as a CRI.

For example, recycling programmes are being introduced to reduce the waste generated by the company and measures are in place to ensure savings in electricity are maintained.

An ongoing programme is in place to replant the ten-hectare Gracefield site with native trees and plants. These include flax species that can be used by local weavers. These have been planted along the Waiwhetu Stream border of the site.

IRL also works with the local community as part of the Waiwhetu Stream Working Group to restore the stream, which is one of the most polluted in the area, back to health. This is a long-term project that has to date produced a marked improvement in the water quality of the stream and encouraged the reappearance of fish along the stretch bordering the IRL site.

IRL research can also contribute to sustainability by coming up with processes and products that allow New Zealand's industrial sector to lessen its impact on the environment.

For example, sustainability is the reason IRL set up its sustainable energy research platform. A major part of its work is to explore moving from an economy based on carbon fuels that aggravate climate change to one based on hydrogen, which will not contribute to global warming.

Other work is underway to develop a device that can be used to harness energy from ocean waves. This area of research is potentially problematic in that any generator needs to be sensitive enough to gather the energy from normal seas, but robust enough to withstand major storms. IRL is currently taking an innovative approach to this problem by producing a prototype all-weather wave generator.



Distributed energy is another focus of IRL's sustainable energy work. It provides an alternative to our present approach of building a few major electricity generators and transmitting the power to where it is needed. This results in significant losses in energy. Distributed energy instead concentrates on developing technologies that can produce power on a localised basis and distribute it to the surrounding area.

See page 17 of this report – *Distributed energy – the Totara Valley story*, for an example of IRL's distributed energy technology in operation in New Zealand.



Human Resource reporting

Staff survey

The second online Staff Climate Survey was carried out between 24 July and 3 August 2007.

An initial review of the findings shows that the general trend of results, when compared with the 2006 survey, is positive and in seven of the eight categories there have been meaningful improvements in staff perceptions.

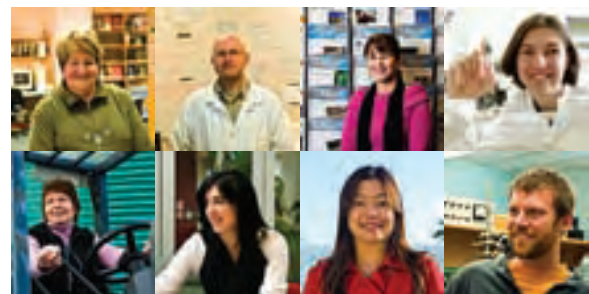
“Common Purpose” is the question category where there has been the largest positive improvement (+7.7 percent), and “Overall Perceptions” has the next largest improvement at +4.7 percent. These are significant gains and may reflect positive perceptions of staff relating to the recently developed organisational strategy.

New remuneration system

A new and modern remuneration system is in the process of being implemented which better reflects the company’s remuneration philosophy of recognising skills and rewarding achievement and recognising the composition and unique qualities of its workforce. It is easy to understand and apply and is sensitive to labour market conditions and movements.

The new system has a number of components:

- the use of a job evaluation system which recognises the specific components of the various positions;
- the development of accurate and consistent job descriptions and competency profiles;
- the introduction of science grades, remuneration bands and ranges that acknowledge individual and team performance;
- the use of salary survey information which considers labour market data that relates specifically to scientists and engineers as well as other functional groups employed by IRL;
- a modified performance management system which will ensure a better relationship between performance contribution and pay; and
- recognition of the level of affordability factor.



Leadership development

There is no shortage of high-calibre scientific and technical expertise at IRL.

However, the company cannot be as confident about areas such as business/commercial management, strategic thinking, financial analysis, staff development, project execution, and resource management.

At the same time, it is clear that, given the right opportunity for development, there are a number of staff with the potential to become effective leaders and managers.

As a consequence, we are in the process of putting together a leadership development programme comprising generic leadership skills, relevant technical knowledge and information, and specific skills required to manage successfully in the IRL environment.

The programme, which IRL will implement in the second quarter of the financial year, will comprise four key components:

- a five-day intensive course, run by a University (using both academic and business experts), geared to IRL’s specific needs;
- development centres to identify strengths and weaknesses and formulate personal development plans;
- short expert seminars aimed at specifically identified areas; and
- the use of business coaches/ advisors/mentors.

Initially this will be run as a pilot programme which will subsequently be reviewed and established as a permanent feature of IRL’s Human Resources strategy.

Using this approach, we would hope to produce a pool of potential leaders over the next two years or so, and ensure continuity and succession of leadership into the future.

Recognition of IRL staff achievements

Mike Andrews, senior scientist in IRL's Imaging and Detecting team has received international recognition for his work in developing devices, most recently in the timber industry. A joint project involving Australia and New Zealand interests saw the development of a way to better measure the grain direction in pine trees, and therefore to provide better quality assurance on the reliability of timber used in construction.

Graham Caygill was made a Fellow of the New Zealand Institute of Chemistry for his work in reaction process scale-up, overcoming the issues of changes in scale and the compounding effects of mass, heat and momentum transfer. Part of IRL's long-term investment in this area of research is evidenced by the cGMP pilot plant facility at GlycoSyn. Graham Caygill continues his work as a scale-up engineer, combining research in process safety and development to assist a wide variety of national and international clients.

Richard Furneaux was awarded the prestigious Hector Medal from the Royal Society of New Zealand for his outstanding contribution to the advancement of carbohydrate chemistry and to the recognition worldwide of chemistry and pharmacology in New Zealand. Richard Furneaux was also chosen as an inaugural winner of Victoria University's Distinguished Alumni Awards for his work in carbohydrate chemistry.

Tim Haskell was awarded the 2006 Marsden Medal from the New Zealand Association of Scientists for a lifetime of outstanding service to science including work on solar heating, IT, novel optical devices, earthquake protection and Antarctic sea ice formation and decay.

Shaun Hendy led a number of IRL staff and a team of New Zealand researchers in a joint project which achieved a rare international double recognising their work with nanoclusters and their use in tiny electronic devices. The team's research results were independently published in two top international physics journals, *Physical Review Letters* and *Applied Physics Letters*.

Conrad Lendrum was runner-up in the Understanding Planet Earth category of the MacDiarmid Young Scientists of the Year Awards for his work on biomineralisation in sea urchins or kina. Biomineralisation is the process by which nature produces hard mineral structures (like bones and seashells) and Conrad hopes his research might lead the way to scientists recreating the complex structures of nature for use in industry and manufacturing.

Jeff Tallon has been elected an Honorary Fellow of the Institute of Professional Engineers of New Zealand (IPENZ) for his eminent contribution to innovation in the design of technological products, specifically his research towards the development of a high temperature superconductivity industry. This has the potential to revolutionise power transmission, transportation, online analysis of industrial processes, and medical applications.

Yong Yuan has been awarded an Honorary Teaching and Research Fellow from Massey University. He is currently leading an international collaboration of research scientists on a four-year FRST funded project to develop diagnostic tools for a new area of science, bond rupture. The project, "Unique Diagnostics Based on Molecular Bond Rupture Scanning", involves scientists from other New Zealand CRIs and from Japan's National Institute for Advanced Industrial Science and Technology (AIST).

Working with industry

Overview

A national research capability matched to national priorities

The research programme at IRL includes projects which have the ability to change the productive capability throughout an entire industry, and to extend New Zealand's economy into new areas.

Some of these developments are at the frontier of emerging fields of science, and some are the result of continuous development from within more mature areas of research.

Breakthrough technology is often measured in incremental gains rather than giant leaps, and the communication between science and industry needs to be strong if the needs of industry are to be consistently met. IRL has a history of successful collaboration with industry over many years and can point to significant developments within the dairy industry, for example, which allow New Zealand to be highly competitive internationally.

Alongside established industry, IRL works within areas of technology which will see new industries established. One such development is the success of its research in carbohydrate chemistry which has led to areas of discovery in medicinal chemistry. The result has been the establishment of New Zealand Pharmaceuticals which has successfully developed a New Zealand-based commercial scale manufacturing operation.

IRL has been able to leverage the knowledge gained in one area of research, such as supercritical extraction in the science of lipids, and apply this to a range of unrelated projects in other industries. Supercritical extraction research aims to come up with extraction processes that are so gentle they preserve the materials being extracted but are also cost-effective at industrial scale. At first glance, the delicacy required to isolate a naturally occurring ingredient for high-value skincare products has little relevance to the robust methods of chemical extraction used by industrial tanneries. However, in an extension of the advances made in the area of low temperature processing, new techniques have emerged which allow leather to be treated ten times faster and with 90 percent fewer chemicals required.

Confidentiality and control over the intellectual property are at the heart of the relationship between IRL and its clients. While IRL operates a range of flexible business and contracting models, the security of project information and the transparency of communication between IRL's business and project managers are crucial. While scientists may work on a range of research themes, clients consistently demand focused outcomes and swift returns.

NZ Pharmaceuticals — the science of manufacturing medicines



The science behind NZ Pharmaceuticals can be described as “complicated carbohydrates”. Glycotherapeutics, carbohydrate nanotech, small molecule synthetic drugs, and stem cell growth factors all contribute to stages of discovery and development in IRL’s work in medicinal chemistry.

The process development and the scale-up to a successful large-scale manufacturing operation involves collaboration with specialist partners. In the case of NZ Pharmaceuticals, partnering with IRL business unit GlycoSyn, has taken IRL’s

initial research into an industrial setting. GlycoSyn contributes an international reputation for its expertise in carbohydrate chemistry and multi-step synthesis, which NZ Pharmaceuticals is able to use to manufacture large-scale and highly specialised biotech products.

Developments in this area of research are dependent on an integrated capability. The logistics of developing a research facility capable of making the required scientific contribution to a focused, and perhaps narrow range of outcomes, is beyond the reach of individual organisations. Certainly in New Zealand, IRL’s capability is playing a key role in extending the nation’s economy through emerging industry.



Pilot scale SuperEx unit

IRL has constructed a mobile supercritical extraction plant – the SuperEx – that allows New Zealand companies to make short-run extractions for market testing at their own premises. Four New Zealand companies – Fonterra, Living Nature, Nutrizeal and Ensis – have so far committed to using the plant on a regular basis.

Supercritical extraction involves an extraction process that is so gentle it preserves the essence of the material that is being targeted. It is a process that has a number of applications in any industry using natural products such as milk, plant material and wood.

A mobile supercritical extraction plant has several advantages for New Zealand companies. Because they can use the unit on their own sites they can be sure they are meeting the stringent health and food safety regulations of overseas markets and product development and technology transfer is accelerated.

Fonterra is the first New Zealand company to make use of the SuperEx unit.

Distributed energy — the Totara Valley story



Research into sustainable energy generation has long been a priority for scientists and industry alike. One of the biggest challenges is how to ensure continuity of supply from alternative sources, while minimising the energy costs of generation.

Alister Gardiner, leader of the Hydrogen and Distributed Energy team at IRL, believes that there is a credible, and viable, solution.

In the rural settlement of Totara Valley in the Manawatu, an integrated micro-generation system which includes a fuel cell hydrogen storage capability proves the point. Three farming families are using a number of energy technologies installed by IRL and Massey University to produce their own electricity. The system is connected to the national electricity grid and complements electricity supply to

each farm. Called 'distributed generation', the project capitalises on the resources available in the farming environment, without having to rely on one, single technology. Although wind, sun, water and a bio-diesel generator all contribute, the distributed energy system includes hydrogen energy for storage and distribution. This chemical energy is later converted to electricity and heat.

Using an IRL-developed concept called Hylink, the system pipes hydrogen gas to a fuel cell and water heater. As well as transporting energy, the Hylink system stores hydrogen so that a supply of energy can be maintained even when the wind is not blowing and generation has stopped. The fuel cell converts the hydrogen fuel gas and oxygen from air into electricity and heat, with water as a by-product.

As a bonus, at times of abundant generation, the system allows electricity to be contributed to the national grid.

Commercial connections

Overview

The process of commercialising research

Scientific entrepreneurs who can navigate the difficult and complicated currents around scientific discovery, patenting, prototype development, establishment of efficient manufacturing and successfully bring a totally new product to market, are few and far between. They do, however, exhibit some common characteristics; they pay attention to detail and they involve experts in those areas which are critical to their success.

One of the key factors influencing the successful commercialisation of innovation is the strength of the research and development (R&D) science which underpins the venture. IRL's contribution is regarded by its clients as critical.

While R&D is more often the process by which a new idea reaches fulfilment in the market, rather than the initial driving force, accurate science plays a crucial role.

The value of IRL to business

R&D exists in a competitive environment and while clients can be fulsome in their praise, particularly when IRL has delivered a crucial scientific breakthrough, clients also point out that, internationally, there are other research options and their decisions are based on a range of business criteria.

While feedback to IRL from its client base is described by those clients as being 'direct and robust', IRL is also acknowledged as offering internationally competitive research capability of significant commercial value.

“
IRL stood out from the other research organisations we looked at. The relationship we have with their business manager is hugely important and their scientific work is excellent. Working so closely together keeps everyone focused on the outcome we want. Basically, we choose to go to IRL because they deliver.”

GC, client.

Totaro™ – a unique product in a global market

When Doug Mende read that IRL scientists had managed to identify a product found in native totara trees and extract it in commercially viable quantities without the use of solvents, he was curious.

When he spoke to IRL further and learned of the antiseptic qualities that this product contained, he became totally focused. With a great deal of work behind both IRL and Mende, Totaro™, as the product is now named, has been patented, produced on a commercial scale and is found worldwide in an ever increasing range of high-value skincare preparations, cosmetics and nutraceuticals. According to Mende, "It's a great New Zealand story and it's just starting to really take off."

Mende has every right to feel enthusiastic. Although it has taken nearly ten years and a great deal of confidence in the science which delivered the technical breakthrough, Totaro™ is delivering into a market with an healthy appetite for safe, stable, natural products with medicinal qualities.

What is Totaro™?

- Granular product extracted from totara logs, old fence posts, and railway sleepers
- Totaro™ exhibits antiseptic and anti-aging qualities – recognised by New Zealand's earliest inhabitants who used totara poles for building structures, boats, carved decoration and fence posts.

Living Nature – achieving international success

In a marketplace crowded with supermodels, big budgets, cross-border trading and slick, high-street branding, Living Nature is getting on with business. The company now supplies natural skincare preparations, made with products extracted from plants native to New Zealand to more than ten countries around the world.

That Living Nature is recognised for its international successes, is due in part to the expertise IRL contributes to its R&D programme. Living Nature is collaborating on a number of current projects with IRL and has a clear view of what the natural skincare and cosmetic market requires.

What IRL delivers to Living Nature is, like much of its commercial research programme, a closely guarded secret. However, Living Nature describes its business relationship with IRL as delivering “outstanding science”.



HTS-110 – high-value, high-tech

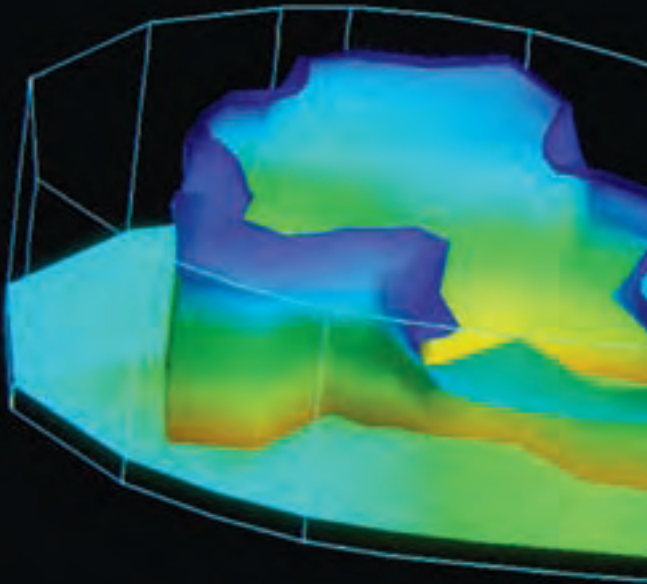
One of the specialised successes of IRL's international expertise in superconductivity is commercial spin-off company, HTS-110 Ltd. The company is marking out a niche in the world of high-value, high-tech and highly specialised industrial and scientific magnets, and is described as being "a leader in high temperature superconducting (HTS) solutions".

In the three years since it was launched, HTS-110 has developed a client base which requires not only components for use in superconductivity industries, but also end-to-end solutions as well.

What began as an organisation strongly connected to clients that reflected its own R&D origins within IRL, is now developing into a broader client base within industry. In addition to high-tech staples such as Cryocooler™ current leads and custom magnets, HTS-110 produces a range of standardised scientific magnets and class-leading industrial NMR analysers for the plastics, refining and mineral markets.

Although relatively small in number – the company has less than 20 staff – HTS-110 has already achieved multi-million dollar revenues and a number of business accolades, including Start Up of the Year (2006) and Start Up Exporter of the Year (2007).

Ultrasonics – imaging with ultrasound



IRL is involved in several applications of ultrasound imaging over a broad range of sectors, from primary industry through to highly specialised bio-medical applications.

Improved sea floor mapping is an area in which IRL is developing advanced integrated transducers and systems while in the forestry industry, acoustic tools for measuring the stiffness of wood are the priority. In the area of physical sensing, IRL has developed small silicon micro-machined diaphragm sensors, which were considered for use in the European space mission for measurements of the Martian atmosphere.

IRL development in custom transducers and signal processing methods have led to advances in Non-Destructive Testing (NDT) and directly benefited a number of research areas, including the analysis of materials. Medical applications are also being considered, including the effect that the microscopic structure of tissue has on high-frequency ultrasound. Effectively imaging this tissue could provide clinically useful data on, for example, how collagen is organised.

Cryocooler – a breakthrough for superconductivity technology



The piece of equipment which is set to transform the superconductivity industry looks innocuous enough but masks a breakthrough in refrigeration technology.

Cryogenics is the branch of physics and engineering that works with matter at very low temperatures. While standard refrigeration technology can remove heat to approximately minus 20 degrees Celsius, it takes an altogether different approach to remove heat to minus 200 degrees Celsius or less.

One of the major issues with creating temperatures below minus 200 degrees Celsius, is that the process for doing so is costly and inefficient. Large amounts of energy are required and the equipment to achieve these temperatures is cumbersome and expensive. As the demand for superconductivity manufacturing increases internationally, demand for better and more sustainable technical equipment is also increasing.

A team from Industrial Research led by Alan Caughley, together with leading US cryo-refrigeration company CryoMech, have produced a breakthrough industrialised cryogenic refrigerator, or cryocooler. The new patent-pending Cryocooler is industrially robust, long lasting and will cost significantly less than the current technology available.

The research benefits of an industry cluster

Through its Imaging and Detecting technology platform, IRL has been part of the NZTE-initiated Medical Devices Industry Cluster, established in 2005.

The Medical Devices Cluster is an association which provides strategic leadership to develop New Zealand's emerging medical industry. High amongst its priorities is the upskilling of medical device companies to meet national and international requirements, with respect to technology, manufacturing and regulatory practices.

By taking an industry cluster approach and focusing a diverse community of specialists on a range of priorities, significant advances are possible.

IRL's role amongst this cluster of experts is to bring leadership into an area where entire new industry sectors are emerging and to promote the uptake of cutting edge research through to practical implementation.

Audio technologies

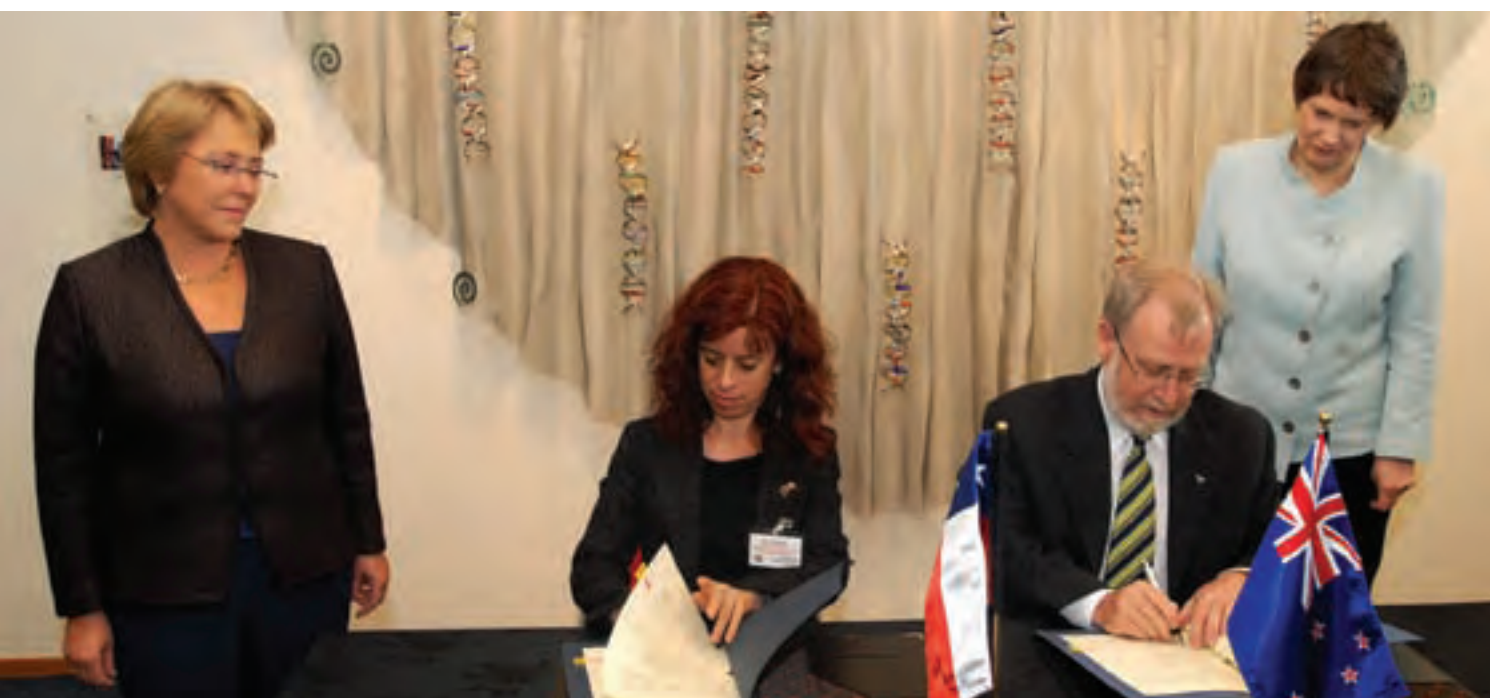
In the world of audio technologies, virtual acoustics is at the leading edge. Being able to hear surround sound, without it first being played through speakers, sounds like 21st century ventriloquism – but in fact it is close to becoming a reality.

IRL scientist, Mark Poletti, is currently involved in auralisation research with leading acoustics specialist, Professor Peter Svensson, of the Norwegian University of Science and Technology (NTNU) Centre of Research Excellence. The work involves creating virtual sound sources around a person by computer simulation rather than the use of traditional headphones.

When it comes to practical applications of acoustic science, IRL's work in the development of Active Noise Cancellation Headphones with the University of Auckland is now proving its commercial value. Various prototypes have been demonstrated at trade shows for a number of years, and a commercial product is now under license to New Zealand company, Phitek, and in manufacture. Long-distance air travellers have been among the first to benefit from the new headphones, which filter out the background noise of jet engines and creates instead high quality sound for the listener.



International connections



Overview

IRL's profile within the international science community is developed in two ways; through IRL's contribution to scientific discovery which is determined by the strength and relevance of its projects within its research programme and through the ability and reputation of its people.

Through a relationship shaped by similar interests, mutual respect and complementary expertise, IRL continues to work with a number of the world's leading scientific institutes to develop the tools and solutions needed to continue New Zealand's economic development and commercial transformation. Recognised as a leader in the development of high-tech solutions for primary industry, New Zealand is highly regarded for its research into marine science, environmental issues and export-focused value-added primary produce.

As part of its engagement with the international science community, IRL is often host to visiting scientists or academics. While these visits maintain a useful profile for IRL with respect to current projects and research themes, the opportunity to offer an exchange programme not only to IRL staff but also to scientists from other institutes makes a valuable contribution to staff development.

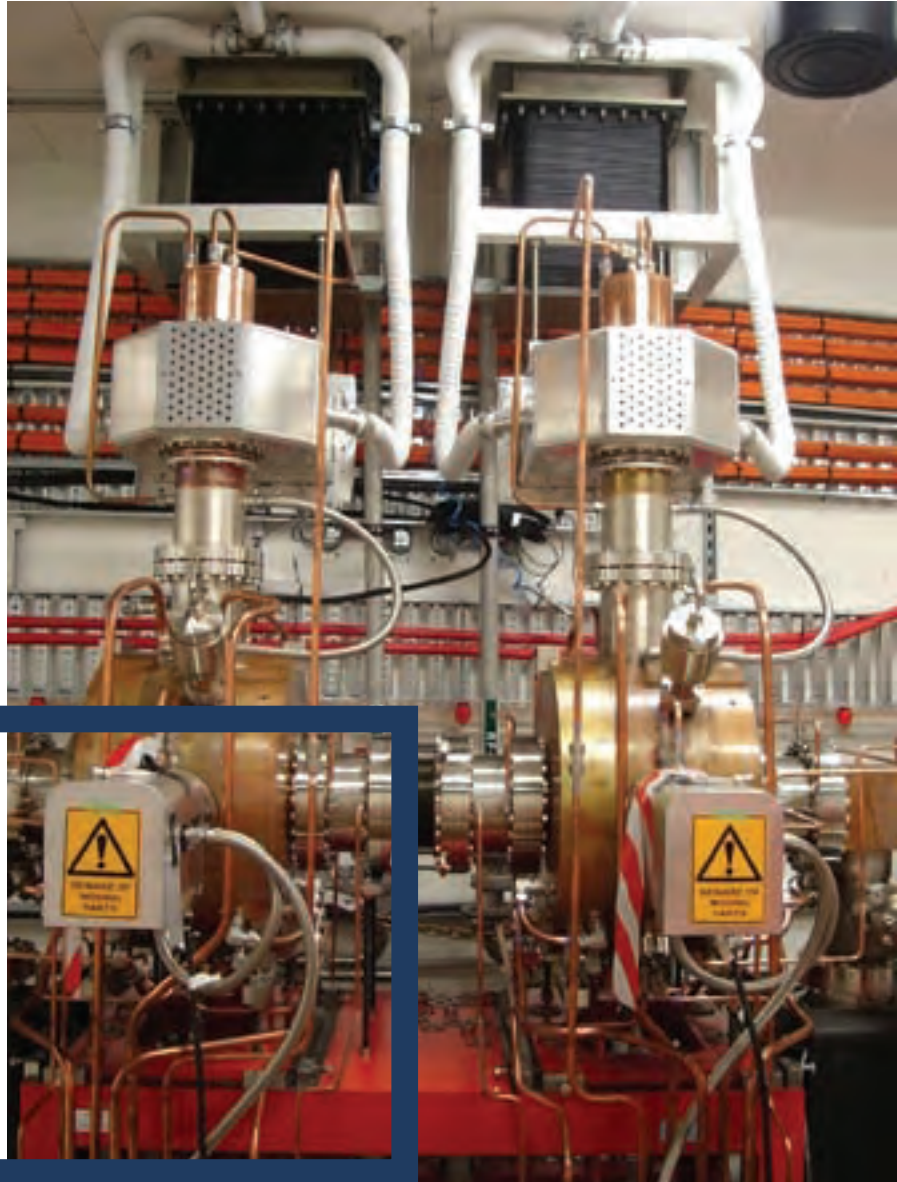
Chilean President visits IRL

As part of her visit to IRL in 2006, Chilean President Michelle Bachelet took the opportunity to confirm an agreement with the Chilean National Commission for Scientific and Technological Research to host a Science and Business Colloquium in Wellington in 2007.

President Bachelet, who was accompanied by Prime Minister the Rt Hon Helen Clark, viewed IRL's pioneering hydrogen energy and high temperature superconductor (HTS) research programmes. Both leaders acknowledged that there are areas of mutual scientific and

technological research and a collaborative approach between scientists from both countries could be mutually beneficial.

The hydrogen energy programme is of particular interest to Chile, a country which presents a number of geographic challenges in maintaining consistent electricity supply to its regions. Internationally, research into energy is a priority and IRL's hydrogen programme is gaining recognition for its fuel cell technology, which aims to bridge the gap between the generation of electricity from a range of renewable resources, such as wind or solar, and its later use.



What is a synchrotron?

A synchrotron is a machine that accelerates electrons almost to the speed of light. As the electrons are deflected through magnetic fields they create extremely bright light. The light is channelled into beamlines which are then used for research in areas as diverse as microbiology and disease mechanisms, environmental science and the development of cleaner industrial production technologies.

Synchrotron science – developing IRL's people

Many branches of science deal with the properties of matter at a molecular level. Nanotechnology is the science of particles measured in millionths of a millimetre, and its theories underpin much of the current research programme at IRL.

Manipulating particles at this level requires highly specialised equipment and knowledge. Synchrotron science, in particular, is providing opportunities for IRL staff to develop their knowledge and laboratory practice.

The Australian and New Zealand synchrotron community decided in late 2005 to prepare a 10-year strategic plan for synchrotron-based science. This plan is being enacted and IRL scientists have made a significant contribution to the development of a new synchrotron facility in Melbourne. This extends to IRL staff the opportunity to collaborate with their international colleagues on a much broader range of projects than would otherwise be available within New Zealand.

New Zealand scientists currently use nine overseas synchrotron facilities. Their work is broad-based in discipline and technique, covering the major areas of strategic importance in government science policy, such as biotechnology, materials, nanotechnology and information science.

Intellectual property



IRL goes to considerable effort to manage the intellectual property (IP) assets of the organisation.

IP rights are assigned through a process of filing provisional and then full patent applications and satisfying a varying number of examining bodies as to the novelty, inventiveness and industrial applicability of an invention.

The process of bringing a new invention or innovative development from a research environment into a commercial marketplace is time-consuming and costly. Of the many research discoveries which show commercial promise, relatively few patent applications go on to completion. The time taken from filing a provisional patent and for the necessary

examinations, appeals and final reports to be completed is normally several years.

Notably, IRL has a successful track record over many years of defending patent applications and managing intellectual property, collaboration and license agreements with third parties.

Working with commercial partners is vital. The costs of R&D are generally prohibitive and for a research organisation to successfully progress an innovation beyond the first stages of a provisional patent without a commercial partner is difficult. A provisional patent allows a 12-month period during which a full patent application must be completed. From this point, a successful application may take from six months to three years, and frequently longer to be approved.

PATENTING ACTIVITY:	FY 2006	FY 2007
Provisional patent applications	18	19
PCT international applications	8	9
National phase applications	57	47
Patents granted (all countries)	17	20
Patents and applications sold / assigned or abandoned	53	28
End of year active inventions	80	84

REVENUE FROM IP LICENSING	FY 2006	FY 2007
Active licenses	11	14
Total licensing revenue	\$6,936,566	\$1,490,446

Note: In 2005/06, IRL received two large sub-licensing milestone payments which substantially inflated the revenue result for that year.

Capability fund

IRL's focus is on providing research, science and advanced technology support to industry to enhance their performance and add value to the New Zealand economy. In fulfilling that role, we use funding from the Government's CRI Capability Fund to ensure we maintain and enhance key science capabilities that are not sustained through direct funds from the Foundation for Research, Science and Technology.

Capability funding also allows us to develop capability in new and emerging areas of science that could lead to new industries for New Zealand.

Looking further ahead, the Fund supports our capability in "discovery" science in areas such as spintronics, also known as magnetoelectronics. This area of science involves changing the quantum spin state of an electron and has applications in electronic devices where it vastly improves sensitivity and storage capacity.

Energy

As part of New Zealand's drive towards sustainability, IRL has been developing internationally recognised work in advanced clean energy technologies. This is focusing on understanding nanoscale electrode chemistry and developing the engineering capability that would allow this to be scaled up for industrial use.

IRL has also continued its work in the niche area of hydrogen storage and generation to support the emerging New Zealand hydrogen energy sector, and the development of cryogenic refrigeration science and engineering that is integral to adoption of high temperature superconductivity.

Carbohydrate chemistry

IRL's carbohydrate chemistry platform is at the forefront of glycotherapeutics – the development of new drug treatments from carbohydrate materials. The platform, in collaboration with biologists, has produced two drugs that are currently in trials, one for the treatment of psoriasis and the other for certain cancers. Capability funding ensures we retain our position in this promising new area of biomedicine.

Supercritical fluid extraction

Supercritical fluid extraction is an important technology to support New Zealand's growing biotechnology sector. By providing a "gentle" way of extracting compounds such as lipids from organic material, it opens up exciting possibilities for adding value to our primary products such as wood, milk, and seafood, taking advantage of their health and other benefits. Supercritical extraction is a "clean, green" extraction process since it leaves no residues and the final extracted product is exactly the same as it occurs in nature. This trait means it has potential in the treatment of waste to remove hazardous substances before discharge as well as in removing contaminants from oil and other products.

More information on some specific projects in these areas can be found elsewhere in this report.