Biomaterial Futures: Everyday products from renewable materials

Measuring our success

forest research

Year at a glance

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Our journey begins

A new maturity emerges

The late 1980s and early 1990s saw a massive upheaval in the New Zealand economy. No sector was more affected by this than the forestry sector. Deregulation brought about corporatisation and privatisation of State assets. New corporates emerged and others were swallowed up. Deregulated financial, labour, and trading markets saw the opening up of new off-shore markets, exposure to international competition, and drastic changes to employment practices in corporates, forestry contracting, and port services, to name but a few. The 1990s saw ongoing restructuring of companies, and an unusually high turnover of senior staff in many businesses, resulting largely from the changing operating environment. Amid these changes, new roles for new players were being defined, including the Crown Research Institutes (CRIs).

The CRIs were set up in 1992, introducing the New Zealand science community to an unfamiliar environment. Early behaviours were overly competitive, amidst high levels of distrust. CRIs competed aggressively with one another, and, to a degree, with their clients.

From this period of change a new maturity of behaviour is emerging.

Forest Research seeks to be a leader in this process of maturing behaviour, fostering a new ability to move forward towards sustained collaborative growth. Our new strategy was the first step in this process. Other aspects include:

- encouraging a collaborative approach in the science sector in order to develop a better environment for science, scientists, stakeholders, and clients;
- developing new horizons for our traditional and new clients; and
- working constructively with our partners to make those new futures a reality.

Ours is a facilitative role, aimed not at self-interest but at a much more altruistic goal – benefit to those whom we service, and through them, to New Zealand and the world at large.

Getting on Board

If 2001/2002 was a year of "pivotal change" for Forest Research in terms of a new vision and a new strategy, 2002/2003 was a year of turning that vision into reality. We have taken our first steps positively and with confidence, and the building blocks cemented in place during the year include the following:

- A new senior management team was appointed within a new structure and operating style, and charged with delivering the new strategy.

- A new middle management team reflects the focus on the three core areas of the new strategy:
  - a sharper and more responsive service to traditional forestry clients;
  - building new science units aimed at delivering new generation biomaterials solutions to global consumers;
  - developing business with chosen segments of consumer markets.

- Two fundamental biomaterial science units were put into place, and a third is currently being launched.

- A more open and empowering leadership style has been actively fostered, providing ownership and involvement throughout the organisation. This is leading to a more energised entity, with greater sharing of knowledge and problem solving.

- A new collective employment agreement (CEA) was negotiated with the Public Service Association, and ratified in September 2002.

- Five critical success factors have been identified which, when achieved, will largely ensure delivery of the strategy itself. These are:
  - doing the **"right science"** and doing it to world class standards;
  - having a vital and **energised organisation** with widespread ownership and involvement by staff and stakeholders;
  - **focusing outward** on the future needs of society, industry, and the environment, and operating toward these outcomes;
  - choosing the correct national and international **strategic partners,** and forging strong and complementary **alliances** with them;
  - Maintain **prudent financial management** with robust cash flows and operating profits, reinvested wisely into the core strategic platforms.

- An intellectual property sharing policy was put in place with staff in December 2002.

- Excess costs to the level of $1.1 million were driven out by means of an organisation-wide efficiency review led by an external consultant. These savings have been locked in with new processes and policies, and improved systems.

- A Maori perspective has been introduced to all aspects of the business. Facilitating measures in this initiative have been formalising Tangata Whenua and Te Aroturuki advisory groups, and the appointment of a Maori Business Development Manager reporting to the Chief Executive Officer.

Kaumatua, Ben Hona (Ngati Whakaue) with Whakapumautanga (Darkie) Downs (Trustee Lake Taupo Forest Trust and member of the Tuwharetoa Trust Board) and Mrs Kore Downs at the launch function on 16 May 2003.

- Consolidation of activities at Rotorua to a smaller central focus has continued steadily, with the northern offices and laboratories now vacated, and rented out to long-term tenants. By year-end new buildings and building plans will be advanced to the stage that staff at the southern end of the campus will be relocated to the central area in the coming year. This will create a more dynamic environment for science teams.

Looking Outward

As part of our commitment to strong business growth, we have developed a robust technology stage-gating process that is now operational. Implemented for the purpose of driving ideas through to marketable products, our stage-gating team is selecting and guiding technologies through the development process to commercialisation.

- We officially launched our new strategy to over 200 stakeholders (and to staff) at Forest Research on 16 May 2003. The feedback was strongly positive. Follow up sessions have been run with a wide spectrum of present and future clients – most of whom are inspired by, and supportive of, the Biomaterial Futures strategy and vision.

- A Wood Quality consortium has been successfully set up and is now operating with industry partners. New participants from both New Zealand and Australia have bolstered the initiative to a $3 million per year enterprise.

- A new consortium in the consumer market end of the spectrum is well advanced at year-end (Built Environment Advanced Consortia – BEACON). It is widely supported, and has attracted Foundation for Research, Science and Technology (FRST) funding. Once operative, BEACON is likely to grow.

People

We continue to actively encourage and provide opportunities for staff to pursue post-graduate education. This year we congratulate Dr Robin Wakeling, Dr Michael Watt, Dr Elizabeth Dunningham, and Dr Kirk Torr who completed their PhD requirements.

We also celebrate the achievements of David Pont (1st class honours), Sonia Foote (1st class honours), Brendan Lee, and Pascal Berrill as Masters of Science, and German Ortiz who completed his MBA.

An additional noteworthy achievement was the election of Dr Paul Kibblewhite, Dr Lloyd Donaldson, and Dr Stuart Corson as Fellows of the International Academy of Wood Science.

Staff numbers stood at 340 full-time equivalents at year-end compared to 363 at 30 June 2002.

Financial Performance

Notwithstanding disruptions by restructuring, business planning, and new strategy implementation, Forest Research performed strongly over the last 4 months of the year under the new structure, to reach a satisfactory year-end position.

Group operating surplus before taxation and non-recurring expenses was $1.204 million ($153,000 in 2002) on total revenue of $39.594 million ($39.502 in 2002).

An increase of $1.716 million in the parent company's commercial revenue over the previous period was offset by reduced sales in the wholly-owned subsidiary FHS Limited (VIGIL), the sale of IFR Technologies Limited on 20 December 2002, and a reduction in FRST funding. Sales of software through the ATLAS business unit increased significantly over those of the previous year.

The corporate efficiency review continued to drive out excessive costs, resulting in an annual saving of $1.1 million. Although the review has now been completed, there remains an on-going commitment to further reduce costs. Reductions in FRST funding in the new financial year, and an ongoing demand on the company's earnings to support key science capabilities will encourage this commitment.

Group operating surplus included discretionary organisational reinvestment of $1.570 million comprising: $497,000 investment in Australia, $979,000 in development of science capability in bioconversion of industrial waste streams, and $94,000 in the Wood Quality Initiative (WQI) Limited.

The non-recurring revenue relates to Mamaku land sold to the Department of Conservation. As part of the sale agreement, Forest Research retained ownership of the plantation forestry trees which increased in value by $96,000, and acquired two bridges providing access to the Rotorua campus, together valued at $284,000.

Non-recurring expenses included a loss of $113,000 on the sale of IFR Technologies Limited to Pocket Solutions, and writing off obsolete buildings of $193,000.

Net surplus attributable to the shareholders (NPAT) was $690,000, ahead of the target of $639,000 and the previous year loss of $1.649 million.

Net cashflows from operating activities were $2.363 million compared to $3.754 million in the previous year. The decrease year-on-year was due principally to lower receipts from customers and a higher payment to employees relating to the cash payout of equity leave entitlements, as part of the CEA settlement.

The net debt level decreased from $2.436 million to $2.000 million over the reporting period. Interest cover was 700%.

Forest Research continued to invest substantial amounts in capital expenditure. Part of the total spend of $2.211 million for the year was for the on-going refurbishment of the central campus offices and laboratories at Rotorua, aimed at creating a smaller campus focus, and reducing operating costs.

FRST Bidding

The year has not been noteworthy for success in bidding to FRST for research funding. Notwithstanding, of the $5.983 million received, support was given in the areas of forest protection, waste-to-resource, new species, and forestry and environment.

Forest Research is active within a number of circles aiming to bring about improvements to the systems currently used to allocate the Government's science budget. Widespread support for improvement is evident throughout the science community, and this is translating into an environment conducive to constructive dialogue at all levels of the debate; this is both pleasing and encouraging for a good outcome.

Other Points of Interest

- Negotiations are well advanced in incorporating a partner into the DNA testing unit, SignaGen.
- ATLAS Technology, the forestry software solutions business unit, achieved an outstanding turnaround in performance, registering an operating profit of $286,000 against a budgeted loss of $371,000.
- Moves are under way to review the Forest Research branding strategy, consistent with the new strategic direction of the organisation.
- An important feature of the year has been the positive response of key staff to the new environment. A greater devolution of decision-making to responsible staff further out in the organisation enables senior management to work on the major strategic issues – a very healthy trend, which is being fostered and encouraged.

Conclusion

Forest Research is evolving rapidly into a rejuvenated organisation. Particularly pleasing to the Board and senior management has been the uptake of the new strategic direction by key staff and stakeholders. Horizons hitherto invisible to us are now opening up new opportunities, often involving new stakeholder groups. New opportunities for existing stakeholders are also evident. We are working in a number of forums to maximise the opportunities presented by this change process.

Our thanks go to all staff, clients, stakeholders, and Board members who are helping us through this critical and important phase of our development.

We look forward to the future with excitement, anticipation, and growing confidence.

Brian Armstrong
Chairman

Bryce Heard
Chief Executive Officer

Biomaterial Futures strategy unfolds

New Zealand has led the world in the development of technology to grow plantation timber and process it into useful products. Tree crops are now commonplace internationally. Our next challenge is to pioneer a new generation of technologies which translate New Zealand's natural competitive advantage in growing and exporting bio-based materials from industrial crops into national wealth.

This is the essence of Forest Research's Biomaterial Futures strategy, with wood and wood products remaining the largest biomaterial of all.

This new strategic direction and how it translates into practice within Forest Research's business were endorsed through a rigorous external review conducted by Dr Clark Binkley, Managing Director and Chief Investment Officer of the Hancock Timber Resource Group. He summed up the opportunity by saying "Valuable markets already exist. Low-cost inputs are available. Economic conditions favor change. Technology is the key missing ingredient. Forest Research's new biomaterials program has been designed to fulfill that need. Profitability from these new products will take time to emerge—perhaps 5 years, perhaps a decade or more. But, R&D is needed now to be sure that these business opportunities are available then."

Forest Research has re-engineered the business over the past year to more effectively service forest industry clients, whilst at the same time creating new capabilities in carefully selected areas of transformational science to underpin the Biomaterial Futures strategy. This has required unprecedented levels of re-investment in the business.

The research focus has altered in many areas and this process has been carefully managed to ensure that key capabilities required by industry remain intact.

Today's business looks quite different from that of a year ago. There are more consolidated forestry science units focused on servicing specific areas of forestry sector market demand. These science groups work with and for industry, addressing hundreds of technical, operational, and strategic problems every year.

Work on biomaterials projects is under way in two new science platforms, Biomaterials Engineering and the Cellwall Biotechnology Centre. A Bioconversion group is also planned to commence in the next year. A core capability in basic biomaterials science, which supports all of the new science platforms, is in the final stages of establishment.

All science teams actively contributed to the selection of areas of science endeavour and the creation of new teams, resulting in a high level of commitment to the change process.

The Biomaterial Futures strategy was officially launched at a ceremony held in Rotorua in May. Feedback from all stakeholder groups was extremely positive. The importance of our iwi partners was emphasised by their full participation on the day. Follow up communication is under way with key stakeholders who were not able to participate.

Forest Research's knowledge of the key markets for biomaterials and the technologies needed to link the industry resources to these markets is growing. Priorities for the coming year include:

- acquiring greater market and competitive understanding of chosen science niches;
- connecting with a broader range of clients who are active in bio-based materials;
- forging carefully selected science and commercial partnerships; and
- creating new intellectual property in chosen fields.

Forest biosecurity and protection

Sustaining national wealth through maintaining forest health

Forest health issues have been dominated by serious pest incursions over the past year. Forest Research staff are closely involved with response initiatives related to painted apple moth (PAM), the gumleaf skeletoniser, fall webworm, and Asian gypsy moth. All of these caterpillars have the potential to cause serious defoliation of prominent tree species in New Zealand, particularly in urban parks and gardens, and exotic plantations.

The challenges associated with management and eradication of pests have seen Forest Research's quarantine unit in Rotorua come into its own as a facility of national importance. Several breeding populations are now in residence, with large numbers of PAM being reared to supply moths for research on sterile male release and for testing of pheromone lures. A gumleaf skeletoniser colony is being maintained for feeding trials, testing insecticides, and experiments on aspects of its biology.

Forest Research continues to advance new technologies relating to biosecurity and protection. A heat treatment system is under development to sterilise imported vehicles at major ports. Over the past year, pathologists have determined what temperatures are required to kill various fungal species. This technology is seen as a viable and environmentally-friendly alternative to chemical treatments.

From pine trees to grapes

The plant protection chemistry team at Forest Research, PPCNZ, has completed a 2-year project with Elliott Chemicals Ltd to develop two new spray adjuvants for use with pesticides on New Zealand wine grapes. Although Forest Research originally developed this technology for the forest industry, it offers potential benefit to all plant growers. On grapes, this new chemical technology halves the spray volumes applied by growers, providing better disease and pest control while minimising spray drift, and greatly reducing application costs.

"Forests make vital contributions to New Zealand's economy, environmental protection, conservation of biodiversity, and its 'green' image. They also embody many cultural and spiritual values. This picture could change quickly and dramatically through the introduction of one or more pests. These risks are real, as indicated by recent and ongoing incursions of serious forest pests."

Dr Brian Richardson – Unit Leader

Recent Canadian recruit, Dr Tod Ramsfield, is providing Forest Research with valuable molecular detection expertise. This DNA-based technology enables rapid diagnosis of diseases that are often hard to identify by traditional means. Dr Ramsfield has made significant progress towards developing tests for western gall rust and pine pitch canker, both of which represent serious potential threats to New Zealand's production forests.

While forests are at risk from insects and pathogens, physical agents such as fire, wind, and snow also cause damage. A major coup for Forest Research's fire research programme has been an invitation to participate in the Australian Bushfire Cooperative Research Centre (CRC). The CRC will bring together scientists, academics, and fire authorities to share information and research to increase understanding of bushfires and how to control them. It has a budget of over AUS$100 million during its 7-year life.

Sustainable forest management

Maintaining New Zealand's capacity to grow

"New Zealand's approach to intensively managed fast-growing forest plantations is world leading, with some highly innovative approaches enabling the development of a high-value export industry. In the past few years, international trends have moved forest industry thinking towards a triple bottom line approach. This has led to the development of draft national standards for sustainable forest management, and numerous companies undergoing third party certification of their forest management processes under the Forest Stewardship Council scheme."

Dr Tim Payn – Unit Leader

This year marked a milestone for New Zealand's sustainable resource management. The Government produced its first report on criteria and indicators for the Montreal Process, an international grouping of 12 countries committed to the conservation and sustainable management of the world's temperate and boreal forests. This report, which was released by the Ministry of Agriculture and Forestry (MAF), contains significant input by Forest Research on plantation forestry and biodiversity issues. It provides a comprehensive summary on the status of 67 economic, environmental, and social indicators (www.mpci.org).

One of the most important aspects of sustainability in productive ecosystems is the management of soil fertility. The past year has seen the completion of long-term field studies planted in the 1960s and 70s on phosphorus (P) deficient soils. As a critical element enabling photosynthesis, P is important to anyone in the business of growing plants. Spanning an entire radiata pine rotation, these studies allowed scientists to model existing P nutrition of pines, and the response to any given level of P fertiliser. Foresters are now using these models to help them select appropriate quantities of P fertiliser for second and later rotations of pines, matching application rates to crop requirements.

A practical means of linking waste management with soil nutrient sustainability is the process of applying biosolids, or treated sewage sludge, to forested land. Forest Research is working closely with PF Olsen and Co Ltd on the land application system on Rabbit Island, in which most of Nelson's biosolids are filtered and absorbed by a pine plantation. Results show that trees growing in plots sprayed with biosolids grow significantly faster than trees in control plots, while displaying no significant accumulation or leaching of heavy metals through the soil profile. Forest Research is also monitoring the effects of biosolids application on two forestry sites in Canterbury.

Forest Research is now investigating how other forms of industrial waste can be used in a similar manner, thereby converting waste streams into a valuable resource.

Streams of information

Environmental managers are obliged to take increasing care when it comes to protecting waterways. Forest Research, in collaboration with NIWA and Landcare Research, is developing a riparian decision support system to assist managers responsible for sustaining instream environments affected by production forestry. This will make scientific information readily available on water quality, aquatic habitat, and soil conservation, to assist in the decision making process. The system has undergone a rigorous series of field trials, with input from interested users including forest companies, Regional Councils, the Departmentof Conservation (DoC), MAF, and the Farm Forestry Association. A prototype is currently being developed.

Forest and crop development

Targeting genetics and silviculture to meet product requirements

An exciting new era is emerging for forest and crop development. This is driven by a market that requires tree breeding for end products, rather than growth and form, which was the mantra for many years. Forest Research has been responsible for driving research projects to deliver better returns to forest owners, and this work is applied across a number of species, some of which will reshape the forest estate in New Zealand.

Research on Douglas fir has reinforced the position of this species as a premium structural timber. On some sites, returns are now better than from radiata pine. Recent studies have identified a Californian provenance that is likely to offer substantial gains in productivity.

Forest growers are showing increasing interest in alternative species, reinforcing Forest Research's earlier predictions that species such as cypresses and eucalypts will be significant contributors to the future forest estate. Our group is working with forest health specialists to identify *Cupressus macrocarpa* that are resistant to canker, and is also developing technology for the hybridisation of *C. macrocarpa* with other *Cupressus* species which have resistance to canker. A key part of this project is maintaining the viability of stored pollen to allow for variations in reproductive readiness between species and location.

"As the importance of wood properties emerge from within the manufacturing sector, combinations of silvicultural regimes and tree breeding require continual review. The shift of emphasis away from volume growth requires a whole new focus in genetic tree improvement, as tree breeders seek to improve wood qualities and enhance other characteristics of tree biology."

Ross Bayer – Unit Leader pictured (left) with Nursery Manager, Warwick Brown.

Exporting tissue culture science

Over the past year, Forest Research has assisted an Australian client in setting up a lab for multiplying and storing cultured plant tissue using advanced tissue-culture technologies. The laboratory uses the latest in micropropagation and cryogenic technology developed by Forest Research for cold storing shoots and embryogenic tissue. This allows valuable genetic material to be preserved for many years, and is enabling the Australians to further their clonal forestry programmes for hybrids. The project demonstrates the opportunities available for Forest Research science to impact offshore.

The results of a study on *Eucalyptus nitens* showed that sawlogs of this species can produce laminated veneer lumber beams of exceptional structural performance. This is an exciting result and reinforces the view that eucalypts have a future in solid wood applications targeting specific products.

At the same time, researchers continue to improve radiata pine. In collaboration with Corrections Inmate Employment, Forest Research is developing a new and improved radiata pine family suitable for farm sites. This product will solve many of the problems of wood quality that the industry is currently experiencing. Tree stocks from this family will be available in 2005.

Farmers can now assess whether farm forestry matches the medium-to long-term profitability of pastoral-based farming on hill country using a software package developed by Forest Research. This easy to use package assesses the cost-benefits of forestry while, at the same time, determining long-term environmental values of reduced soil erosion and improved water quality. This project was supported by the Sustainable Farming Fund and the Farm Forestry Association.

Wood and fibre quality

Knowing our resource from the inside, out

Over the past year, research into wood and fibre quality has received a significant boost. The national Wood Quality Initiative (WQI) has been formed to facilitate wood quality research programmes that are relevant to specific industry needs. WQI is the first research consortium of its type to arise from a partnership between research providers, the forest industry and FRST. Forest Research is both a shareholder in WQI and a research provider.

"There is increasing concern that consumers are favouring alternative building materials over wood. This has prompted wood engineers to develop wood-based products that offer greater flexibility and scope. Another approach is to grow better quality wood right from first principles, in order to strengthen traditional areas of dominance in the consumer market."

Bob Shula – Unit Leader

The aim of this initiative is to move radiata pine to higher value markets and thereby increase revenue to the forest industry by more than $400 million/year. This will be achieved through understanding the factors affecting wood quality, measuring and monitoring key quality parameters, and segregating wood material in processing.

In addition to WQI-funded projects, Forest Research has an ongoing research programme to develop wood quality assessment techniques. Funded by FRST over a 5-year period, this work seeks to advance fundamental understanding of wood behaviour.

This programme is independent of, but coordinated with, WQI in order to avoid duplication of effort. Included in the FRST programme is a pilot study to investigate how wood properties are affected by conditions during tree growth.

Each study compared two different trees of the same clone growing side by side. They were as near identical as possible, except that one was bent over to the ground when it was young. Whenever a tree starts to lean, it forms compression wood in order to straighten itself up. This study has enabled scientists to investigate the mechanisms and properties of compression wood at a microscopic level, and relate this to product performance. Forest Research, in collaboration with CSIRO in Australia, has developed new methods of determining fibre length and using this as a quantitative indicator of compression wood. Fundamental knowledge of this kind enables the measurement and monitoring of key quality parameters, so wood material can be segregated in processing.

Cooperative gets quality results

Research supported by the Stand Growth Modelling Cooperative (SGMC) has made a significant practical contribution to the wood quality programme. This industry-based partnership has continued to support the development of individual tree growth models, linking crown architecture to wood properties inside the stem. Genetic gain trials established by SGMC between 1984 and 1994 have also been used in the past year to provide samples for Gene-Assisted Selection (GAS) research. The GAS programme seeks to identify genes that are involved in determining important wood properties, and is building an integrated bioinformatics platform to enable hypotheses testing from the level of gene regulation through to end-product performance. Ultimately this will allow tree breeders to customise plants to produce specific wood quality traits.

Wood products and processing

Creating new value from solid wood

"If New Zealand is to expand its international markets for plantation-grown wood, solid wood products must perform reliably in service and exceed the requirements of our customers. Improved technologies will extend the ways in which wood can be used beyond current applications while meeting the environmental needs of existing and future generations."

John Gifford – Unit Leader

One of the biggest challenges faced by the forestry sector is finding bigger and new markets for New Zealand wood products. In order to gain market access, it is imperative that radiata pine is properly recognised in standards that are written overseas. While building standards are being drafted in China, Forest Research timber specialist, Dr Bryan Walford, has worked closely with the New Zealand Embassy to make sure that radiata pine is listed as a permissible construction material. It is also important to ensure these documents contain information that will allow New Zealand to supply timber and even complete buildings into the associated markets. A similar process is under way in both India and Korea, both of which have the potential to accept increased export volumes over time, particularly in components such as roof trusses, fittings, joinery, and engineered wood products.

Protecting the image and integrity of radiata pine as a building product has also been an important concern for the domestic market in the wake of the "leaky building syndrome" issue. Wood preservation specialists at Forest Research have constructed a unique facility to test the decay rate of different wood protection systems.

The facility, which has attracted the interest of chemical companies keen to test potential products, allows different treatment systems to be assessed in a relatively short space of time. The results of such studies have contributed to the review of NZS 3602 (Timber and wood-based products) and the New Zealand Building Code, which are looking to incorporate compulsory treatment for all framing timber.

In an ongoing quest to improve the performance of wood in high-value applications, Forest Research is seeking to enhance the durability of varnish coatings. Consumers often avoid using clear finishes on exterior wooden surfaces because of photodegradation (i.e., damage caused by the sun). Microscopic studies show it is not the varnish that is failing but the wood itself, since the lignin holding wood cells together breaks down when exposed to sunlight. Having demonstrated the fundamental reason for this failure, Dr Bernard Dawson has developed a concept to overcome problems with exterior varnishes, and which improves the performance of wood. Opportunities to develop this technology further are currently being explored with manufacturers.

Mapping out the future of energy

The wood-processing sector is a significant user and generator of bioenergy in New Zealand. With the help of visiting Danish scientist Dr Bernd Moeller, Forest Research is developing a nationwide database to quantify how much wood waste is available, and where. The GIS-based study will analyse the geographical distribution of biomass resources (i.e., in-forest residues and sawmill waste) and the related transportation costs for different areas of the country. This represents an important first step in expanding the practical utilisation of waste as a renewable energy source for New Zealand, through determining what the energy consumption will be in an area, and what resources are available to service the demand, and to improve prediction of future fuel supplies.

PAPRO – pulp, paper, and packaging

Building better products from the fibre up

The Pulp and Paper Research Organisation (PAPRO) has a long history of close collaboration with industry partners to improve manufacturing processes and products using wood-based fibre. Over the past year, key relationships have been strengthened to ensure the entire research spectrum is supported, from applied to fundamental.

In partnership with Carter Holt Harvey Tasman, PAPRO constructed a pilot-scale fibre cement machine to simulate panel production in the laboratory. This enables detailed analysis of how improvements can be made in the manufacture of fibre cement panels, which is a rapidly growing sector of the construction materials market worldwide. Radiata pine fibres provide superior performance in fibre-cement panels, and enhanced knowledge of the fibre/matrix interactions will help to optimise this advantage for New Zealand industry and lead to new value-added products.

"In order to remain internationally competitive, the New Zealand paper and fibre industry continues to develop new products. Our focus is on seeking radical step-changes in conventional processing technologies to augment those already practised by manufacturers."

Dr Bob Allison – Unit Leader

Development of new papers is being carried out in partnership with Norske Skog Australasia. This presents an opportunity to design printing papers with high information carrying and transfer capability by optimising the structure and surface of the fibre network. This project draws on the manufacturing expertise of Norske Skog and PAPRO's extensive knowledge of fibre processing and product development.

A further collaborative study is investigating the potential of bio-assisted mechanical pulping, using fungal species found in New Zealand. By using fungi to naturally degrade targeted wood components, it is possible to significantly decrease the energy demands of mechanical pulping. This technology has been demonstrated successfully in the United States, using fungal strains that cannot be introduced into New Zealand. In collaboration with Pan Pacific Forest Products, Norske Skog, and the University of Waikato, PAPRO has identified local strains of fungi that have potential to perform a similar function. The aim is to find the right organism that will match or improve on existing bio-assisted technologies overseas.

Protecting the rivers

Environmental scientists at Forest Research are conducting a 3-year study to determine how much oxygen is needed to keep river life safe in water carrying pulp mill effluent. This project was started in response to concerns about the combined effect of pulp mill operations and low dissolved oxygen on aquatic life in the Tarawera River. Its purpose is to determine exactly what levels are considered "safe" for local conditions. Funded by the three pulp mills concerned, DoC, and Environment Bay of Plenty, this is believed to be the first time a research project has been used as part of a resource consent.

The built environment

Enhancing the places where we live, work, and play

Recent Government strategies show that support for sustainable urban development is growing. Awareness at national level of the need to incorporate stronger sustainability principles into policy development is now being reflected in the building code. Forest Research believes that the desired measures can be achieved through the expanded utilisation of wood. The Built Environment team recently published a bulletin entitled "Building Green in New Zealand", which provides information to practitioners in the building professions. This bulletin demonstrates a more sustainable approach to urban construction through the use of New Zealand's renewable wood resources.

In addition, research by acoustics specialist, Dr Grant Emms, has sought to improve the performance of timber-framed buildings, particularly in multi-storey structures. Forest Research has constructed a testing facility to assist in the design of inter-tenancy flooring systems that minimise sound transmission and allow timber framing to compete with concrete in high density urban housing.

"New Zealand's population is growing, there is less urban land available, and there is a trend towards extended family members sharing one household. Coupled with this is the need for resource efficiency and also the belief that time is a very precious commodity. Each day 49 people arrive in Auckland, they need 21 houses, and 35 cars. These conditions demand a more creative approach to urban development and greater flexibility in housing construction. Here, wood and other biomaterials have a strong role to play."
Karen Bayne – Unit Leader

Energy efficiency has also become a major consideration in all building systems, prompting a rush of design innovation to optimise thermal performance. Timber-framed buildings have a low thermal mass compared with concrete, causing indoor temperatures to fluctuate more rapidly in relation to outdoor conditions. Forest Research's Mike Collins has developed a proposal to improve thermal mass in wooden buildings in a way that gives much greater flexibility than masonry structures. The proposed system is connected to solar panels, and stores heat and cold in insulated underground reservoirs containing water. This provides stored energy for use in low-grade space heating, air conditioning, and other applications. Preliminary estimates of performance indicate that the system could provide useful heat storage and therefore reduce energy consumption for both heating and cooling applications. Plans are now under way for testing a prototype of the system.

NOW home

The NOW Home project is the first step in a wider project primarily aimed at enhancing the quality of life for residents in New Zealand. Plans are now in place to construct a home that demonstrates best use of today's technologies, with a view to creating a building that meets Government and personal requirements for the next decade. Far from being just another "eco-home" this is the first stage in a series of demonstration homes that will investigate ways in which housing can be designed differently, or enhanced through retrofitting, to incorporate the changing needs (social, economic, and environmental) of our society. The goal is to demonstrate real solutions that will improve living standards, health and wellbeing for the whole population. Forest Research conceived the NOW Home project in partnership with the Waitakere City Council, Winstone Wallboards Ltd, the Building Research Association of New Zealand Ltd (BRANZ Ltd), the Energy Efficiency Conservation Authority (EECA) and with the support of FRST.

Biomaterials: past, present, future

Throughout human history, people have been using materials sourced from plants. Forest Research is continuing this work and rediscovering the potential of natural fibres and plant chemistry to create sophisticated new materials for tomorrow's world.

The development of modern, high-performance biomaterials starts from a deep knowledge of plant cells. Genetic scientists are discovering how plants go about building themselves, and how their structure can be influenced, using advanced biotechnology tools, to meet the requirements for other new applications.

Pictured from left are Tupara Morrison (Maori Business Development Manager), Teresa Murray (Pou Raranga – traditional fibre weaving specialist), Taporoto Nicholson (Maori Arts & Crafts Institute) and Dr Phillip Wilcox.

Cell wall biotechnology

The CellWall Biotechnology Centre (CBC) has been set up at Forest Research to investigate the development of plant cell walls. And what is so special about cell walls? Cellulose, a complex carbohydrate, is the main component of plant cell walls and is also the world's most abundant bio-polymer. A greater understanding of cell walls at a molecular level will lay the foundation for widespread utilisation of this vast renewable resource, both as an energy source and a basis for new biomaterials. Furthermore, the fibre cell itself is the basic building block of the pulp and paper industry, and potentially a feedstock of choice for the natural composites revolution.

"My view is that you have to put science alongside Matauranga Maori [spiritual and cultural values] and find where they complement each other. Once cultural acceptance is gained, you should have a pretty good basis for sustainable economic development."

Dr Phillip Wilcox (Ngati Kahungunu) – genetic scientist

Slicing through the walls

Microscopy specialist, Dr Lloyd Donaldson has recently made a breakthrough in the study of plant cell walls. Using a range of techniques, including sophisticated image analysis, computer modelling, and novel techniques for cutting extremely thin slices through the cell wall, Dr Donaldson is uncovering details of how the different chemical components of cell walls are organised with each other. These details allow a fundamental understanding of cell wall properties. This knowledge is essential to underpin modification of these components for new appications.

Biomaterials: past, present, future

As scientists now look to develop new biological-based materials, it is necessary to fill major gaps in technical knowledge. Over the past century, manufacturing industries have focused much attention on the production of synthetics. Starting with a non-renewable mineral base, it has been possible to create large volumes of materials that are uniform in consistency and highly cost-effective to produce.

Biological raw materials, such as solid wood and plant fibres, are not so straightforward but, unlike finite mineral resources, their potential supply can be endless. Forest Research sees current biomaterial developments as the way of the future.

"Biomaterial science is about more than just gaining knowledge. It means understanding market opportunities where creative chemistry can generate an innovative process to germinate an entrepreneurial business. We need to fulfill market expectations, or even to create a market, which was hitherto unrealised - there was never a market demand for a Rubik Cube!"

Dr Robert Franich – Principal Scientist

Pictured with Dr Robert Franich (left) are Warren Moore, Marketing Manager, Pacific Hardwood and Jeremy Warnes, Senior Scientist.

Creating business opportunities from chemistry results

Invented by Dr Robert Franich, Indurite™ is a wood hardening process that makes radiata pine look and behave like a stable hardwood. This innovative chemical process involves modifying the wood cell walls and filling the natural spaces within wood cells with biopolymers instead of petro-chemicals. The resulting patented technology, Indurite™, has been commercialised and further developed both in New Zealand and overseas. Now marketed by licensees such as Pacific Hardwoods Ltd under their brand Green Seal™, the sustainable solidwood, the new high-performance biomaterial is growing rapidly in commercial production.

The Indurite story illustrates how the ideas of today can become the biomaterial products of the future. This can be achieved only through a long and challenging process of technology development, commercialisation and marketing, against the fierce competition of established materials. Forest Research has proved it can be done.

Exploring the inner space of biomaterials

Forest Research scientists have recently developed a unique microscopy technique that allows them to see inside composite materials in a manner previously impossible. This advanced resin visualisation technology can be applied to a variety of materials ranging from MDF (medium density fibreboard) to natural fibre-bioplastic composites. Scientists can now gain a fundamental understanding of how fibres bond and interact with the resins, waxes, and plastics that make up the binding matrix. The advanced visualisation technique has already been used to improve product performance and resin bonding efficiency in MDF. Similarly, it opens the way for significant step changes to be made in constructing natural fibre-plastics to suit different end-uses in just the same way that synthetic materials have been tailored to meet the performance demands of varied applications over many years.

Biomaterials: past, present, future

Nature contains a vast reservoir of miniature factories in the form of micro-organisms. Many species perform a function or produce some kind of chemical byproduct that could be of value to industry, medicine, or a host of other applications. Forest Research is exploring New Zealand's largely untapped microbial resource in search of new allies to help in waste management and biomaterial production.

Microbiologists in the Eco-Smart Technologies Science Unit at Forest Research have developed sophisticated methodologies for isolating and identifying different species of micro-organisms for specialised purposes. This expertise sprang from studies of wastewater treatment systems at pulp and paper mills. Scientists are now "bioprospecting" for bacteria that can break down other waste streams, manufacture polymers and other complex chemicals, and create value in ways that were previously unexplored.

"Eliminating waste impacts and creating new biomaterials using microbiology makes great sense. We are helping nature to help us and to save the natural environment."

Dr Trevor Stuthridge – Science unit leader, Eco-Smart Technologies.

Microbiologist, Sonia Foote collects samples with Technician, Sarah Addison, Senior Scientist, Dr Daniel Gapes and Dr Trevor Stuthridge.

N-ViroTech goes live

This year has seen the first full-scale application of N-ViroTech®, a process which uses nitrogen-fixing bacteria to treat wastewater in an environmentally-friendly manner. The trial was undertaken at a Scandinavian pulp and paper mill and successfully converted a conventional activated sludge treatment system to the N-ViroTech® process. As predicted, the new technology substantially lowered nutrient discharges, eliminated the need for expensive chemical additives, and obtained a 27% energy saving during the study period. The trial gave Forest Research scientists a valuable opportunity to identify and overcome technical challenges, and the participating mill is now exploring options to make a permanent switch to the new system.

Completion of this trial is a key step towards our development of a suite of innovative waste treatment technologies based around nitrogen fixation. As the first generation of this technology takes hold within the industry, it will enable the commercial development of the next revolutionary opportunities. These include a new process that produces bioplastics from waste streams. In the past year, Forest Research has isolated strains of bacterial species capable of yielding almost 60% of their weight in biopolymers. Ultimately, such technologies will be critical suppliers of renewable resources for tomorrow's biomaterials engineering opportunities.

Environmentally intelligent plastics

Forest Research scientists are developing a range of biomaterials that can be tuned to their natural environment. By combining synthetic and biological plastics with additives obtained from industrial wastes, scientists can adjust the relative biodegradability of the material. This will allow the design of products which will break down at defined rates during use or after disposal. Opportunities include biodegradable containers, and slow-release products.

Strengthening ties with Tangata Whenua

In the past year, Forest Research made significant progress in the development of a Maori strategy for the organisation. Critical to the success of such a strategy is the recognition of the Treaty of Waitangi obligations of partnership, participation, and protection, and within this framework the recognition of Tangata Whenua status in relation to the lands on which Forest Research is based.

The key drivers to achieve organisational recognition are Board commitment and Chief Executive leadership. This allows strategic frameworks and structures to be put in place to raise staff awareness and create an environment that is responsive to Maori.

Progress so far:

- Partnership developments with Tangata Whenua (Ngati Taeotu, Ngati Hurungaterangi, and Ngati Te Kahu) include endorsement and monitoring of genetic engineering trials, advisory functions provided by kaumatua Ben Hona and Eria Moke, and recognition of Tangata Whenua status at the Biomaterial Futures launch in May.

- The appointment in June of Maori Business Development Manager, Tupara Morrison, has assisted in building strategic relationships with Maori, and driving the Maori strategy across Forest Research.

- A number of business units have celebrated success in terms of Maori responsiveness such as the relationships built by Tim Barnard (Sustainable Forest Management) with hapu, iwi, and Maori research groups, and the employment of Maori students in other areas of the organisation.

Forest Research's progress needs to be seen as the beginning of a journey towards recognition. Increasing awareness across the organisation can assist with forging new partnerships with Maori. Increasing connectivity and participation by Maori in the work that Forest Research undertakes is a key priority for the future.

Te Aroturuki

To monitor

Aro = consider, think.
Turuki = come as a supplement, follow, reinforce.

Forest Research, in association with the Tangata Whenua (Ngati Taeotu, Ngati Hurungaterangi, and Ngati Te Kahu), has initiated a national Maori consultation group, to ensure that areas of concern to Maori around plant gene technologies are addressed as part of the science programme. The specific role of this group, known as Te Aroturuki, is to advise scientists on mechanisms for utilisation of Forest Research biotechnologies, for the benefit of Maori in general, or specific iwi and hapu and Maori organisations. The group will also monitor current Government-funded research activities and assist researchers with new ways of looking at biological issues in the light of Maori perspectives and priorities, including tikanga and Matauranga Maori.

In the past year a kaupapa has been worked out and the group has been established with the blessing of Tangata Whenua. An external consultant (Henare Kani, Ngati Kahungunu) assisted with the establishment of the group, as well as issues around monitoring of field trials and transfer of genetically modified materials. Group membership is based on diversity of skills and knowledge, ranging from forestry and agriculture to Matauranga Maori. Tangata Whenua are specifically represented, along with Te Whare Wananga o Awanuiarangi, which is developing an educational science programme.

Growing totara for timber

Forest Research has recently produced a bulletin on growing totara as a production species. Written by indigenous tree specialist, David Bergin, this book provides information on planting totara and managing young, naturally regenerating stands on pastoral land. Dr Bergin says that totara is one of the easiest indigenous trees to establish on a wide range of sites and it is seen as a promising high-value species for wood production, as well as fulfilling environmental, cultural, and social values.

The bulletin covers all aspects of tree growth, wood characteristics, and the management of totara for wood and non-wood values. It was funded from the Sustainable Management Fund of the Ministry for the Environment and FRST, with in-kind support from community-based interest groups, iwi, resource managing agencies, and landowners.

Staff achievements

Forest Research is proud to record the following staff achievements during the year.

Medals/Awards

Dr John Moore was awarded the Chavasse Travel Award from the New Zealand Institute of Forestry to attend the IUFRO Conference on "Wind Effects on Trees" in Kalsruhe, Germany.

Nick Ledgard was honoured as the South Island Farm Forester of the Year at the annual New Zealand Farm Forestry Association's conference.

Nick Ledgard and daughter, Penny with the South Island Farm Forester of the Year Åward

Karl Murton won the Tampella Trophy awarded biennially to the author of the best paper presented to the technical session of the Eminent Refiner Groundwood Scientist (ERGS) meeting in Quebec City, Canada.

Roche Diagnostics invited Dr Sheree Cato to attend the Queenstown Molecular Biology Conference and report on her xylem gene expression results using the Roche LightCycler real-time PCR machine. The poster Sheree presented won the Student Award for best poster. This is the third year running that Sheree has won the Student Poster Award!

Stuart Anderson was successful in gaining a travel award from the Forest and Rural Fire Association of New Zealand to undertake a study tour of provincial fire management and fire research centres in Canada.

Jerzy Zabkiewicz was an invited speaker at the 10th IUPAC International Congress on the Chemistry of Crop Protection in Basel, Switzerland. This congress is held every 4 years and is the pre-eminent forum for crop protection research in the world.

Dr Adya Singh received the Brain Pool Scientist Award from the Korea Science and Engineering Foundation to undertake collaborative research in plant cell biology.

Callum Kay was a finalist for Forest Health Trainee of the year at the Forest Industries Training Awards.

Charles McIntosh was one of four finalists for the NSC KO-LOK travel and study grant funded by National Starch & Chemical NZ Ltd.

The Forest Research Annual Report for 2002 was a finalist in the Large Companies category at the Institute of Chartered Accountants of New Zealand Annual Report Awards.

Qualifications

Bronwyn Rogers was awarded a Graduate Diploma with distinction in Geographic Information Systems.

Master of Science degrees were conferred on David Pont (1st class honours), Sonia Foote (1st class honours), Brendan Lee, and Pascal Berrill.

PhD degrees were awarded to Elizabeth Dunningham, Robin Wakeling, Michael Watt, and Kirk Torr.

German Ortiz completed his MBA degree at the University of Waikato.

Dr Dave Cown won the FIEA Bill Thode Award recognising his outstanding contribution to the forestry and wood products sectors.

Dr Elizabeth Dunningham graduated at the University of Bangor, Wales

Fellowships/ Memberships

Dr Paul Kibblewhite, Dr Lloyd Donaldson, and Dr Stuart Corson were elected Fellows of the International Academy of Wood Science.

Sonia Foote and Dr Mike van den Heuvel were each awarded a Royal Society of New Zealand ISAT Linkages Fund Scholarship, which enabled them to travel to Germany and establish new collaborations in their fields of endeavour.

Mike was also chosen as an honorary lecturer at the University of Waikato's Department of Biological Sciences.

Dr Tom Richardson was appointed to the Biological Sciences, Agricultural and Environmental Studies panel, one of the 12 peer review panels which have been established to support the implementation of the Performance Based Research Fund (PBRF).

Dr Toni Withers was selected as the Technical Advisor to the MAF Forest Biosecurity Group, to provide expert scientific advice on *Uraba.*

Dr Mike van den Heuvel

Dr Adya Singh was re-elected to the Council of International Association of Wood Anatomists for a second term.

As well as his appointment as Secretary of the Soil Physics Commission, International Union of Soil Sciences, Dr Gujja Magesan joined the Executive Committee of the New Zealand Society of Soil Science.

Finally, two PhD students, Kai Hofig and Ralf Moeller, had their research results published in the highly reputable international journal, *Planta.* This is an indication of the high quality of their work since *Planta* currently accepts only 10% of the submitted manuscripts for publication. Ralf's paper describes the development and detailed analysis of secondary wall tissue culture, a new technology that will be an important tool for the testing of genes involved in cell wall formation. Kai's work on genes and promoters involved in sterility will enable us to better understand reproductive development in conifers and possibly mitigate risk when deploying genetically modified trees.

Business units

VIGIL

Forest Research's forest health advisory service, VIGIL, continued to provide a range of specialist forest surveillance and monitoring services during the year. An ISO 9001:2000 certified company, VIGIL operates out of offices in Auckland, Rotorua, Wellington, Nelson, Christchurch, and Mosgiel.

Samples collected by VIGIL surveillance officers in the field are diagnosed at Forest Research, and new pest and disease records are reported to the owner and to MAF. There were four new-to-New Zealand finds and a total of 116 new records (including new regional distributions and new host species) reported in the period ended 30 June 2003.

All elm trees in the four cities of greater Auckland continue to be inspected over the summer period for evidence of Dutch elm disease. This programme is funded jointly by the city councils and MAF. Any signs of infection are promptly dealt with by way of tree removal. This programme remains on track for eradication, which will be a world first if is it achieved.

VIGIL also participated in MAF pest response programmes for the extensive spraying operation of PAM over western Auckland, as well as ongoing monitoring in the North Island for subterranean termites. Other contributions included responses for fall webworm and gumleaf skeletoniser.

VIGIL also makes a major contribution to the country's national forest health surveillance programme. Work includes aerial and ground surveys in plantation forests aimed at early detection of new pests and disease. Post-border surveillance work for MAF included 267 scheduled inspections of areas historically designated as risk sites for new pest and disease introductions.

In addition to these risk site surveys, VIGIL carried out a pilot survey in the vicinity of Auckland International Airport and successfully tested new intensive surveillance techniques. VIGIL also responded to some 171 documented enquiries from members of the public with responses provided either at the time of enquiry or through a follow-up site visit.

Increasingly VIGIL is involved in broader forest condition monitoring, where a more intensive inspection process is required in both exotic and indigenous forests.

Nursery

The highlight of the year for the Forest Research nursery has undoubtedly been the building of the new propagation house. This state-of-the-art facility has replaced glasshouses, some of which were originally built in the 1950s. The new facility allows for commercial scale propagation in three separate controlled environments, which can be operated all year round. It is currently being used for the mass production of radiata pine seedlings, selected from 100 families suitable for farm sites. These clonal stocks are being prepared for planting by Corrections Inmate Employment, who will use them to produce cuttings on a large scale.

The nursery has also supplied stock for several trials established by Forest Research and external clients, such as the Radiata Pine Breeding Company and Cellfor. Forest Research projects include *Eucalyptus* species trials, *Acacia melanoxylon, Cupressus macrocarpa* and *C. lusitanica* for canker and clonal screening trials, and clonal *P. radiata* for sustainability trials. The nursery also produced a large commercial crop of *Eucalyptus fastigata* for Carter Holt Harvey Forests. The nursery has several years of work in the pipeline and is looking forward to the future with confidence.

Centre for human factors and ergonomics – COHFE

COHFE's work has traditionally focused on logging and silviculture. COHFE ergonomists continue to demonstrate a proven track record in applying research to achieve practical outputs which benefit the industry as a whole. Over recent years, COHFE has extended its work into other industries including timber processing, agriculture, and construction.

Recent work includes the development of a video rear vision system for forestry machines to reduce the risk of hitting workers. The COHFE team is also addressing musculoskeletal disorders in timber processing plant workers, quantifying dehydration in forest workers, and developing ways to reduce all-terrain vehicle accidents.

In the past year, COHFE researchers assisted the Built Environment group in exploring issues associated with working from home. This project relied on case-studies gained through visiting self-employed or employed participants who work from home, and establishing the thermal and physical characteristics of their home workplace (usually office). A need for better resources was identified, to assist the increasing numbers of people who work at home to set up an environment that is conducive to performance, health, and safety. This work is being continued to establish whether participants are working within recommended thermal conditions during the winter months.

COHFE scientists also enjoy regular collaboration with other national injury prevention groups and ergonomics researchers; these include Massey University, with whom they are currently conducting a 2-year study addressing slips, trips, and falls in dairy farming and construction. So far this work has involved detailed interviews with a sample of workers from both industry sectors, establishing the factors which initiated the slip or fall event and how the injury was sustained. This level of detail, along with site visits and task observation, will allow interventions to be proposed, which the researchers will then be implementing and evaluating over the next year.

COHFE's work has included a number of research contracts with forest companies, the New Zealand Forest Owners' Association and the New Zealand Forest Industries Council, the Accident Compensation Corporation, and Health Research Council. As well as its strong national profile, COHFE has an enviable reputation overseas and strong international links. Researchers have continued this year to liaise and/or collaborate with groups such as NASA, Heller Institute of Medical Research in Israel, Loughborough University in the UK, Nagoya University in Japan, and the US Army Research Institute of Environmental Medicine, amongst others.

Veritec

Veritec has experienced an estimated 20% growth in commercial volume over the past year. Part of this increase is due to the advent of "leaky building syndrome", requiring tests that determine whether timber samples contain the appropriate level of chemicals for their given application. Due to the change of wood treatment regulations, more tests of this nature are coming on line, such as Permethrin and IPBC (Iodo propynyl butyl carbamate) in wood. In the newly drafted New Zealand Timber Preservation Standard, these chemicals are now required in H1 and H3 treated timber to provide protection from insect attack and fungal decay.

Veritec has also developed methods to detect lignin and carbohydrates in wood on a routine basis using small sample sizes. Using a method developed by Dr John Ralph, formerly of Forest Research, they can also provide the S:G (Syringyl:Guaiacyl) ratio in the lignin.
By determining the ratio of the monomer units of the lignin structure, a better idea of the structural composition of the lignin in the wood can be gained. This ratio affects the ease with which wood can be pulped, and so provides a means by which the pulp industry can reduce energy inputs.

A number of new staff have been appointed to process Veritec's increased workload.

SignaGen®

SignaGen's fifth year of operation was one of consolidation and continued confidence in its ability to attract commercial revenues. Revenues were kept within the previous year's level while the business was further positioned to attract external investment.

SignaGen continued to provide services across the sheep, cattle, arable, horticultural, and forestry sectors to a core set of large clients. At the same time, increasing numbers of new smaller clients were attracted, particularly in the sheep and cattle sectors.

Significant in-roads into the Australasian sheep DNA testing market continued, with SignaGen's Baa Code® service now accounting for a third of all revenues.

Successful development of business in Australia has been accomplished during the worst drought, and most depressed livestock sector in decades, giving further cause for confidence in future Australian expansion.

SignaGen's strategy of diversification continued with the instigation of development programmes for a number of new services including equine, deer, and canine DNA profiling, which will be rolled out in the new year.

In April, Dr Peter Reed was welcomed as SignaGen's new General Manager. He returned to New Zealand to take up the position after 17 years working overseas in both the commercial and research sectors. Dr Reed has a PhD in genetics from the University of Oxford and helped create and manage one of the UK's most successful commercial genetic research companies. He brings to SignaGen a consummate level of expertise in DNA technology as well as significant global commercial experience.

ATLAS

ATLAS Technology, the software business unit for Forest Research, has had another successful year, building and strengthening customer relationships along with establishing a higher awareness in the marketplace.

Continuous improvement of software development processes has helped to provide a more efficient service to clients in the commercial market. A systematic implementation process was developed that enables clients to effect a business/system change within their organisation with a minimum of disruption.

Support for our established products (STANDPAK, FOLPI, MARVL) has continued and training has been given to a number of clients in the use of these tools. In the newer generation products, further development and enhancement to the two lead products ATLAS Cruiser™ and ATLAS GeoMaster™ have increased their flexibility and capability to meet industry requirements in their respective fields. ATLAS GeoMaster™ has proved to be a powerful forest and land information system, which has been successfully implemented into a number of large forest companies.

The major area of development undertaken this year is the prototype of ATLAS Market Supply™, a harvest-scheduling product designed to optimise the allocation of mature forest to log market orders. Jointly developed with State Forests of New South Wales, this software uses innovative algorithms and technological advancements in terms of data management and systems integration, providing better management information for business operations.

Further developments are planned with sights being set on continued growth for the future, providing next-generation, user friendly tools for the industry.

Australia

The 2002-2003 year has been a successful one for Forest Research in Australia. Overall revenues from the Australian market rose from $1.3 million to just over $2 million.

Particular highlights include the contracting and development of software optimising and logistics systems for State Forests of New South Wales (SF NSW). The main emphasis of these projects is to support the SF NSW harvest planning and delivered sales business.
The SF NSW relationship has enabled Forest Research to develop specific software systems within well-defined specifications matched to specific business needs. The close relationship Australian-based project management staff have with counterparts in SF NSW has been crucial to this relationship's success.

There has been steady growth in the pulp and paper market with PAPRO undertaking increased work with Australian-domiciled clients. Given the scale of the Australian pulp and paper sector this trend is expected to gather pace.

Forest Research is operating more frequently with, and through, strategic partners. This method is of increasing importance for any significant and sustained activity outside the New Zealand market. The genesis of this operating mode in the Australian context is the collaborative work Forest Research has undertaken with CSIRO Forestry and Forest Products. Both organisations are undertaking joint R&D projects for the Forest and Wood Products Research and Development Corporation (FWPRDC), and for the recently established Wood Quality Initiative (WQI) in New Zealand. The deliverables to clients are enhanced by leveraging off the competencies of both companies.

Looking forward, and given the dynamic and changing nature of the forest industries research and development market in Australasia, it is likely that science and services will be delivered more and more through key partnership arrangements, both with R&D providers and industrial partners.

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Forest Research's miracle dog

Dr Paul Kibblewhite's guide dog, Taupo, is proof that miracles do happen. Earlier this year, the world-renowned scientist was hiking in the Tongariro National Park with Taupo as his eyes, when disaster struck. One evening in a remote hut, Taupo went into serious convulsions, apparently having eaten some kind of poison.

Fortunately there was a veterinarian in Dr Kibblewhite's party, who was able to recognise the symptoms. One of their companions managed to find some long forgotten sleeping pills in the bottom of a first aid kit, which helped to control the initial convulsions. Although there was no local cellphone coverage at the hut, an Austrian backpacker happened to have a phone that could transmit an emergency call via Europe. Taupo wasn't expected to live another hour, but the dog showed remarkable strength until a search and rescue party arrived on foot with more drugs. Miraculously, she made it through the stormy night until a rescue helicopter was able to land.

Without any one of these factors in an amazing chain of events, the dog would certainly have died. Taupo went on to make a full recovery, with none of the liver damage that was feared. The only difference Dr Kibblewhite observes is that his dog is a bit crazier than she was before. "It's because she is happy to be alive," he smiles.

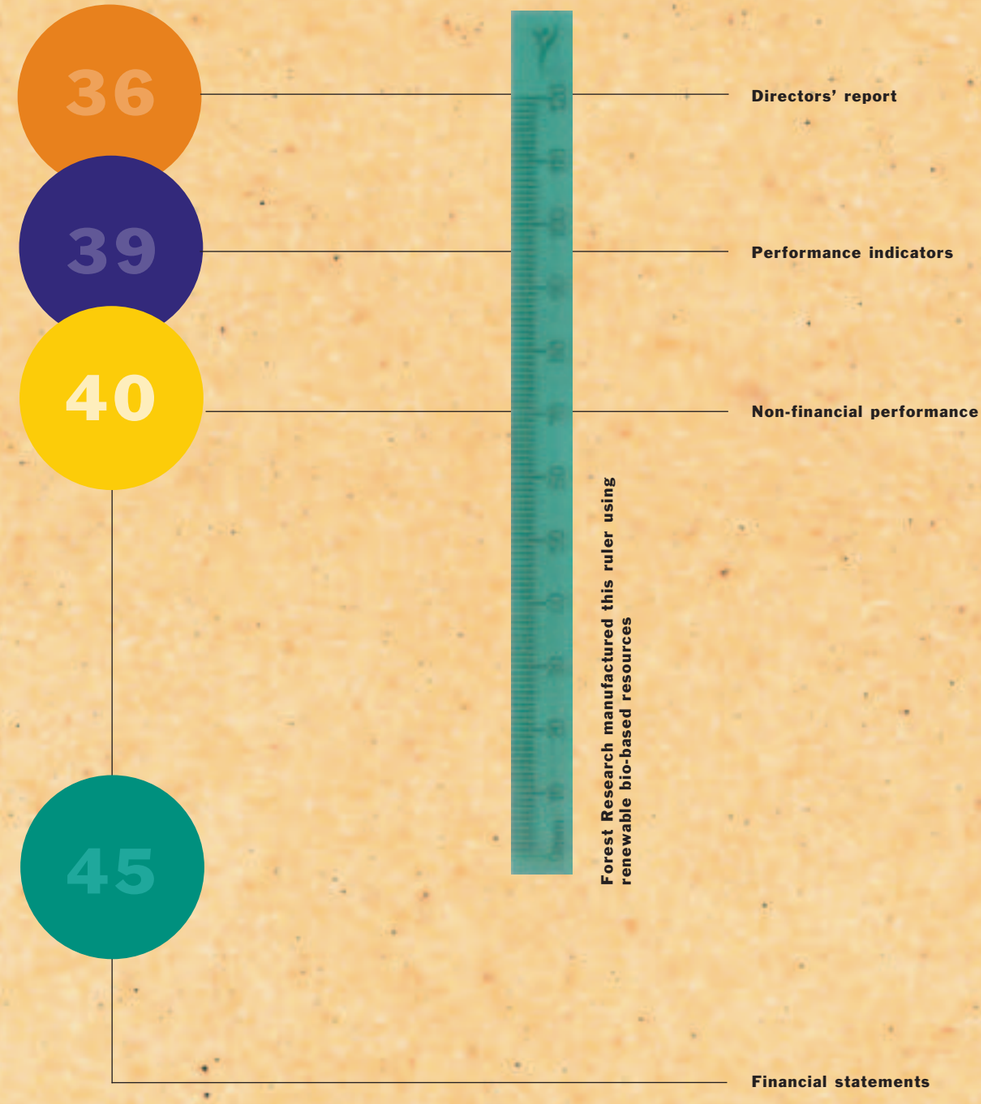
High-performance scientists

Forest Research fosters achievement in more than just science. Located right next to Whakarewarewa Forest, the Rotorua campus represents a haven for sports-minded staff.

Microbiologist, Sonia Foote has taken full advantage of the excellent training ground on her doorstep and become one of New Zealand's leading woman mountain bikers. She successfully defended her National Mountainbike Championships title in the Expert Senior Women's category staged recently in Blenheim. A week later she became the National Champion in her age-group at the XTERRA Champs in Rotorua, a major triathlon event. This success has qualified Sonia to represent New Zealand at the World XTERRA (off-road triathlon) Championships to be held in Hawaii later this year. "Forest Research is a perfect place because it's so easy to train at lunchtime or after work," she says. "You can step out of the lab and within minutes you are running or riding in one of the country's best recreational areas. We're amazingly lucky here."

Sonia's cycling coach is fellow Forest Research scientist, John Lee. While working in the tree-breeding group since 1985, John is the national mountain bike coach of Cycling New Zealand and is currently a national selector for the mountain bike team preparing for the Athens Olympics. In 2002, John was one of the cycling coaches for the Commonwealth Games team in Manchester. He says that working with athletes like Sonia is a dream, because she is immensely competitive and incredibly focused. These characteristics have also been borne out in her science career where, as a Bright Futures scholar, Sonia achieved her Masters Degree with first-class honours. "It's hard to ignore mountain biking when you live in Rotorua, and Forest Research people are often out on the trails. Sonia puts 100% into whatever she does, so she is taking it to the extreme," John says.

Sonia Foote with coach, John Lee



Directors' report

Principal activities

Forest Research is a company registered under the Companies Act 1993 and our principal activity is to conduct research in accordance with the purpose and principles specified in Sections 4 and 5 of the Crown Research Institutes Act 1992 (the Act). Forest Research has met all the obligations under the Act in the year ended 30 June 2003.

Forest Research is a commercially focused science and technology company, delivering solutions to both commercial and Crown clients. The principal research facility is located in Rotorua.

Forest Research, at balance date, has eight wholly-owned subsidiaries, FHS Limited (FHS), Liro Limited, DNA Testing Services Limited, N-Fix Technologies Limited, Forest Research (Australasia) Pty Limited, Forest Research (Australasia) #2 Pty Limited, Atlas Technology Limited, SignaGen Limited, and two associates – 50% shareholding in the Centre for Advanced Composite Materials Limited (CACM) and 25% ownership of Frontline Biosecurity Limited. Forest Research is a member of a consortium with a 13% shareholding in WQI Limited.

FHS, currently trading as VIGIL, provides a range of services to industry, Government, and local and regional authorities aimed at the early detection of pests and diseases. VIGIL's total revenue for the year to 30 June 2003 was $2.463 million, with an operating loss of $50,000.

Forest Research (Australasia) Pty Limited is the Australian trading vehicle. The Company is a New Zealand registered company.

N-Fix Technologies Limited, CACM and Liro Limited are non-trading companies.

DNA Testing Services Limited, Atlas Technology Limited, SignaGen Limited, and Forest Research (Australasia) #2 Pty Limited are shelf companies. Forest Research (Australasia) #2 Pty Limited is an Australian registered company, held for name protection purposes.

Summary of group financial results to 30 June 2003

	2003	*2002*
	$000	*$000*
Operating Revenue	**39,594**	**39,502**
Operating surplus before non-recurring revenue, expenses and taxation	1,204	153
Non-recurring revenues	380	-
Non-recurring expenses	(306)	(2,117)
Net surplus/(deficit) before taxation	1,278	(1,964)
Taxation expense	583	(261)
Net surplus/(deficit) after taxation	**695**	**(1,703)**
Share of after tax retained (deficits)of associate companies	(5)	(5)
Minority interest share	-	59
Net surplus/(deficit) attributable to the Shareholders	**690**	**(1,649)**
Equity		
Issued and paid up capital	15,716	15,716
Retained earnings	7,829	7,138
Minority interest	-	-
Total equity	**23,545**	**22,854**

Frontline Biosecurity Limited is an incorporated joint venture, the purpose of which is to collaborate in the research and development and commercialisation of the heat disinfestation process and other biosecurity processes.

WQI Limited (Wood Quality Initiative) is a Consortium with 14 other shareholders.

Forest Research is a major provider of technology solutions and research services and consultancy to the forest and wood products sectors in New Zealand and internationally. It is one of the few forest research organisations in the world whose expertise spans the value chain, from seed to market.

Forest Research has extended its focus beyond wood to meet the growing consumer demand for renewable materials and products from plants.

Researchers concentrate on transformational science in the areas of CellWall biotechnology, Bioconversion, and Biomaterials engineering.

Complementing these fundamental science programmes, six responsive science units meet client needs in the areas of Biosecurity and Protection, Forest and Crop Development, Sustainable Forest Management, Wood and Fibre Quality, Pulp and Paper, and Wood Products and Processing.

Our three commercial business units are:
- ATLAS Technology - forestry management software solutions.
- SignaGen® - DNA technology and testing services.
- Veritec - high-volume testing of soil, water, wood, chemicals, and foliage.

Dividend

No dividend payment is recommended (2002: $3million).

Directors' Remuneration

	30 June 2003	*30 June 2002*
Brian Armstrong	38,000	35,375
Bryce Whitcher *	29,375	39,188
Jane Taylor	26,500	19,250
Giff Davidson	22,500	19,250
Temuera Hall	17,500	16,000
Mere Roberts	17,500	16,000
Margaret Emerre	18,250	1,333
Nick Roberts (Resigned 27/02/02)	-	10,667
External Director Shaan Stevens (IFR Technologies - Resigned 20/12/02)	6,250	12,500
Total	$175,875	$169,563

** Bryce Whitcher was also a Director of IFR Technologies Ltd until 20 December 2002.*

Directors' Profiles

Mr Brian Armstrong (Chairman) – is a Consultant and Company Director. Mr Armstrong is currently a Director of Kiwifruit International Limited and a number of private companies. He has considerable experience in international business, his own entrepreneurial ventures, and a private investment consultancy. Mr Armstrong has recently retired from the Zespri Group where he held a range of positions – Deputy Chair of Zespri Group Ltd and Chair of Zespri International Ltd and Director of NZKMB. He has also recently retired as long term Chair of Athenberry Holdings Ltd. Mr Armstrong holds a MSc (Hons), and a BCom.

Mr Bryce Whitcher (Deputy Chairman) – is CEO of Electronic Data Holdings Limited and former Chairman of IFR Technologies Limited. Mr Whitcher previously held senior management positions with Tasman Pulp and Paper and Fletcher Challenge Paper both in New Zealand and Chile. Mr Whitcher holds a BSc in Chemistry.

Mrs Jane Taylor (Director) – is a Barrister and Company Director. Mrs Taylor previously practised as a Chartered Accountant. Her business background includes business and share valuations, corporate finance, insolvency and company reconstruction, and litigation support. Mrs Taylor has a long association with the forest industry, and was previously a Director of Forestry Corporation of New Zealand. Mrs Taylor holds an LLB (Hons), a post-graduate Diploma in Accountancy, a BSc (Hons) Forestry, and is a member of the Institute of Directors, NZ Law Society and the Institute of Chartered Accountants of NZ.

Mr Temuera Hall (Director) – is Managing Director of LTF Limited, Investment Company, a subsidiary of Lake Taupo Forest Trust. Mr Hall is also Investment and Planning Advisor to the Lake Taupo Forest Trust and Project Team Leader of the Tuwharetoa 2000 Project. He is an Executive Member of the Maori Forestry Association and Forestry Industries Training Runanga. Mr Hall holds a BSocSc.

Mr Giff Davidson OBE, JP (Director) – is a professional Company Director, Chairman of Animal Products Limited, and Chairman of the Korea/New Zealand Business Council. Mr Davidson is a past President of the New Zealand Institute of International Affairs, past Chairman of the New Zealand Chamber of Commerce, and past Chairman of EECA. He had a long and successful business career with Shell NZ Holdings Ltd.

Dr Mere Roberts (Director) – is a Senior Lecturer, School of Environmental and Marine Sciences, and Assistant Dean (Maori) Faculty of Science, University of Auckland. Dr Roberts' principal research interests cover genetics of Polynesian plants and animals and traditional Maori knowledge. She has been, and remains, engaged in a broad range of professional, community and Maori organisations. Dr Roberts holds BSc, and MSc degrees, a PhD in Zoology and a Diploma in Medical Parasitology.

Ms Margaret Emerre (Director) – is Manager, RS&T of the NZ Forest Industries Council. She was previously CEO of the Queensland Science and Technology Council, Director Queensland Innovation Centre, Director Electronic and Electricity Industry Training Organisation. Ms Emerre has also managed the Graduate Business Development Programme at Victoria University. She holds an MSc, a post-graduate Diploma in Administration, a BSc in Biological Sciences and a Diploma in Physical Education. Ms Emerre also holds a Certificate in Company Directing from the Institute of Directors.

Mr Shaan Stevens (IFR Technologies Limited Director – resigned 20 December 2002 upon the sale of IFR Technologies to Pocket Solutions Limited) – is an Executive Director of Guinness Gallagher, Wellington.

Directors' Interests

Any business the company has transacted with organisations in which a Director has an association has been carried out on a commercial "arms-length" basis.

Remuneration

Remuneration included performance awards, superannuation benefits and payouts of equity leave provisions. Some other benefits were not quantified and therefore excluded, including staff parking, home telephone and fax costs, and membership of relevant professional societies.

Bands	*Number in Each Band*
$220,000 — $229,999*	1
$170,000 — $179,999	1
$160,000 — $169,999	1
$150,000 — $159,999	1
$140,000 — $149,999	3
$130,000 — $139,999	2
$120,000 — $129,999	5
$110,000 — $119,999	4
$100,000 — $109,999	6

** Denotes Salary of Chief Executive*

The increase in numbers of staff earning more than $100,000 is due to the payout of equity leave provisions during the year.

Change in directors

There were no changes to Directors in the 2002/2003 year.

Use of company information

During the year no notices were received from members of the Board requesting to use Forest Research information received in their capacity as Directors which would not otherwise have been available to them. There have been no additions to the Interests Register.

The state of the company's affairs

A commentary on the year's performance is outlined in the Chairman and Chief Executive's Report. In the opinion of the Directors, the state of the Company's affairs continues to be satisfactory.

Auditor

In accordance with Section 21 of the Crown Research Institutes Act 1992, the Audit Office is Auditor for the Company and pursuant to Section 29 of the Public Finance Act 1977 has appointed Ernst & Young to undertake the audit on its behalf.

Directors' indemnity and insurance

Forest Research has insured all Directors and the Directors of its subsidiaries against liabilities to other parties (except to Forest Research or a related party of Forest Research) that may arise from their position as Directors. The insurance does not cover liabilities that may arise from criminal actions.

For and on behalf of the Board

BD Armstrong
Chairman

27 August 2003

Management statement

The following statement from management is made in accordance with Section 42 of the Public Finance Act 1989:

1. The management is responsible for the preparation of the annual financial statements and the judgements used in these;

2. The management is responsible for establishing and maintaining a system of internal control designed to provide reasonable assurance as to the integrity and reliability of the financial reporting; and

3. In the opinion of the management, the annual financial statements for the year ended 30 June 2003 fairly reflect the financial position and operations of the New Zealand Forest Research Institute Limited.

BD Armstrong
Chairman

BC Heard
Chief Executive

27 August 2003

Performance indicators

Forest Research's performance against the targets contained in the 2002-2005 Statement of Corporate Intent was:

	Actual 2002	*Actual 2003*	*Budget 2003*
Revenue ($000)	39,422	39,553	41,886
EBIT Margin (EBIT % of revenue)	0.3%	3.36%	3.2%
Return on average equity	(6.8%)	2.97%	2.6%
Return on average total assets	(4.9%)	2.36%	2.4%
Equity ratio	70.8%	67.2%	70.1%
Quick ratio:1	0.9	1.05	1.01
Gearing	9.6%	7.83%	10.7%
Interest coverage	N/A	10.71	5.7
Free cashflow to average total assets	10.5%	6.8%	4.6%
Non-financial Performance Measures	*Actual 2002*	*Actual 2003*	*Target 2003*
Staff Composition (FTE's)			
Research	280	266	283
Management and Support	83	74	81
Total FTE's	**363**	**340**	**364**
Revenue per FTE ($)	**108,601**	**116,332**	**115,000**
Science Output and Excellence			
Science reviews for excellence	Commentary	3	7
Papers in international externally refereed journals, series or books	81	79	70
Papers in local, internally or editor refereed journals, series, or books	64	90	90
Research monographs or books	3	2	4
Conference papers	122	127	120
Licensed products or patents	17	18	40
Technical records/scientific papers	341	362	380
Popular books	2	4	2
Application and promotion of science			
Number of industry seminars or field days	75	38	40
Number of current TechNZ contracts	5	1	7
Workshops or field days	68	74	90
Social Responsibility/ Community	Commentary	See commentary	Report
Treaty of Waitangi			
Consultation with Maori on significant scientific research and business issues	N/A	See page 24	Report
Maori Scholarships	N/A	0	1
R&D proposals incorporating Maori	N/A	4	3
Benefit to New Zealand	Commentary	See commentary	Report
Good Employer			
Policies to meet provisions of CRI Act	Commentary	See commentary	Report
% time in training	1%	0.5%	3%
Number of post-grad students supported	32	36	30
Work days lost in work-related accidents	7.6	28	0
Human capital protection	Commentary	See commentary	Report

Non-financial performance

Children's christmas party

Policies to meet provisions of the Crown Research Institutes Act, 1992

Forest Research complies in all respects with its obligation under the CRI Act.

Social responsibility/ community

Forest Research continued to honour an ongoing commitment to provide support in the community.

This year marked the 10th anniversary of the annual Forest Research Suffrage Scholarship. The scholarship is open to young women from all secondary schools in the Rotorua region and provides a cash grant along with vacation work at Forest Research throughout the under-graduate years. Several excellent nominations provided the judging panel with a difficult task in choosing the young woman who would receive support for her under-graduate studies. As a result, the judges awarded the scholarship to Shona Pearson, with an additional special award given to Emma McGeorge. Shona is now studying at the University of Auckland while Emma is at the University of Otago.

Forest Research sponsored a number of community activities throughout the year including: the Bay of Plenty and Canterbury Science Fairs; Community Watch; Police Manager's Guild "Kids programme"; There Bears; and the Heart Foundation. Once again Forest Research staff were sponsored to compete in a number of local and national sporting activities including the Fay Richwhite Corporate Triathlon, the Rotorua Marathon, and a number of local mountain bike events.

The company supports a School Holiday programme at the Rotorua campus catering for children from the ages of 5-13 during the school term breaks. Up to 70 children attend the programme with first priority given to children of Forest Research and Rotorua District Council staff. The programme, which has been in operation for 19 years, provides a range of activities and excursions such as crafts, swimming, zoo visits, golf driving, treats at McDonalds, and horse riding.

The annual Forest Research Children's Christmas party was a resounding success. Seventy-five children joined their parents and grandparents to enjoy party food, and games and receive a gift from Santa.

Benefit to New Zealand

The Food and Agricultural Organisation (FAO) of the United Nations contracted Forest Research to conduct a study on the status and trends of the development of genetic modification in forest trees, and the application of genetic modification in forestry. The goal was to provide updated, factual information on the scientific and commercial activities that could lead to the deployment of genetically engineered trees in forestry.

Dissemination of information to the public on genetic engineering is actively promoted. Dr Christian Walter and Dr Julia Charity gave a number of presentations to service organisations, conferences, and to Environment Bay of Plenty. Dr Walter was subsequently invited to participate in a 'roadshow' on genetic engineering in the Bay of Plenty. Both scientists also provided information to high schools and universities for various projects on this topical matter.

The Forest Health and Biosecurity group hosted the annual conference of the New Zealand Plant Protection Society, with a record turnout of 222 delegates. Forest Research staff presented six papers at the conference, increasing its presence in the society, and Dr Toni Withers was nominated and voted on to the national executive. In another area Dr Geoff Ridley was elected to the Executive Committee of the International Mycological Association (IMA). The IMA was founded in 1971 and represents the interests of 20,000 mycologists worldwide.

Dr Tim Payn attended a Montreal Process Technical Advisory Committee (TAC) meeting in Mexico to develop an international overview report with input from the 13 participating countries. The aim of the meeting was to collate national data on seven selected indicators of sustainability and to work on the layout, content, and style of the report. New Zealand was very well represented in terms of the state of the data and the progress we have made with our national report development. This has been due in large part to a significant contract Forest Research undertook for MAF in 2000-2001 and the close linkages we have developed with the MAF Montreal Process team. Dr Payn was invited to take on leadership of the TAC for the next 5-year period.

Forest Research participated in the 2nd Government/Expert review of the IPCC (Intergovernmental Panel on Climate Change) of the draft GPG LULUCF (Good Practice Guidance for Land Use and Land Use Change and Forestry). The GPG specifies what is "good practice" to inventory carbon emissions and sequestration from direct, human induced degradation of forests and other vegetation.

During the year Ruth McConnochie visited the Institut National de la Recherche Agronomique (INRA) at Pierroton, France, as part of a quest to improve the productivity and quality of *Pinus pinaster* (maritime pine). The visit was part of the on-going exchange arrangement between Forest Research and INRA, which is supported by The France and New Zealand Cultural Agreement, and partially funded by the French Embassy. Ruth is helping to establish an international genetic gain trial of *Pinus pinaster,* using the best selections from the breeding programmes in south-west France and New Zealand. The French breeding programme has focused heavily on improving growth, tree form and adaptation. In New Zealand, maritime pine is seen as an important contingency species, suited to exposed sites and poor soils. The aim of this trial, from a New Zealand perspective, is to produce a species that will grow well on sites that are not ideally suited to radiata pine.

Forest Research secured funding from the Ministry of Foreign Affairs and Trade to enable the company to gain accreditation as a Registered Foreign Certification Organisation (RFCO). Accreditation will enable Forest Research to help the New Zealand timber industry maintain access to the Japanese market through vital third party auditing services. The local timber industry has traditionally operated without auditing of the quality of wood products. For export commodities, however, the customer generally

demands this, and in the case of Japan has set up a comprehensive system of QA under the Japanese Agricultural Standards (JAS) system. Lumber used in Japan has to be graded according to JAS if its use is subject to government loan finance. Also, JAS standards are gaining wider recognition in the Asian lumber trade, particularly Taiwan.

John Gifford participated in a Government/forest industry sponsored study tour of Finland and Norway to evaluate the impacts of climate change policy on the forestry sector. The tour group identified options for improving the forest industry's involvement in bioenergy production in New Zealand, and investigated whether other countries have developed forest industry related agreements to mitigate the impacts of climate change policies. Mr Gifford's participation was funded by the New Zealand Climate Change Project. In both Finland and Norway the pulp and paper industry have made strategic investment in energy efficiency and bioenergy projects over the last 10 years which is now minimising their exposure to risks arising from the implementation of climate change policy. One specific example was the investment in heat recovery for mechanical refiners in thermo-mechanical pulp (TMP) mills. The tour provided an excellent opportunity to develop relationships with Government officials from the New Zealand Climate Change Project and New Zealand industry personnel.

During the year a project was initiated to assess the energy demand for a range of energy users in Rotorua. In particular the assessment focuses on schools, public buildings, and hotel/ motels. The work will provide information to construct supply duration curves for a range of energy users and be used to design specific bioenergy solutions based on the use of fuel pellets, chips, municipal-derived wood waste, and other biomass supplies. The work is being undertaken with support from the Rotorua Bioenergy Group and the Rotorua District Council. A student was engaged to assist in undertaking the site assessments and generating a database on energy usage. Early indications from the work programme indicate that energy systems in schools are oversized, inefficient, and costly to operate.

In addition, Forest Research provides benefit to the nation through contributing to Government agencies, companies, and stakeholders across a number of sectors including:

- Provision of high quality and cost-efficient consultancy, research, and development services.
- Undertaking joint development and commercialisation projects with the private sector.
- Licensing and/or assigning technology developments to New Zealand companies.
- Provision of turnkey customer solutions.
- Publishing science papers, and organising conferences, workshops, field days, and seminars.
- Active participation in, and membership of, the New Zealand Forest Industries Council.
- Active participation in, and membership of, the Association of Crown Research Institutes.
- Operating research and development cooperatives in major areas of research and development.
- Providing a market intelligence gathering service for clients and Government agencies.

Forest Research has developed strong science and industry linkages, both nationally and internationally. This ensures effective science delivery and an international perspective to its activities.

Science reviews for excellence

An independent review of the N-Fix Technologies research programme was undertaken by Dr Eric Hall, a Professor at the University of British Columbia and an acknowledged international expert in the field of advanced wastewater treatment. His findings confirmed that the research capabilities and facilities available at Forest Research for the N-Fix programme are highly impressive by international standards. Furthermore, he found that Forest Research is beginning to generate information that puts the entire team and its technology development strategy in the front rank internationally.

In the Sustainable Forest Management Unit, Emeritus Professor Dale Cole from the College of Forest Resources, University of Washington carried out two science reviews. The first examined the Unit's future science planning process. Professor Cole also reviewed the mechanisms used by the science unit to transfer research information to stakeholders.

Good employer

Health and Safety
Forest Research is committed to effective health and safety management with a strong emphasis on integrating safe practices into our daily business. During the year we introduced the role of safety representative to assist managers in the daily tasks of dealing with health and safety. Changes to the legislation that impact on our business were identified and an education programme was commenced to ensure awareness of the changes and the impacts, particularly in the areas of work stress and fatigue. A dynamic health and safety Steering Group was established to provide an overview for company-wide health and safety issues, resulting in the development of a Forest Research health and safety plan.

Following on from the Secondary Pass achieved in the ACC Workplace Safety Management Practices Audit programme, Forest Research was awarded a Tertiary Level Pass in March 2003. Of the 1445 employers in New Zealand who currently belong to this programme, only 457 have achieved a Tertiary Level Pass. Forest Research is among the top third of employers in the programme demonstrating excellent consolidation of health and safety management practices and workplace injury prevention systems.

Human Resources Initiatives
The year commenced with a drive to recruit suitably qualified leaders for the business units, to help reshape the company's new strategic direction. Underpinning this organisational change was a philosophy of self-managing and self-motivating teams, requiring leaders with the ability to ensure strong team participation among staff. This process included a full induction programme for the new management group and has proved the most successful leadership initiative across the organisation. These new positions provided the opportunity to introduce new thinking from external candidates as well as create scope for existing staff to develop their careers further.

A survey in June confirmed that the new structure and leadership are viewed positively by staff in moving the company forward.

Human Capital Protection
As part of the development of a supportive culture of collaboration and co-operation, an in-house leadership and team development programme has been implemented. Initiatives designed to support this philosophy include a revamp of the annual staff achievement (performance) discussions and planning processes.

Greater emphasis was also placed on internal communications. The achievements in this area include a consistent approach to quarterly briefings by the senior management team to staff, and the involvement of staff in the development of business plans.

Acknowledgement needs to go to those people who have worked during the year to foster work by the following groups:

- The Culture and Communications team has made a valuable contribution to effective communications across the company.
- A women's network aims to create a lively and active programme that encourages women in their careers at Forest Research.
- The Partnership for Quality Group comprises representatives from management and the PSA. It is designed to foster good working relationships both here at Forest Research and also nationally.

During 2003, Forest Research joined the Equal Employment Opportunities Trust.

Corporate governance

The New Zealand Forest Research Institute Limited Board is appointed by the Shareholding Ministers to guide and monitor the business of the company and its subsidiaries, which constitute the Forest Research Group. The Board has seven Directors including the Chairperson and deputy Chairperson who normally meet 11 times a year.

Responsibility for the management and administration of the company is delegated to the Chief Executive, who is responsible to the Board.

The Board has two committees: Audit and Risk; and Remuneration and Organisation.

The function of the Audit and Risk Committee is to assist the Board in carrying out its responsibilities under the Companies Act 1993 and the Financial Reporting Act 1993 in respect of the company's financial accounting practices, policies, and controls, and to review and make appropriate inquiry into the audits of the company's Financial Statements by external auditors.

The Remuneration and Organisation Committee assists the Board to review and approve senior executive remuneration arrangements as well as the Group's human resources strategy.