SCION

forests · products · innovation

Statement of Corporate Intent

2011 - 2016

forests · products · innovation

Statement of Corporate Intent

2011 - 2016

Published June 2011
Scion
49 Sala Street, Private Bag 3020
Rotorua 3046
New Zealand

This document is available on our website: www.scionresearch.com

ISSN 2230-4908 (Print)
ISSN 2230-4916 (Online)

Profile

New Zealand Forest Research Institute Limited – trading as Scion

Head Office: 49 Sala Street, Rotorua

Postal Address: Private Bag 3020, Rotorua 3046

Web address: www.scionresearch.com

Ownership: Crown owned entity (established under the Crown Research Institutes Act 1992)

Governance: Shareholder-appointed Board: Chair, Tony Nowell; Deputy Chair, Alison Andrew; Directors, Peter Berg, Sheldon Drummond, Chris Insley, Michael Ludbrook, Brian Rhoades, Judith Stanway.

Executive Management: Chief Executive, Warren Parker; Group Manager Investments, Russell Burton; Group Manager Bioproduct Development, Elspeth MacRae; Group Manager Corporate Services, Chelydra Percy; Group Manager New Forests and Forest Science, Brian Richardson; Group Manager Sustainable Design, Trevor Stuthridge; Group Manager Human Resources, Keri-Anne Tane; Chief Financial Officer, Rob Trass.

Staff: 334 full-time-equivalent staff located at five sites: Rotorua (327), Albany (3), Wellington (2), Christchurch (18), Dunedin (1); representing 271 research and research support staff; 63 in management and general support.

Fixed Assets: Total book value $25.623 million at 30 June 2011.

Core Purpose: Scion's purpose is to drive innovation and growth from New Zealand's forestry, wood product and wood-derived materials and other biomaterial sectors, to create economic value and contribute to beneficial environmental and social outcomes for New Zealand.

Values: Scion's organisational values reflect its people. We are vital, innovative and collaborative.

Shareholdings

Company	Company type	Scion shareholding
Future Forests Research Ltd	Subsidiary where the single share is held by Scion on behalf of the investors	100%
Te Papa Tipu Properties Ltd	Land holding subsidiary	100%
ATLAS Technology Ltd	A non operating subsidiary	100%
Biopolymer Network Ltd	An incorporated joint venture	33.3%
Frontline Biosecurity Ltd	An incorporated joint venture	25%
Beacon Pathway Ltd	A Ministry of Science and Innovation (MSI) supported consortium – which is no longer operating	20%
WQI Ltd (Solid Wood Innovation)	An MSI supported consortium in wood processing	5.95%

CONTENTS

Executive summary

The forest industry, in its broadest sense, is vitally important to New Zealand's successful future. It is a key driver in building a stronger economy and achieving better environmental and social outcomes for New Zealanders. The forest industry's wood and fibre value chain incorporates forest production, solid wood and fibre processing, as well as the rapidly emerging sectors for renewable energy and biochemicals. Collectively, these activities produce about $11 billion of sales annually (not including environmental services such as carbon storage).

World population growth, natural resource limits, the need to respond to climate change and the rapid development of economies in countries such as India and China provide opportunities that offer a positive outlook for New Zealand forestry. There is a high level of confidence that forestry exports of $3.9 billion in 2010 can at least double and onshore economic activity treble by 2025. However, to achieve these benefits for New Zealand, the forest industry will need to overcome significant technical challenges and expand export markets through product and process innovation.

This Statement of Corporate Intent describes how Scion will work with the forest industry to address these challenges and enhance the industry's international competitiveness. In doing so, Scion will achieve its Core Purpose as a Crown Research Institute to achieve the following National Outcomes:

- Increase the value and productivity of the forestry, wood product and wood-derived materials and other biomaterial industry sectors to the New Zealand economy through improved forestry practices and production systems and increased diversification of New Zealand's biological industry base to meet current and future global market needs.
- Protect and enhance market access and improve risk management in the forest industry.
- Increase renewable energy production and energy security by growing New Zealand's ability to produce sustainable bioenergy and liquid biofuel products.
- Enhance New Zealand's opportunity to benefit from forestry-based ecosystem services to improve both the global market position of industry and the environmental sustainability of forestry production in New Zealand.

To define the science needs and priorities of the forest industry in relation to each of these national outcomes, Scion consulted with more than 80 industry leaders, iwi partners and other stakeholders. Using this information and other strategic analyses, Scion has refreshed its organisational strategy and aligned its science and innovation programmes to achieve six Intermediate Outcomes / Impacts over the next five years. These are to:

1. Maximise the value and productivity of commercial forestry.
2. Improve the competitiveness of the solid wood processing industry.
3. Expand opportunities in the wood fibre, biopolymer and biochemical industries.
4. Improve New Zealand's preparedness for biosecurity incursions, fire and climate change.
5. Ensure New Zealand forest industry's licence to operate domestically and internationally and enhance environmental performance.
6. Increase New Zealand's energy security through the expanded utilisation of forest biomass for energy.

With user support and improved methods for the transfer of new knowledge and technology from these science programmes, Scion expects to make excellent progress in achieving its Statement of Core Purpose National Outcomes (see above). Core Funding ($17.7 million in 2011/12) will be invested to support achievement of the Intermediate Outcomes / Impacts. About 60% of this will be for applied research. In addition, Scion will reinvest $5.07 million (including $4.0 million for capex)[1] of its surpluses in 2011/12 to strengthen its science capabilities, improve industry engagement and technology transfer, and improve its facilities, equipment and operating systems.

With respect to financial performance, Scion expects to achieve revenues of $45.70 million and earnings before interest and tax and after reinvestment of $1.67 million for the 2011/12 year. This target equates to a return on equity before reinvestment of 8.0% and 4.9% post investment. This level of strong underlying financial performance is expected to be maintained over the planning period.

[1] Capex for infrastructure upgrade was included in the 2010/11 business plan.

1. The New Zealand forest industry – its potential

The **New Zealand forest industry**, as described in this document[2], encompasses the following broad range of activities:

- Growing and managing forests for economic, environmental and amenity purposes.
- Converting trees into multiple products including logs, lumber, manufactured products (e.g. pulp, paper, panels and fit out), structural products, cladding and chemicals.
- Producing energy from wood and forest residues.
- Producing chemicals for forestry or wood processing applications.
- Manufacturing equipment for forest management and timber processing (e.g. drying kilns).
- Exporting forest and wood products to international markets.

Forest growing, processing, design and construction sectors of the industry produce about $6.4 billion of outputs[3] per annum. This figure would increase to about $11 billion of sales per annum for New Zealand if downstream activities (such as furniture making) were included[4]. Adding the value of carbon capture and other environmental services from forests means the expected total value to New Zealand would be even greater. Forest and wood products were New Zealand's third largest export earner in 2010, worth $3.9 billion[5].

The forest industry represents one of New Zealand's strongest prospects to lift its economic performance and create employment (currently over 27,000 people work in the industry). This opportunity is embodied in the current planted estate as it matures to produce an estimated further 15 million m^3 of wood by 2025 (about a 75% increase over current volumes, see Fig. 1[6]). Realising this opportunity will require market expansion, productivity improvements, new processing capacity and the ability to harvest wood economically through developments in infrastructure and upskilling of the labour force.

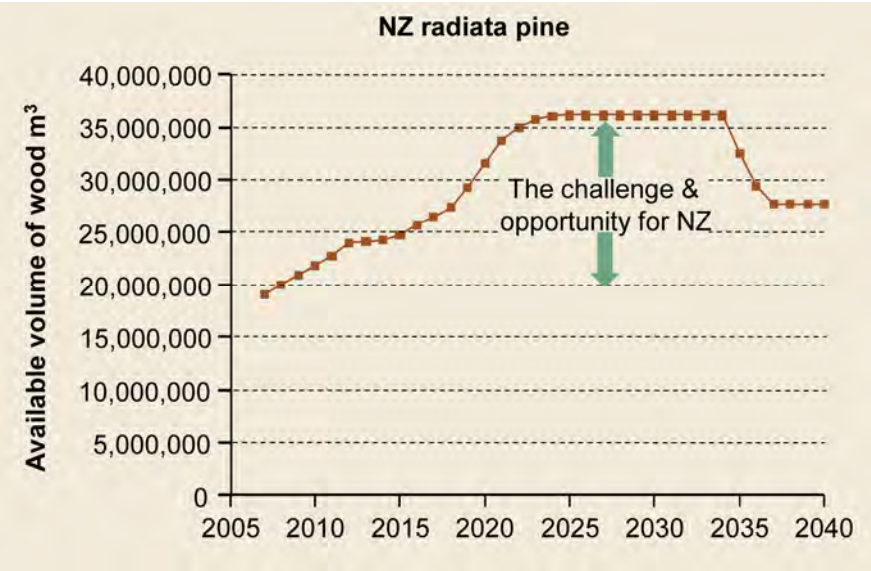


Figure 1: Projected harvest of radiata pine in New Zealand's planted forests

[2] This is a broader definition than that typically used within the forestry sector which would normally only include forestry growing, forestry management, wood processing and wood re-manufacturing.
[3] Wood Processing and Manufacturing Science and Innovation Plan 2011. www.wpa.org.nz
[4] Based on Annual Enterprise Survey Data, New Zealand Department of Statistics (2009), including forestry, wood processing, paper manufacturing, support industries and downstream processing such as wood buildings and furniture.
[5] Forest Owners Association Facts & Figures 2010/2011.
[6] From a forestry sector study, MAF 2009, Interim national wood availability forecasts using the "All Owners Constrained" scenario.

The forest industry is strategically significant for New Zealand because it contributes strongly across the entire spectrum of economic, environmental, cultural and social outcomes. No other industry in New Zealand can achieve this. In addition to its substantial export and employment contribution it also:

- Provides the dominant construction material in our housing and light commercial buildings which are well suited to high hazard (e.g. earthquake) areas.
- Supports other export industries, such as food, through the supply of renewable packaging material.
- Is an asset with increasing economic and cultural value for Maori.
- Provides renewable energy and thereby reduces sovereign risk associated with energy supply.
- Makes the major contribution to New Zealand meeting its Kyoto commitments.
- Protects our landscapes, waterways and atmosphere.
- Attracts significant and increasing offshore investment.
- Utilises advanced manufacturing and industrial technologies, expanding New Zealand's capabilities in these critical areas.
- Provides the backdrop to many of New Zealand's recreation and tourist activities.

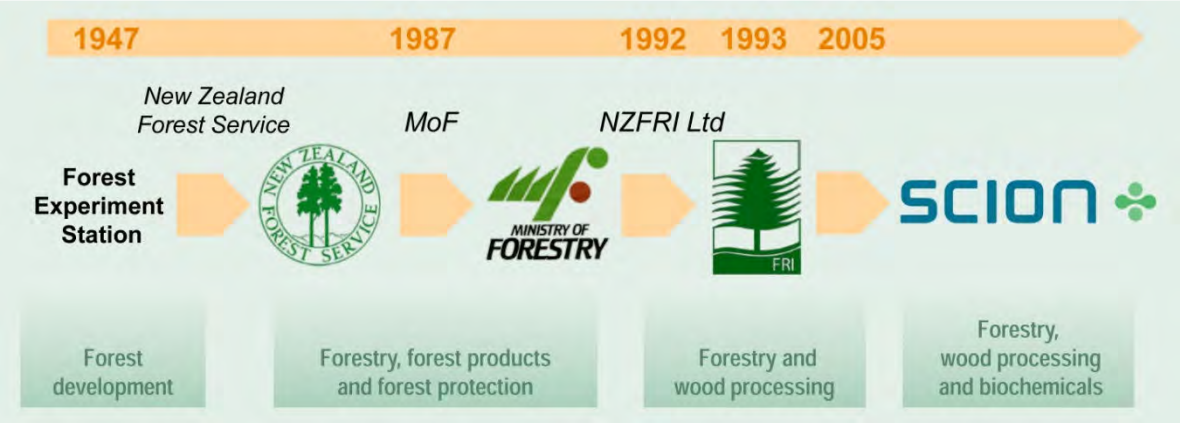
Focussed research and innovation is critical to realising the forest industry's full potential. Scion must build enduring partnerships with industry, government and Maori, supported by strong working relationships across the entire value chain. Developing effective strategic and implementation plans with these parties will be critical to addressing the nationally significant challenges and priorities for the industry (as set out later in the Science and Innovation Framework in Section 4). Scion's stakeholder consultation has helped identify these challenges as:

- Increasing the productivity and profitability of radiata pine commercial forests.
- Reducing the cost and risk of harvesting trees on steep country where the bulk of new forest estates will be sourced.
- Increasing the productivity and profitability of the wood processing sector and building new markets for New Zealand's solid[7] and engineered wood products.
- Enhancing the value of forestry to Maori.
- Increasing the use of wood used in domestic and commercial buildings in New Zealand.
- Developing and scaling up industries that use wood as a feedstock, such as packaging, chemicals and energy, to reduce dependency on oil-based derivatives and create new high value products.
- Improving supply chain logistics, infrastructure, and increasing the availability of skilled workers to cope with the projected 75% increase in potential harvest by 2025.
- Quantifying the value of forest ecosystem services, such as carbon sequestration, to support the expansion of forestry to meet New Zealand's 2020 greenhouse gas targets and improve forestry's land-use competitiveness.
- Maximising protection of our forests from biosecurity incursions and other hazards such as fire.
- Providing authoritative technical support to address barriers to international and domestic market uptake for New Zealand's forest products.

This Statement of Corporate Intent (SCI) sets out Scion's strategy, and how it will work with the forest industry to provide science-based solutions to these challenges, thereby meeting its Core Purpose over the next five years.

[7] Henceforth in this document "solid wood" will also include engineered wood products but excluding composite panel products such as particleboard and medium density fibre.

2. Scion's capabilities, achievements and core purpose



Scion is New Zealand's leading provider of science and technology to the forest industry. In this section, Scion's history, development, capabilities and achievements are briefly outlined. The company's Statement of Core Purpose, which specifies Scion's role, focus areas and responsibilities is also outlined.

Brief history and current status

The New Zealand Forest Research Institute (now trading as Scion) was established as a Crown Research Institute (CRI) in 1992. It is wholly owned by the New Zealand Government and constituted as a limited liability company under the New Zealand Companies Act 1993. Scion's evolution from a Forest Experiment Station established in 1947 to its current status as a CRI is described above.

Capabilities and achievements

Over the past 64 years Scion and its predecessors have been integral to the development of the New Zealand forest industry. It has world leading capabilities in plantation forestry science and many aspects of wood processing, resource use and the development of products from trees. In conjunction with industry and policy agencies Scion has, among other outcomes, developed:

- The trees whose progeny now populate over 90% of New Zealand's commercial forestry estate.
- Modern silvicultural and tree improvement practices which have increased the value of forestry to New Zealand by $6.2 billion since 1980[8].
- Forest management practices and tools that are used to manage the bulk of New Zealand's forests.
- Forest management software systems worth an estimated $80 million in added value to the forestry industry over a five year period (to 2007)[9].
- The modern softwood drying systems that process almost all of New Zealand's timber and underpin gross outputs of $2.4 billion per annum[10].
- Standards and certification systems (e.g. timber performance) to ensure that New Zealand forest products meet the requirements of domestic and international building markets.
- Tools for the proactive management of climate, biosecurity and fire risks to New Zealand's forests.
- Significant aspects of the use of radiata pine as a quality fibre for paper applications.
- Tools to support the New Zealand forest industry to meet best practice environmental standards and prepare for the implementation of the Emissions Trading Scheme.

The rebranding of the New Zealand Forest Research Institute as Scion in 2005 was accompanied by an extension of research activities into the development of novel materials from woody biomass. This was in response to a predicted 2020+ future where oil is increasingly scarce and expensive, and countries are seeking to decarbonise their economies. This extension strengthened Scion's research capabilities in industrial biotechnology, bioenergy, biopolymers and

[8] Forest improvements – increasing the value of forestry in New Zealand, A Scion impact study 2010 www.scionresearch.com
[9] Forestry Software solutions. A Scion impact report 2007. www.scionresearch.com
[10] Economic Impact of Wood Drying Technology, June 2004. Report to MoRST, BERL.

other bio-derived chemicals – all important areas for New Zealand's economic future.

Scion's head office is based on a 113 hectare site in Rotorua. The site has evolved from the early 20th century when it was used as a nursery for creating New Zealand's forests through to today where there are over 100 buildings (including offices, laboratories and pilot plant facilities) as well as nurseries and forests. The latter contain breeding and archival genetic material. This site defines Scion's character and rich heritage. The second largest site by staff numbers (18) is co-located in Christchuch with the School of Forestry on the University of Canterbury Campus. Small numbers of staff are also based in Dunedin (1), Wellington (2) and Albany (3).

Scion's Statement of Core Purpose

In October 2010 Scion's Statement of Core Purpose (SCP) was adopted. The full document is available at www.scionresearch.com. Scion's Core Purpose is to "drive innovation and growth from New Zealand's forestry, wood product and wood-derived materials and other biomaterial sectors, to create economic value and beneficial environmental and social outcomes for New Zealand"[11]. The SCP also specifies the following National Outcomes that Scion is responsible for achieving in partnership with industry, government and Maori:

- Increase the value and productivity of these industry sectors to the New Zealand economy through improved forestry practices and production systems and increased diversification of New Zealand's biological industry base to meet current and future global market needs.
- Protect and enhance market access and improve risk management in the forest industry.
- Increase renewable energy production and energy security by growing New Zealand's ability to produce sustainable bioenergy and liquid biofuel products.
- Enhance New Zealand's opportunity to benefit from forestry-based ecosystem services to improve both the global market position of industry and the environmental sustainability of forestry production in New Zealand.

In addition, Scion is expected to take a national CRI leadership role in:

- Sustainable forest management and tree improvement.
- Forestry biosecurity and risk management and mitigation.
- Wood processing, wood-related bioenergy, waste streams and other biomaterials.
- Forestry and forestry-based ecosystem services to inform land-use decision making.

Scion will work closely with other research providers and end-users to contribute to the following areas:

- Biosecurity land, soil and fresh water management.
- Climate change adaptation and mitigation.
- Indigenous forestry.
- Industrial biotechnology and high value manufacturing.

Scion must also:

- Remain financially viable delivering an appropriate rate of return on equity.
- Develop strong long-term partnerships with key stakeholders, including industry, government and Maori, and work with them to set research priorities that are well linked to the needs and potential of its end-users.
- Maintain a balance of research that both provides for the near-term requirements of its sectors and demonstrates vision for their longer-term benefit.
- Maintain Scion's databases, collections and infrastructure.

The Statement of Core Purpose defines the scope of Scion's research for at the least the next decade. This, together with Core Funding provides the certainty to enable Scion to make long-term investment into its capabilities, facilities, research collaborations and relationships with industry, Government and Maori to achieve its National Outcomes.

[11] Scion's Statement of Core Purpose. www.scionresearch.com

3. Scion's operating environment and strategic context

To meet the National Outcomes in Scion's Statement of Core Purpose, it is necessary to clearly define the 'technological challenges' that must be overcome to enable the forest industry to realise its potential. Scion therefore undertook extensive consultation with over 80 individuals across New Zealand, representing forest growing, harvesting, wood products, Government, energy, packaging, construction, materials, environmental, territorial authorities and Maori. The definition of these challenges, together with the strategic context in which the forest industry operates, and implementation of the CRI Taskforce recommendations[12] has informed Scion's science direction and focus areas for the next five years. The outcomes from this analysis are described in this section.

Shareholder priorities and guidance

The Government has identified, 'science and innovation', as the main driver of a modern, future-looking economy and one of the six 'planks' in its economic growth agenda. The Crown's priorities and principles for research and development, set out in its documented guidelines *Igniting Potential*[13], indicate how Scion should work with the forest industry to:

- Produce higher margins, industrial products, processes and technologies, as well as renewable industrial materials and biosensing and bioprocessing technologies.
- Provide knowledge that helps New Zealand's economy develop within environmental limits and supports the sustainable development of industries.
- Improve the quality of urban and infrastructure development, increase national resilience to hazards and mitigate infrastructure risks.
- Accelerate the growth and development of a vibrant, high-value, technology-based products and services sector, including through novel materials.

Each of these areas is addressed in Scion's Science and Innovation Framework (see Section 4).

Global context and strategic drivers for the New Zealand forest industry

Global drivers that will influence the New Zealand forest industry's future prosperity have been identified as follows:

Positive

- There will be increased demand for improved housing in large developing regions such as Asia, Africa and South America.
- Critical non-renewable resources (e.g. oil) are becoming increasingly scarce.
- There is an impending global shortage of 'long fibre' which is derived from softwoods such as radiata pine.
- The limits of natural ecosystems are being reached or exceeded (e.g. water, land, tropical hardwood forests).
- The United Nations Reducing Emissions from Deforestation and Forest Degradation in Developing Countries Scheme (REDD+[14]) provides the most politically acceptable solution to climate change.

Negative

- The industry lacks international competitiveness, particularly in wood processing.
- Uptake and implementation of new technology is low.
- There is a general lack of innovation and capital.
- Competition from timber substitutes is growing.
- There is a perception that New Zealand's key product, radiata pine, cannot compete against other timbers in terms of quality, price and properties.

Within New Zealand, the forest industry must also consider:

- The slow recovery from the global financial crisis.
- A challenging domestic economic situation.
- New Zealand's isolation from its international markets.
- Rising log prices.

[12] Report of the Crown Research Institute Taskforce www.morst.govt.nz/current-work/critaskforce/final-report
[13] www.morst.govt.nz/publications/govt-policy-statements/Igniting-Potential-New-Zealands-Science-and-Innovation-Pathway
[14] www.un-redd.org/

- International competitors with better economies of scale (e.g. Chile, China, Canada).
- The need to recapitalise and modernise processing plant.
- The rapid expansion of markets in Asia (with consequent high log prices impacting on on-shore wood processors).
- The urgent need for housing solutions in Christchurch and Japan as a result of the earthquakes.
- The implementation of the Emissions Trading Scheme (ETS).
- Conclusion of Treaty of Waitangi settlements by 2014.

In the future, the high cost of capital in New Zealand relative to competitors such as Chile and Canada, will precipitate further consolidation of, and innovation within, the wood processing sector towards high value, niche products. However, domestic processors also have significant comparative advantages in accessing log supply, skilled labour, water and relatively inexpensive energy including from low greenhouse gas (GHG) emitting geothermal and bioenergy sources. Processors have enhanced their competitiveness by re-capitalising to automate processes and maximise log yields, product innovation, developing new markets and building scale through 24/7 work shifts. As described in Section 1, there is a substantial opportunity for further gains in these areas and to expand New Zealand-based technology firms to service them.

Identifying research needs through consultation

Scion undertook extensive consultation in order to define the research needs of the entire forest wood-fibre value chain, including emerging industries that will further expand and strengthen this value chain. The groups consulted included:

Industry including:

- **Forest growing/managing,** which produces trees for commercial, environmental, cultural and amenity (landscape and recreation) uses.
- **Solid wood products and wood processing,** which includes primary and secondary processors (sawn timber, engineered wood products, pulp and paper, composites and remanufacturing) and related support services such as adhesive manufacturers.
- **Chemicals and materials industries,** in particular those companies producing chemicals, plastics and composites derived from wood. These include the bioplastics/biopolymers and packaging manufacturing industries.
- **Energy** which utilises renewable forest biomass to produce heat and liquid fuels.

Government including the Ministry of Agriculture and Forestry, the Ministry for the Environment, regional councils, and the Department of Conservation, as forests become increasingly important to land protection and amenity application.

Maori whose ownership of forests and forested land in New Zealand is large (about 500,00 hectares and $2.1 billion of assets in 2010) and increasing rapidly through Treaty settlements (and the return of Crown Forest Land). Maori influence over the philosophy underpinning forestry and processing in New Zealand is growing quickly.

In the ensuing sections, each of these stakeholders and partners is described.

Industry

Forest growing/managing

There are around 1.7 million hectares of land in commercial forests in New Zealand with a standing volume of 467 million m^3 of timber as at 1 April 2010. About 90% is radiata pine, 6% is Douglas-fir and the balance consists of cypresses (0.5%), eucalypts (1.4%), other exotic softwoods (1.4%) and exotic hardwoods (0.7%). The majority (91%) of forests are privately owned, with the balance owned by the Crown (3%), local government (3%), State Owned Enterprises (1%) and public companies (2%). Around 23 million m^3 of logs were harvested in 2010, with 13.6 million m^3 of these further processed domestically and 10 million m^3 exported as logs. Total forestry exports in 2010 earned $3.9 billion or 2.9% of GDP[15].

The ecosystem services provided by forests such as carbon storage, land and water protection, biodiversity enhancement and the contribution of forests to tourism and recreation, further add to the total positive economic impact of the forest industry within New Zealand.

[15] New Zealand Plantation Forest Industries Facts and Figures, NZ Forest Owners Association 2010/11.

Solid wood products and wood processing

The range of products generated from solid wood by wood processing firms includes:

- Structural, appearance and landscape timber.
- Engineered products such as laminated veneer lumber and plywood.
- Composite materials such as particle board, medium density fibre board, pulp and paper and packaging products.
- Furniture and building products.
- Energy from wood, mostly to meet internal energy needs.

New Zealand's wood processing and manufacturing sector purchases 60% of the current annual log harvest and adds $4 billion per year of value to those logs. From a total income of $5.3 billion, it currently generates $2.8 billion in export receipts and employs 11,000 New Zealanders[16]. The primary challenge confronting wood processors is to improve their productivity and profitability, and increase and diversify market returns through product innovation.

The forest growing/managing and wood processing sectors are supported by industries that build and export plant, machinery and supplies such as wood drying kilns, harvesting equipment, adhesives and preservatives.

Chemicals and materials from wood

These industries produce bio-based chemicals (biochemicals) as alternatives to petrochemical products and highly specialised materials used, for example, in the packaging industry. Biochemicals production is rapidly expanding internationally, supported by global investment predicted to reach €340 billion in 2017 from a base of €48 billion in 2007. Biopolymers and biofibres are one of the fastest growing sub-segments[17].

New Zealand already has a substantial packaging industry and a small but developing industry focussed on the production of chemicals and specialty materials from renewable resources. These include resin acids, terpenes, polyphenolics, biodegradable plastics and composites. Two very recent New Zealand developments include a (bio)foam based on starch that can replace expanded polystyrene (EPS)[18] and a polymer-wood composite that can be moulded and formed into complex shapes.[19] Such new materials meet the very sophisticated demands of European and North American markets where product stewardship and/or requirements for use of renewable resources are becoming the norm.

Wood-derived chemicals such as terpenes are already a by-product of the pulping industry. Development of further co-product opportunities could provide substantial economic growth and lead to the formation of new manufacturing industries. At the same time, co-products could provide the materials needed to support other parts of the productive sector such as packaging for horticulture or fish exports.

In these emerging industries, New Zealand must therefore:

- Exploit New Zealand's biological resource advantages and capture value in the growing global biochemicals markets.
- Adopt a biorefinery concept to extract greater value from co-products generated in existing wood processing operations as well as future bioenergy developments.
- Produce new packaging materials from New Zealand's fibre resource to meet the requirements of ever more discerning markets and support the growth of other export industries in New Zealand.

Energy

New Zealand already derives around 7% of its energy demand from combustion of renewable resources such as wood residues and black liquor from the pulping process. This activity is an integral part of the current wood processing industry, meeting internal process energy demands and, in some instances, providing revenue through the sale of electricity to the national electricity network.

The potential for forests to expand their contribution to New Zealand's energy needs, particularly heat and transport fuels, has been defined in Scion's Bioenergy Options Study[20]. There is an opportunity to increase

[16] Wood Processing and Manufacturing Science and Innovation Plan, March 2011, Wood Processors Association of New Zealand and the New Zealand Pine Manufacturers Association Inc.
[17] Festel Capital May 2009 (private source) OECD Bioeconomy to 2030.
[18] Winner of the Best Innovation in Bioplastics Category at the 2009 Bioplastic Awards in Europe.
[19] Patent title - Method for Producing Wood Fibre Pellets.
[20] Scion Bioenergy options for New Zealand Situation Analysis and Analysis of Large Scale Bioenergy from Forestry. www.scionresearch.com

recovery of forest residues, and expand forests onto marginal land where a large proportion of the harvest could be used for energy production. However, unless purpose-grown energy forests can become viable, such developments would require both: the expansion of the wood processing sector to increase the supply of residues; and the development of viable technologies to extract biomass in New Zealand forests.

The New Zealand Bioenergy Strategy[21] aims to see by 2040: bioenergy supplying more than 25% of New Zealand's projected energy needs, including 30% of the country's transport fuels; and the use of biomass to produce heat as a substitute for coal or gas increasing by up to 60%.

By 2040, the largest energy demand is projected to be for transport fuels. The most important fuels will be diesel (for farming, transport, construction and fishing) and jet fuel. With many countries investing heavily in the development of second generation bioenergy technologies, New Zealand should position itself as a fast-follower and adaptor of these advances, modifying them to suit local conditions as required. Integrating these technologies into current wood processing sites provides an excellent opportunity in the short-term. This approach to develop wood-derived energy requires close collaboration with international groups to secure access to the appropriate research and establish proof-of-concept and pilot-scale testing in New Zealand.

Central and local government

The Government's goal is to foster economic development that will deliver greater prosperity, security and opportunities to all New Zealanders. To achieve this, the Government is seeking, through a six-point strategy, to create an environment that will encourage businesses to grow, export and create high-value jobs. The elements of the strategy most applicable to Scion are enabling better science, innovation and trade; developing infrastructure to support productive growth; and lifting levels of knowledge and skills. To meet these requirements, Scion works closely with:

- The Ministry of Agriculture and Forestry which has the responsibility for forest and trade policy; implementation of the Emissions Trading Scheme and Biosecurity.
- The Ministry for the Environment for environmental policy and regulation regarding forests (e.g. the national policy statements for forestry, water and biodiversity).
- The Ministry of Economic Development (and New Zealand Trade and Enterprise) for bioenergy from woody biomass, economic development through forestry, and international trade opportunities for forest wood products and services (e.g. development of the Chinese and Indian export markets).

Scion also works closely with the Department of Conservation (forest conservation management, biodiversity protection, weed and pest management) and plans to strengthen its links with the Department of Building and Housing (quality and productivity in the building sector) and the Ministry of Foreign Affairs and Trade (addressing forest biosecurity risks).

Local government is increasingly focussed on supporting the Government's economic growth agenda. This is being delivered through regional economic development plans, development of infrastructure, removal of 'red tape', and minimising rate increases. Local government is a significant owner of forests (3% of the national estate). With respect to the forest industry, the Bay of Plenty and Waikato Regional Councils' plans are especially significant in the near term for Scion. The plans indicate constraints on economic development through the forest industry as: transport and port infrastructure; restrictions on water availability (and quality); access to low cost, low greenhouse gas emissions energy; and attracting skilled labour. Scion will continue to work closely with the local government sector to address these needs.

Maori

Maori freehold land comprises a little over 1.5 million hectares, or 5.5% of New Zealand's land mass. Within this area Maori are substantial land owners supporting the forest industry (around 36% or 500,000 hectares of pre-1990 forests). This ownership will increase with further Treaty settlements to be completed by 2014. Current major iwi entities in forestry include Ngati Hine Forestry Trust, Lake Taupo Forest Trust,

[21] www.bioenergy.org.nz/NZBioenergyStrategy2010.pdf

Lake Rotoaira Forest Trust, Ngati Porou Whanui Forests and the Central North Island Iwi Collective (CNIIC). Of Maori's $36.9 billion total asset base, $2.1 billion is related to forestry over 81 organisations [22].

Issues that Maori entities face in this industry include fragmentation of land ownership (around 550,000 hectares of Maori land has no formal administration), the distance to market and associated transport costs, access to working capital for forest establishment, management of intergenerational investment, the impact of the Emissions Trading Scheme, and the development of employment opportunities for their people.

Some Maori forest owners wish to diversify species and, in some cases, to re-establish land in species other than radiata pine, including indigenous species. This choice is driven by the desire to re-establish taonga species as part of the cultural reinvigoration, for carbon revenue and ngahere for traditional uses (carving). Examples of iwi wanting to diversify are Ngati Porou, Tuhoe, Te Arawa, Te Rarawa and Ngati Whare.

In considering the use of forest resources, Maori are also driven by the desire to incorporate Matauranga Maori (traditional knowledge) and increase the education and skills of iwi/hapu members. Science and innovation are seen as enablers of a strengthened future Maori economy. A number of iwi/Maori are currently pursuing the use of science, innovation and technology strategies to better understand the potential benefits for iwi economic, social (cultural) and environmental outcomes.

Maori Affairs Minister Pita Sharples stated at the Maori Economic Summit in Auckland, 5 April 2011, that "Maori and iwi are now recognised as playing an important role in the New Zealand economy" and that "there was a need for greater investment in science and research".

Critical challenges facing the forest industry

In distilling the key challenges facing the forest industry, Scion's consultation process included the various parent industry associations: WoodCo[23]; the New Zealand Forest Owners Association[24]; the Wood Processors Association of New Zealand[25]; and the New Zealand Pine Manufacturers Association Inc.[26]

WoodCo covers the seed-to-wood and wood-fibre value chain. WoodCo is currently completing an industry consultation process, in which it is gauging the level of support for developing a pan-industry strategy and identifying priority issues. The report from this study will be released in mid 2011. This study is likely to influence the 2012 update of Scion's Science and Innovation Framework.

Of immediate relevance are the recently released co-developed strategies for the forest growing industry[27] and wood processing industry[28] developed by the Forest Owners Association, the Wood Processors Association of New Zealand and the New Zealand Pine Manufacturers Association Inc. They, along with the specialist wood processing and forestry research entities, Future Forests Research[29], the Radiata Pine Breeding Company[30] and Solid Wood Innovation[31], have identified further critical issues related to industry growth, productivity and profitability as:

- Delivering high quality tree germplasm to deliver stiffer, clearer, more stable wood and improved tree health.
- Increasing forest productivity to at least 40m^3/ha/annum by 2035 through improved silviculture practice, improved genetic material and health, as well as improving profitability.
- Lowering the costs of forestry, such as reducing tree harvesting costs by 25% on steep slopes, where the bulk of the future resource is located.

[22] www.tpk.govt.nz/_documents/taskforce/met-rep-assetbaseincexpend-2011.pdf
[23] www.woodco.org.nz.
[24] www.nzfoa.org.nz
[25] www.wpa.org.nz
[26] www.pine.net.nz
[27] Forestry – Science and Innovation Plan (Draft), April 2011. Forest Owners Association of New Zealand.
[28] The Wood Processing and Manufacturing Science and Innovation Plan, March 2011. Wood Processors Association of New Zealand and the New Zealand Pine Manufacturers Association Inc.
[29] www.ffr.co.nz
[30] www.rpbc.co.nz
[31] www.wqi.co.nz

- Improving supply chain logistics and addressing lack of infrastructure and a skilled workforce that could adversely impact on the ability to expand future harvest.
- Enhancing the availability of timber from alternative species such as Douglas-fir, cypresses, eucalypts and indigenous species.
- Monetising the full value of carbon stored in forests.
- Improving the productivity and profitability of wood processing through reduced resource use (water, energy and chemicals), improved log yield and the development of technologies to differentiate logs on the basis of their wood quality features in order to optimise processing.
- Developing new composite products such as packaging and paper grades.
- Further exploiting the use of wood to produce energy.
- Developing new building solutions from timber to improve the competitiveness of the solid wood processing sector and increase domestic demand for solid wood products.
- Demonstrating the environmental sustainability of New Zealand forest management systems and supply chains to international markets by meeting international protocols such as the Forest Stewardship Council protocols and providing technical tools to address non tariff barriers to export.
- Protecting New Zealand's forests from biosecurity incursions, wind and fire.

The critical issues are described in Figure 2 from an industry value chain perspective. Many of them are interdependent. For example, expansion of solid wood processing increases the availability of wood for the pulp, paper and composites industries and for energy production. Substantial improvements in harvesting on steep slopes improves the value proposition for developing forests on marginal land. This will catalyse growth in economic and environmental benefits for New Zealand.

Collectively these challenges can be summarised into four broad categories:

1. Realising substantial economic gains from productivity improvements, new product development and capturing value from environmental, social and cultural benefits.

2. Ensuring that the New Zealand forest industry continues to grow export and domestic markets through resource use efficiency and meeting international stewardship, performance and environmental standards.

3. Ensuring that capability is maintained to minimise the impact of biosecurity, wind and fire risk on New Zealand's forests.

4. Partnering with Maori to grow Maori forestry assets and returns.

As outlined in the subsequent sections, these needs and issues have:

- Shaped Scion's science and innovation framework (Section 4).
- Been used to inform or better focus Scion's current research programmes (Section 5).
- Helped to direct the investment of Scion's Core Funding (Section 7).

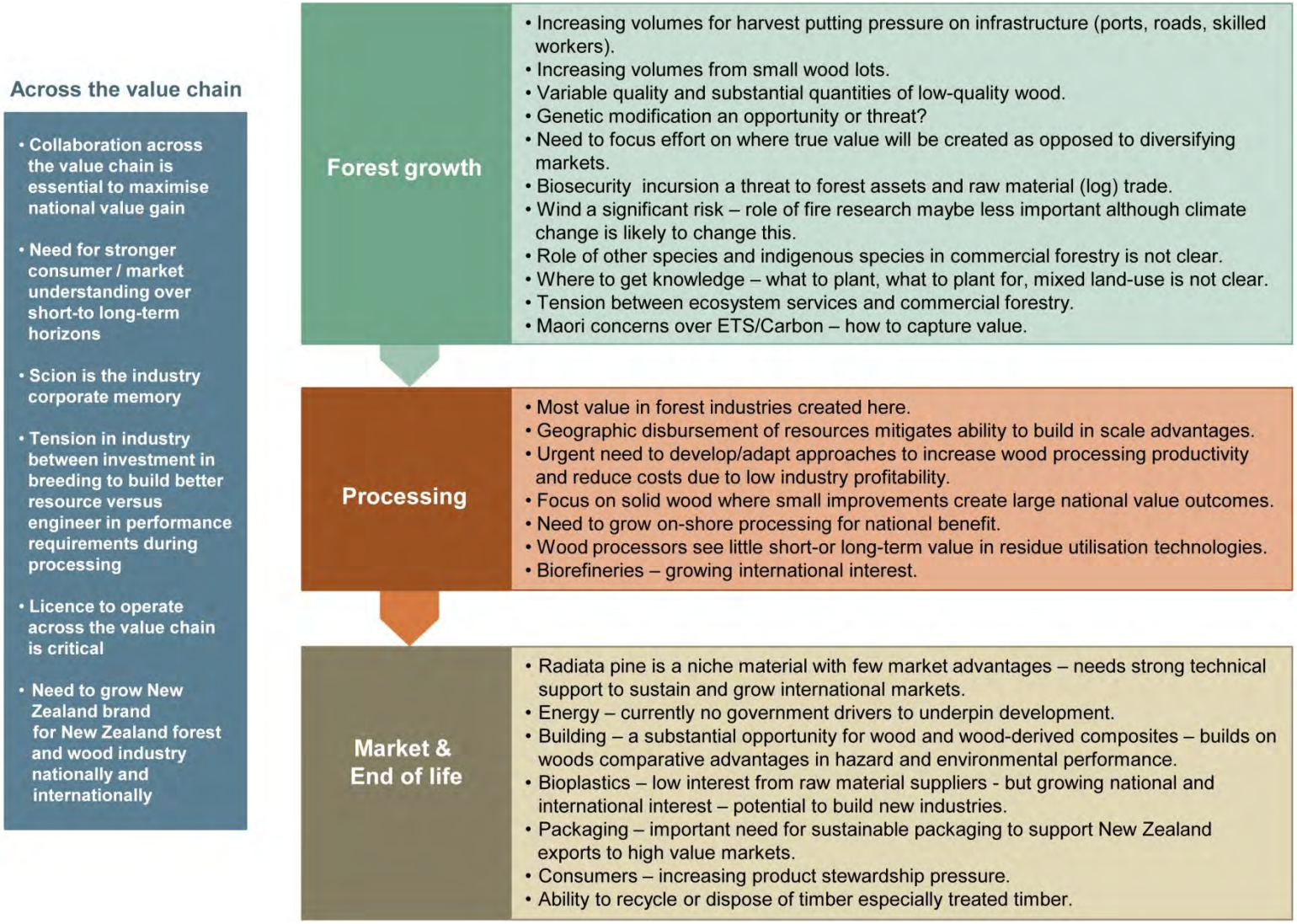


Figure 2: Stakeholder issues across the value chain

4. Scion's strategy and science plan

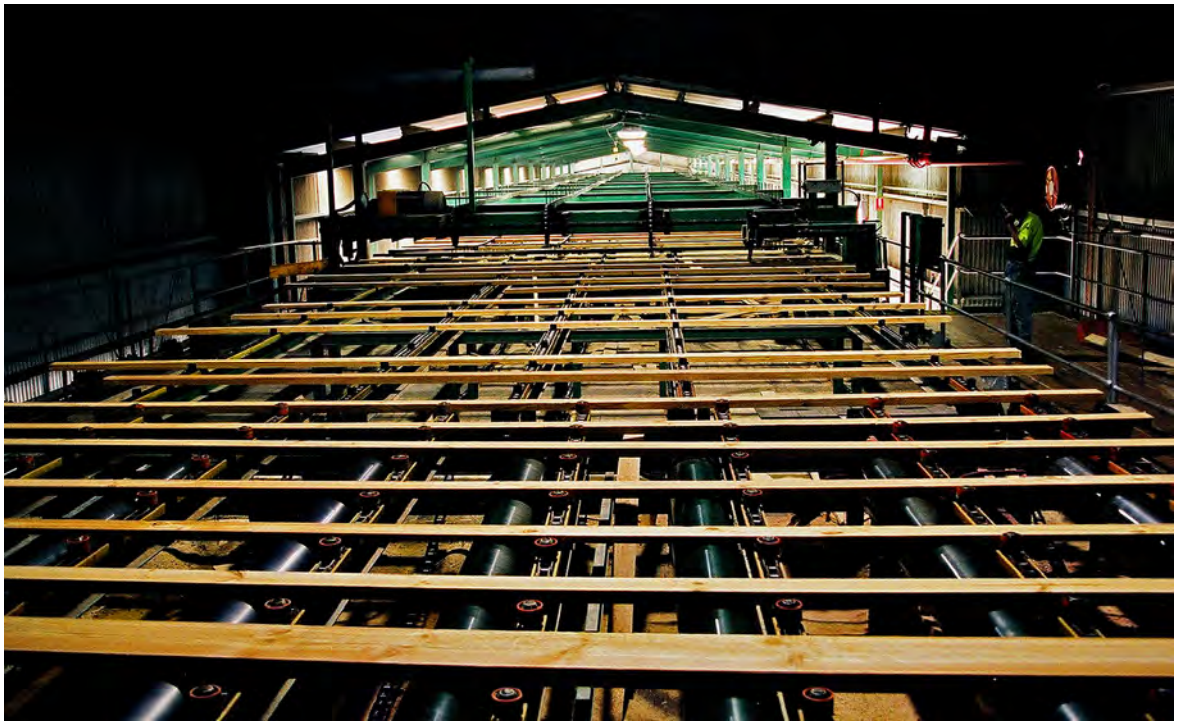
Scion's strategy focusses on delivering the science and technologies required to address the challenges described in Section 3. In particular the strategy seeks to:

- Assemble the best science teams to deliver solutions.
- Accelerate uptake of new knowledge and technology and to embed this within the relevant parts of the New Zealand forest industry to achieve Scion's Statement of Core Purpose National Outcomes.

To achieve this strategy Scion will:

1. Deliver the Intermediate Outcomes / Impacts (IOs) as defined in Scion's Science and Innovation Framework.
2. Strengthen relationships with users to ensure the science is well focussed and uptake maximised.
3. Develop the best available science and innovation teams.
4. Effectively allocate and monitor Scion's investment (Core Funding and internal) to achieve national value and impact, and support growth in industry co-investment.
5. Develop Scion's people and culture to be high performing and customer focussed.
6. Achieve operational excellence through the application of 'best practice' processes and systems in a modern, stimulating workplace.
7. Strengthen foresight (analysis of future trends in science and industry).

Scion's strategy has been extensively refreshed to be fully consistent with its Statement of Core Purpose, incorporate stakeholders' feedback in the science priorities, and achieve the shift in organisational capabilities and culture necessary to respond flexibly and quickly to the complex environments in which Scion operates. The strategy, which follows the balanced scorecard approach[32], is summarised in Figure 3.



[32] Kaplan and Norten. 1993. The Balanced Scorecard, Harvard University, Free Press.

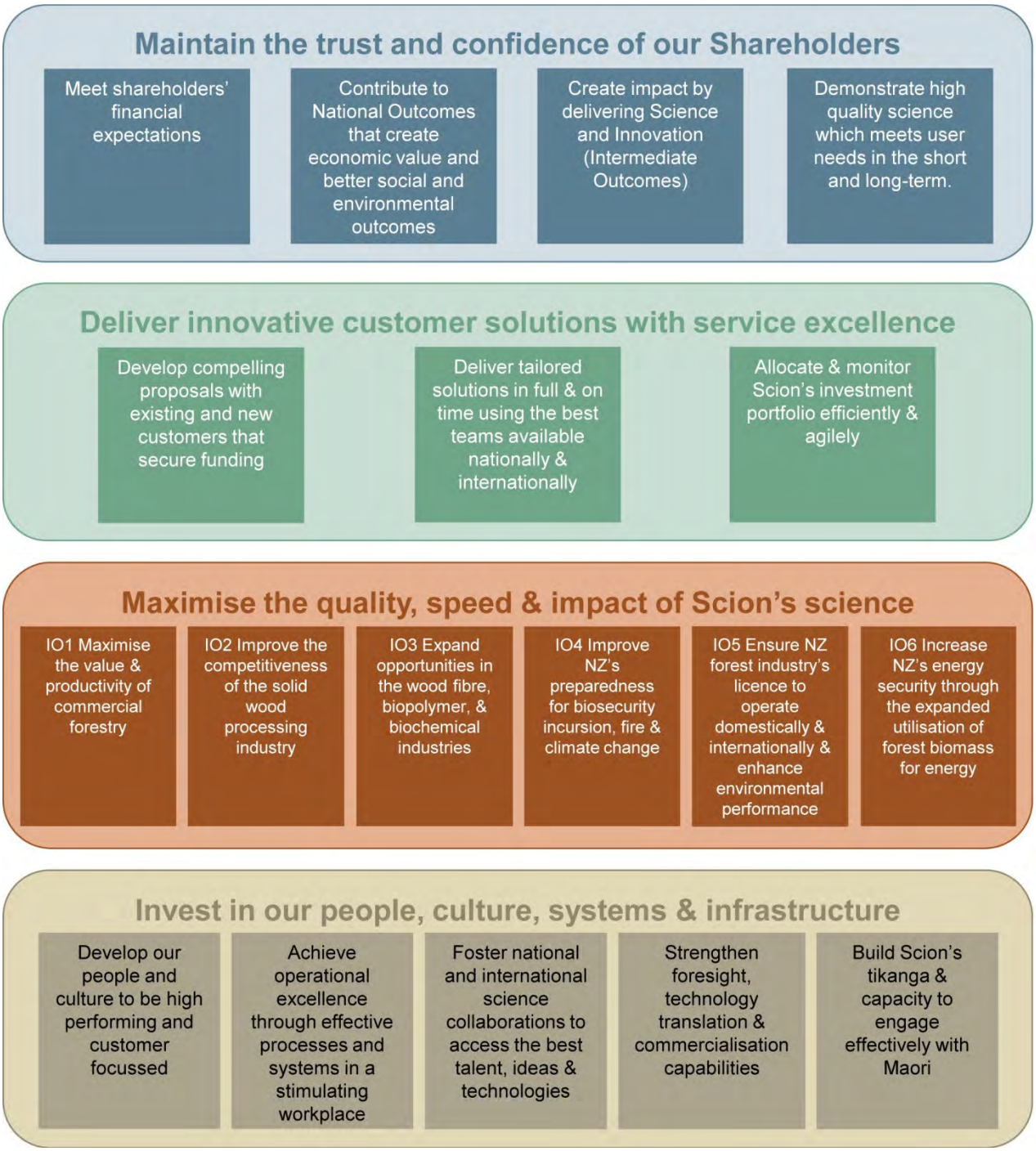


Figure 3: Scion's strategic framework

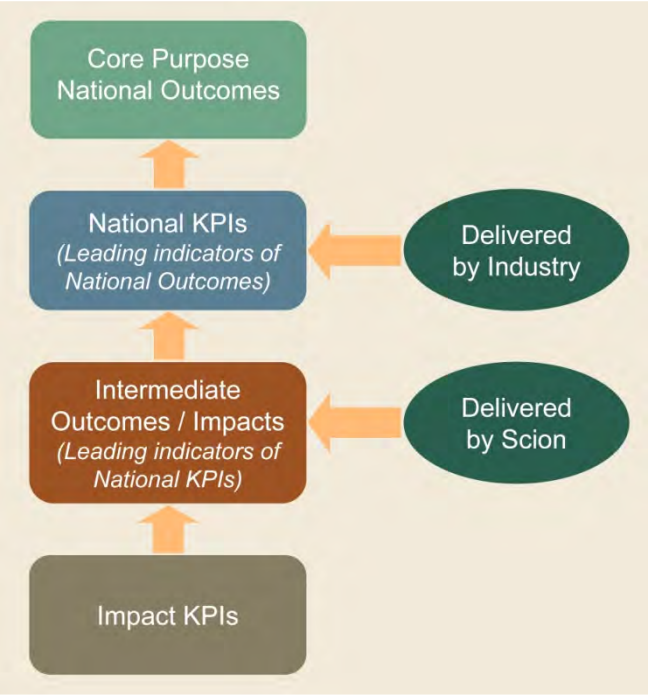


Figure 4: Hierarchy of Indicators and Outcomes

1. Deliver the Intermediate Outcomes / Impacts (IOs) as defined in Scion's Science and Innovation Framework.

Scion's Science and Innovation Framework (see page 21) describes the critical relationship between the National Outcomes and the science outcomes delivered by Scion. The latter are referred to as Intermediate Outcomes / Impacts (IOs) which are targeted at a 15-year horizon. Each IO, as depicted in Figure 4, informs a National Key Performance Indicator which in turn provides a measure of achieving the National Outcomes as defined in Scion's Statement of Core Purpose. Underpinning each IO are Impact Key Performance Indicators (achieved within a three- to five-year timeframe) to gauge progress towards achieving the IOs.

The IOs are defined specifically to respond to the challenges identified in the previous section. They are:

IO1 - Maximise the value and productivity of commercial forestry by:

- Developing superior radiata pine germplasm to meet current and future consumer performance requirements including tree health.
- Improving forest productivity by increasing mean annual increment through better forest management.
- Developing mechanical harvesting solutions that reduce the cost of harvesting on steep slopes, and enhancing supply chain logistics.
- Enabling expansion of New Zealand's commercial forest estates in other species, including indigenous species by developing new breeding approaches and providing tools to support their establishment.
- Enabling carbon values to be more effectively monetised by development of tools to enable better capture of carbon data.

IO2 - Improve the competitiveness of the solid wood processing industry by:

- Expanding the use of wood and wood-derived materials in the housing market through development of new building solutions.
- Improving productivity and profitability of solid wood processing including developing wood segregation tools to avoid adding unnecessary processing costs to low quality timber.

IO3 - Expand opportunities in the wood fibre, biopolymer and biochemical industries by:

- Improving productivity in the wood fibre processing industries to enhance competitiveness.

- Developing new wood fibre-based composites.
- Developing new industries to produce plastics and polymers from forest biomass.
- Developing new fibre-based packaging materials to support New Zealand's export industries and enabling them to meet strict consumer requirements.

IO4 - Improve New Zealand's preparedness for biosecurity incursions, fire and climate change by:

- Sustaining capability and developing tools to minimise risk to New Zealand's forests from biosecurity incursions, the impacts of climate change and fire.

IO5 - Ensure the New Zealand forest industry's licence to operate domestically and internationally and enhance environmental performance by:

- Delivering tools to enable New Zealand forests to meet strict international codes of practice including environmental impacts.
- Delivering tools and processes to enable the New Zealand wood processing industries to meet best acceptable environmental practice.
- Providing tools to enable optimal land use decisions and to utilise forests to protect land.
- Providing tools to enable monetary value to be captured from ecosystem services.
- Providing technical support to permit the industry to address non tariff barriers to uptake.

IO6 - Increase New Zealand's energy security through expanded utilisation of forest biomass for energy by:

- Developing processes and decision systems appropriate for New Zealand to realise greater value from exploiting forest biomass for energy and fuels.

Each of the Intermediate Outcomes / Impacts and associated performance measures is described in detail in Section 5.

2. Strengthen relationships with the users to ensure the science is well focussed and uptake is maximised.

Forest growing/managing: Scion has a close working relationship with the forest growing industry, through the Forest Owners Association, the industry's research and investment groups – Future Forests Research, the Radiata Pine Breeding Company and sub committees such as the Forest Biosecurity Committee. The Rural Fire Authority is another critical and important relationship in this area. Scion has worked with all of these groups to ensure its research is aligned to their needs and to grow co-investment. Over 2011/12 Scion will be seeking to strengthen its relationships at the CEO-to-CEO level across this group. In the 2011 calendar year, Scion and the forest industry (acting through Future Forests Research) are reviewing the forest development programmes. This aims to strengthen the focus of science and technology transfer in the areas of improved forest productivity, forest and the environment and in alternative (to radiata pine) tree species development.

Wood processing: Solid Wood Innovation (SWI) and the Structural Timber Innovation Company (STIC) are major investors for this part of the industry. SWI programmes are focussed on improving process efficiency and segregation technologies. STIC's focus is on developing multi-storey timber buildings. Scion is a major participant in the SWI programmes and is increasing its association with STIC. As many parts of this industry compete in the market place, many of Scion's interactions are with individual companies. Scion will seek to strengthen its relationship with the individual companies, industry associations and industry groups.

Specialty materials manufacturing industries: These include firms that focus on the production of chemicals, energy and specialty fibre composites. Typically engagement is at an individual company level, although Scion has implemented user-advisory groups in biochemicals and packaging during 2011 to provide stronger strategic input into research direction and priorities.

Government departments: The Ministry of Agriculture and Forestry, Ministry for the Environment, Department of Conservation, New Zealand Trade and Enterprise and the Department of Building and Housing are important stakeholders and customers for Scion. The CRI Taskforce changes will be used to progress preferred provider relationships with these departments and minimise duplication of capability.

Maori: Scion's interactions with Maori include participation by iwi in management of Scion's land, the development of important communication tools (Te Aroturuki[33]) to ensure Maori concerns are addressed in all areas of research (especially in sensitive activities such as genetically modified organisms) and supporting Maori economic and social development. Scion is actively seeking to improve the company's overall ability to build strong and enduring partnerships with Maori and the initiatives to achieve this are set out in its Maori Plan[34].

3. Develop the best available science and innovation teams.

Scion undertakes extensive national and international collaboration to form the best possible teams to deliver its science and innovation outcomes. Major collaborators in relation to Scion's Intermediate Outcomes / Impacts are tabulated below.

Scion also seeks to leverage international science investment to supplement New Zealand's science and innovation expenditure and access innovations that can be quickly adopted and/or adapted into the New Zealand context.

Table 1: Major collaborators in relation to Scion's Intermediate Outcomes / Impacts

Intermediate Outcome / Impact	Key Collaborators
IO1 - Commercial forestry	Future Forests Research Ltd Radiata Pine Breeding Company Ltd ArborGen Forest Research UK (Wales) University of Canterbury
IO2 - Wood products and processing	Solid Wood Innovation Partnered companies European Union (EU) Cooperation in Science and Technology (COST) actions
IO3 - Wood fibre, biopolymer and biochemical industries	Plant and Food Research AgResearch Biopolymer Network Ltd Auckland University (including the Materials Accelerator Group) Waikato University Massey University EU COST actions VTT Technical Research Centre of Finland Partnered companies
IO4 – Risk and adaptation	Better Border Biosecurity Plant and Food Research AgResearch
IO5 - Licence to operate	Future Forests Research Ltd AgResearch Landcare Research Environmental Science and Research EU COST actions Solid Wood Innovation
IO6 - Bioenergy	International Energy Agency Bioenergy Tasks US Department of Energy Bioenergy Labs Partnered companies University of Canterbury

[33] Te Aroturuki. A model for cross cultural engagement. A Scion impact report 2008 www.scionresearch.com.
[34] A summary commentary on Scion's Maori Plan 2011-16 is available at www.scionresearch.com.

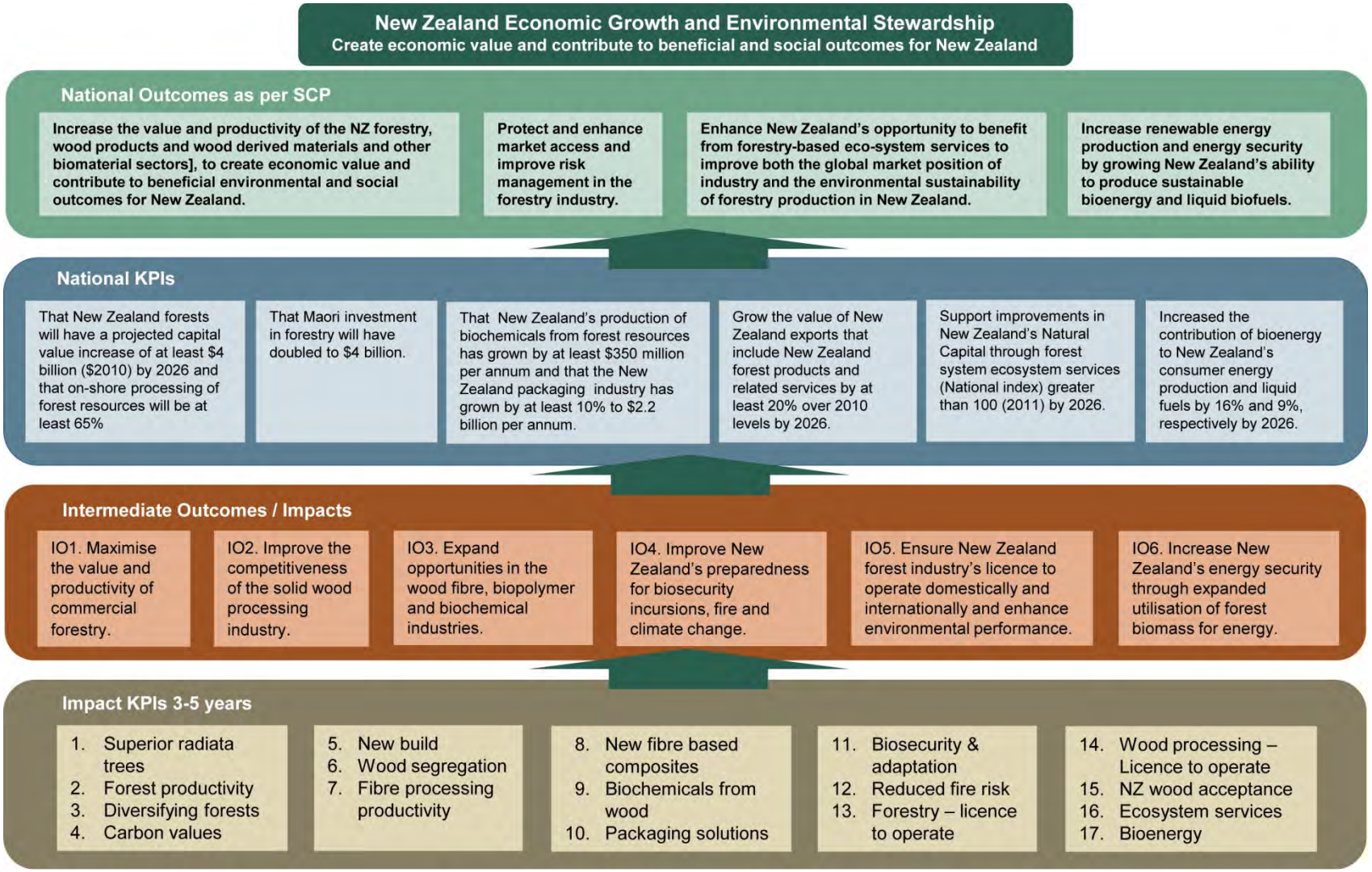


Figure 5: Scion's Science and Innovation Framework

4. Effectively allocate and monitor Scion's investment (Core Funding and internal) to achieve national value and impact, and support growth in industry co-investment.

Investment management

With the addition of Core Funding from July 2011, Scion has modified its investment management processes to reflect the significant value of funds involved and the role of the Board in its strategic allocation[35]. Key elements include:

- Scion's science is grouped into programmes, each of which contributes to the delivery of at least one Impact Key Performance Indicator (KPI) and at least one IO.
- The programmes are funded in accordance with the research needs but not for more than seven years.
- Between 10 to 15% of Scion's investment will be refreshed each year to provide for new opportunities, emerging science, collaborations and capability building.
- The investment process and monitoring of portfolio 'health' will be managed by Scion's Investment Committee which is chaired by Scion's CEO and, through the CEO, accountable directly to the Scion Board.
- All programmes will be subject to a quarterly performance check and formal review every three years in addition to normal internal annual science reviews.
- Investment will be based on the contribution of the science; the balance of research and risk across the six Intermediate Outcomes / Impacts; and meeting special requirements such as the stewardship of critical capability or databases and collections.
- During 2011/12 Scion's programmes will all be reviewed and, as necessary, adjusted to be fully aligned to the Science and Innovation Framework and Statement of Core Purpose by July 2012.

Science programme review

A Scientific Strategic Advisory Science Panel of international standing and a User Strategic Advisory Panel with knowledge and expertise across the New Zealand forest industry value chain has been established. These panels will ensure that science quality and relevance meets the expectations of Scion's Board (including value for money) and technology uptake by users is maximised. The first meeting of the panels with Scion's Board and Executive is scheduled for November-December 2011. The panels will contribute to a review of two IOs per annum. Terms of reference for the panels and biographies of their members are available at www.scionresearch.com.

At the programme level, industry and science advisory groups will continue to support the respective science manager and programme manager in achieving programme outputs, strengthening foresight activities and ensuring the science undertaken remains dynamic, resilient and relevant. The latter advisory groups are largely in place already, and will complement the work of the Strategic Advisory Panels.

5. Develop Scion's people and culture to be high performing and customer focussed.

Scion's "People, Performance and Culture (PPC) Plan 2011-16" outlines the people and cultural requirements necessary for Scion to achieve its Statement of Core Purpose. The plan specifies actions to deliver outcomes to:

- Build a high performance culture aligned to Scion's values: vital, collaborative and innovative.
- Develop organisational leadership and capability through workforce planning and tailored learning and development programmes.
- Attract, recruit and retain top talent.
- Ensure workplace safety and legislative compliance.
- Develop Scion's tikanga and capacity to engage effectively with Maori.
- Align remuneration and reward to the achievement of the KPIs.
- Implement systems and administration support to achieve organisational efficiency and consistency in people management.

6. Achieve operational excellence through the application of 'best practice' processes and systems in a modern stimulating workplace.

A comprehensive plan is in place to enhance Scion's facilities, information technology (IT) systems and equipment as follows:

[35] Further information on the investment principles, annual cycle and criteria are described at www.scionresearch.com

Facilities: A 10-year infrastructure development plan, adopted in 2010, was designed to bring laboratories, office facilities and IT up to the standards required for a 21st century research organisation. The plan addresses deferred maintenance and building new plant and equipment to enhance the uptake of Scion's technologies. This process will involve the modernisation and refurbishment of laboratories, office facilities and infrastructure and development of containment facilities consistent with the Environmental Risk Management Authority specifications to support extension of biological material development and enhancement.

Systems: Completion of the IT-based financial and human resource management systems and application of IT systems to improve data management and local, national and international collaboration.

Science Equipment: Construction of bio-refinery pilot plant facilities to support Intermediate Outcomes / Impacts 3 and 6, in particular. Scion will be seeking industry co-investment in the plant as part of its plan to support the scale-up of technologies for industry adoption.

Final allocation of funds – including the re-investment of surpluses – will be subject to Board approval of the final business cases for each initiative.

Databases, collections and unique facilities

Scion has stewardship of several resources of national significance described in Table 2. These will continue to be maintained to a high standard enabling public access and re-use of the data.

Table 2: Databases and collections of national significance

Database/Collection	Description
National Forest Herbarium and Database	This nationally significant database and collection specialises in plants significant to plantation and indigenous forestry in New Zealand. It includes a wide range of native and amenity species. This is the only database and collection held by Scion that was supported by the Research Infrastructure (Backbone) Investment Fund.
National Forestry Library	The National Forestry Library contains publications, in a variety of formats, relating to forestry and wood processing research over the last 75 years. It represents the collected published heritage of forestry and related industries in New Zealand.
Permanent Sample Plot Database	An internationally unique database of sites that are used to measure growth and development of plantation forest trees across New Zealand.
National Wood Performance Archive	More than 70 years of records of wood durability and performance across four sites in New Zealand.
National Forest Insect Collection	An internationally registered collection of identified forest insects in New Zealand.
National Forest Culture Collection	An internationally registered living collection of fungi (and bacteria).
National Forest Mycological Herbarium	An internationally registered collection of dried specimens of fungi and plant material containing fungi.
The Wood Fibre Refining Facility	This is a small-scale industrial facility capable of processing wood to produce fibre and pulp. It is used extensively to test operational scenarios for New Zealand's pulp and fibre production companies. It is the largest such test operation in the Southern Hemisphere.

7. Strengthen foresight technology translation and commercialisation capabilities.

Scion will be boosting its foresight programme from 2011/12 with additional resources to undertake technology and market foresight, and supply chain economics. Stakeholder input and co-investment will be sought to ensure this work is highly targeted to the forest industry.

During 2011/12, Scion will review its technology transfer approach and, through reinvestment of surplus initiatives, evaluate some new approaches to strengthen industry engagement and ensure faster uptake of its science outputs. This will include strengthening the implementation plan for technology transfer in programme development, and stronger, earlier engagement of user advisory panels before initiating research.

Annual Operating Plan

The objectives and performance metrics for each of the strategic initiatives will be set out in the Annual Operating Plan. Progress in achieving the People, Performance, Culture Plan outcomes will be reviewed annually with the Board and adjustments made as appropriate to respond to factors, such as emerging employment trends, legislative changes and organisational development.

5. Investment in science and capabilities

This section describes the investments made by Scion to support the implementation of its strategy; specifically, the investment of Core Funding and reinvestment of financial surpluses.

Core Funding investment

In the 2011/12 year, Scion will receive $17.7 million from the Government to invest in science and innovation programmes that will contribute towards the achievement of Scion's Statement of Core Purpose National Outcomes. This investment has been consolidated from current programmes contracted with the Ministry of Science and Innovation and former CRI Capability Funding. It will be directly applied to achieving the Intermediate Outcomes / Impacts in Scion's Science and Innovation Framework (see Section 4).

Core Funding has been allocated as described in Table 3 but will be fully reviewed during 2011/12 in response to further developments in industry strategies and any changes in stakeholder and partner priorities.

Table 3: Indication of application of Scion's Core Funding

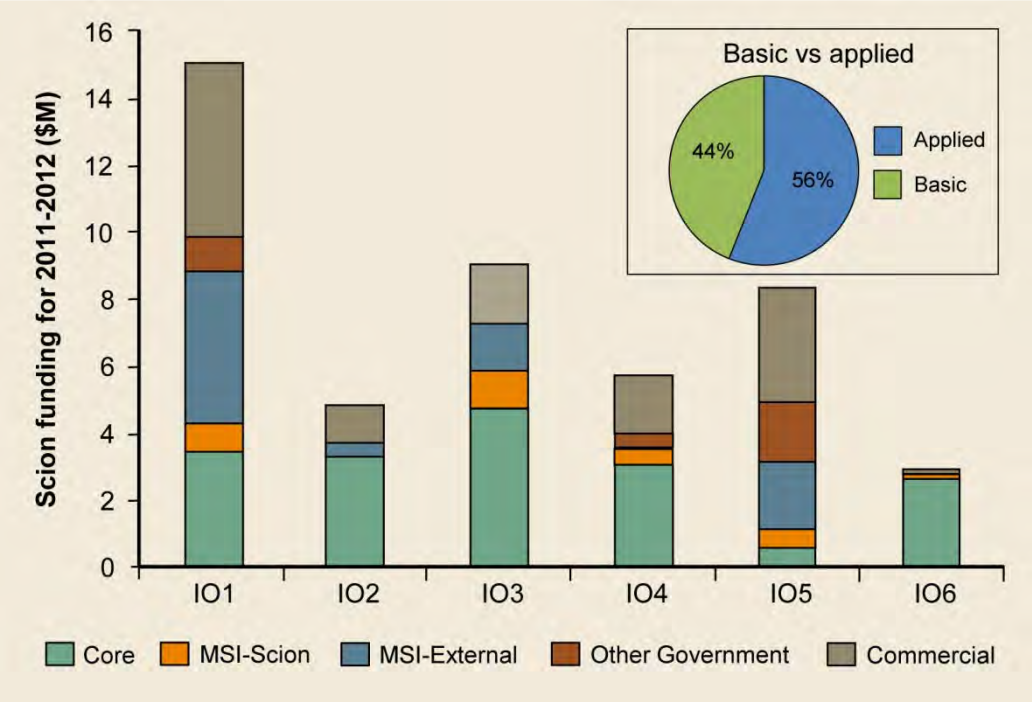
Intermediate Outcome / Impact	Title	Activity	Investment (million)
IO1	Commercial forestry	• Applying genetic and conventional breeding approaches for radiata pine. • Improving genetic gain for exotic (other than radiata pine) commercial and indigenous species. • Applying quantitative genetics to support the new germplasm target and defining the potential opportunity to use molecular techniques for rapid gain in genetic stock. • Supporting the National Forestry Herbarium to sustain this asset of national significance. • Developing systems to reduce the environmental impact of harvesting, developing mechanical harvesting solutions and exploring options for addressing barriers in supply chain logistics.	$3.47
IO2	Solid wood processing and products	• Developing wood-based building solutions and new engineered wood-based products for building and related applications.	$3.28
IO3	Wood fibre, biopolymer and bio-chemical products	• Developing new fibre products and new products from wood fibre processing. • Developing new wood-derived functional materials to meet consumer demands in packaging and specialty chemicals markets.	$4.75
IO4	Risk and adaptation	• Developing tools to sustain nationally important capability in managing biosecurity risk.	$3.06
IO5	Licence to operate	• Developing environmental technologies and land decision systems to support standards development and standards harmonisation.	$0.56
IO6	Bioenergy	• Developing tools, technologies and expert decision systems to enhance the potential exploitation of forest biomass for energy production.	$2.61

The focus of investment is to:

- Ensure that Scion capability is well aligned to deliver the Intermediate Outcomes / Impacts. Full details are presented later in this section.
- Support activities where industry investment (e.g. bioenergy) is unlikely until proof of concept and the risks are better quantified.
- Enable industry to build its investment into joint business cases as they are developed.

Investment source mapped to Intermediate Outcomes / Impacts

Investments in Scion's science and technology are mapped below, with an indication of the overall investment in basic science and applied science[36].



Key to investment:

- **Core** – relates to Scion's Core Funding.
- **MSI/Scion** – describes investment into Scion from MSI contestable funding contracts.
- **MSI/External** – describes investment from MSI into Scion from third parties including Core Funding sub contracts from other Crown Research Institutes.
- **Other government** – describes investment from government departments other than MSI.
- **Commercial** – describes investment from all other sources including private companies.

Figure 6: Investment in Intermediate Outcomes / Impacts

[36] Refer to glossary for definitions of applied science.

About one third of investment into Scion is focussed in commercial forestry (IO1) with a large component directly and indirectly sourced through the government. This area reflects some of the strongest relationships across the forest industry and also with Scion.

Scion has increased its investment in the solid wood products and processing area (IO2) to strengthen activities in wood based building solutions for residential applications, to work with the wood products industry, to enhance its competitiveness and increase industry co-investment in research and development.

The level of Core Funding investment in IO3 (biochemicals and wood derived materials) reflects the need to support the development of these emerging industries and strengthen productivity and new product development in the existing fibre processing industries.

Much of the co-investment in forest risks and adaptation (IO4) and licence to operate (IO5) is derived from government departments which face stringent financial constraints over the next decade. Scion has increased its investment in IO5 to reinvigorate this area of activity.

Sustainable bioenergy (IO6) is a key national priority, but the industry is not yet well developed. Although current investment in this area is relatively small, Scion will work pro-actively with users and stakeholders to increase the level of research and direct co-investment.

About 56% of Scion's research programmes are applied science, reflecting the strong intended focus on technology transfer and rates of uptake, strengthening the industry-science interface.

Science and Innovation Framework Intermediate Outcomes / Impacts

The six Intermediate Outcomes / Impacts are described in detail in the following sections, together with the Impact Key Performance Indicators. It should also be noted that:

1. Impact Key Performance Indicators may align to several IOs.
2. The research approach is indicative and subject to review during programme development with users.
3. The investment levels are based on 2011/12 budget figures.

Intermediate Outcome / Impact 1 (IO1):
Maximise the value and productivity of commercial forestry

The potential to increase forestry's contribution to the New Zealand economy is significant, through value enhancement, operational cost savings and carbon storage. These can all be achieved by productivity enhancement in existing forests and through new plantings of improved trees. Already since 1980, genetic improvement and advances in forest management practices for radiata pine have increased the value of forestry to New Zealand by $6.2 billion[37] and this is projected to rise to around $10 billion by 2026. The New Zealand forest growing industry's goal is to increase the average mean annual increment (MAI or yield in m^3/ha/annum) from about 19 to 40 by 2035[38] and improve the average stiffness and density of timber to enhance its intrinsic value to the wood products sector.

Steep country harvesting so typical of New Zealand forestry has been identified as a target area where a reduction in costs would substantially improve industry profitability. A successful application to the Primary Growth Partnership[39] identified that "harvesting costs need to be reduced by at least 25%, New Zealand's harvest machinery industry must grow to future-proof the industry and harvesting jobs must be made safer and more desirable for workers."

Industry has also identified supply chain logistics as a critical issue. There is concern regarding the increased infrastructure required for New Zealand to support harvesting of the developing forest estate. "Currently, forests in some parts of the country are not being harvested as the cost of harvesting plus transport exceeds the value of the crop. Furthermore, approximately 60% of the plantation estate is first rotation, which means that expensive roads will need to be constructed before logs can be extracted. This will be a significant issue around 2015 when many of these forests mature, and unless harvesting costs can be reduced, many forests won't be harvested." [40]

Species such as Douglas-fir, cypresses and eucalypts represent less than 10% of the commercial forest estate and indigenous species such as kauri and totara are not yet commercially viable. There is an increasing interest in planting species in addition to radiata pine because of the special timber value they create (including durability, provision of short fibre for paper production, valuable biochemicals, iconic value and in some cases cultural value). They also improve biodiversity within New Zealand forests.

New Zealand's forests are pivotal to achieving our Kyoto commitments whilst generating new economic activity within the forest industry. Quantification of stored carbon, and the development of tools able to predict future storage, will be critical to realise these opportunities.

Key research approach:

- Develop genetically improved planting stock reflecting industry's goals for productivity, quality and disease resistance gains using traditional and/or molecular assisted breeding and selection tools, as well as genetic engineering to introduce novel genes into breeding and production populations.
- Improve propagation techniques to allow more rapid deployment of that genetic gain.
- Understand the relationships between site, species, operational and environmental factors to maximise opportunities for productivity gains.
- Understand the factors limiting the efficiency of steep country harvesting to allow development of advanced machine solutions.
- Develop improved look-up tables relevant to species and site to predict carbon sequestration into forests.

[37] Scion Impact Study (2010) Forestry improvements – Increasing the Value of Forestry in New Zealand.
[38] Future Forests Research Ltd Productivity Workshop held 8th/9th March 2011, and the Forest Industry Science and Innovation Plan (Draft), April 2011, Forest Owners Association.
[39] Future Forests Research Ltd, Innovative Harvesting Solutions Business Plan prepared for the Primary Growth Partnership, February 2010.
[40] New Zealand Forest Industry – Science and Innovation Plan (Draft), April 2011, Forest Owners Association ww.foa.org.nz

IO1 - Commercial forestry

By 2026, the projected capitalised value of New Zealand's commercial forest estates has increased by at least $4 billion, supported by a reduction of least $70 million per annum in operational costs (both over 2010 values), by:

- Infusing germplasm for radiata pine and alternative exotic and indigenous tree species;
- optimising land-use and matching species to site.
- Introducing superior mechanical harvesting solutions for steep country, and improved supply chain logistics.
- Expanding New Zealand's commercial forest estates.
- Realising value from stored carbon.

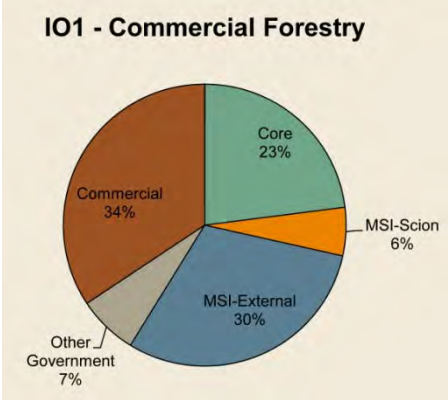
These outcomes will be achieved in collaboration with forest growers, tree breeders, iwi and harvesting companies.

Impact Key Performance Indicators

1.	By 2016, research support has assisted the Radiata Pine Breeding Company to (i) release new selections that increase volume growth by 10% and outerwood density by 10kg/m^3 over current best planting stock; (ii) increase the number of elite parents with corewood stiffness greater than 7GPa by 70%; and (iii) embed a new research programme in foliar disease resistance.
2.	By 2016, in collaboration with Future Forests Research and other forest growers, new forest management tools have been developed and validated by the New Zealand industry enabling (i) a 25% reduction in costs for steep country harvesting operations; and (ii) improved new crop forest productivity leading to an average gain of 6m^3/ha/annum MAI both over 2010 practices.
3.	By 2016, in collaboration with Future Forests Research, iwi and other special interest groups, the New Zealand forest industry has expanded its alternative species estate by 20% over the 2010 area through commercial plantings of eucalypts, Douglas-fir, cypresses and indigenous tree species.
4.	By 2016, in collaboration with the Ministry of Agriculture and Forestry and Ministry for the Environment, New Zealand's national carbon inventory related to land use, land use change and forestry sectors has been verified and includes Kyoto compliant post-1989 planted and naturally regenerated forest.

Total investment: $15.09 million

Distribution of investment: Core ($3.47m), MSI/Scion ($0.83m), MSI/External ($4.57m), other government ($1.03m) and commercial ($5.18m)



Intermediate Outcome / Impact 2 (IO2):
Improve the competitiveness of the solid wood processing industry

The strength and viability of the solid wood processing sector (including engineered wood products) in New Zealand has important direct and indirect benefits to New Zealand and to the wider forest industry. The bulk of the value in a tree lies in the solid wood products that can be created from it. The pruned logs and sawlogs comprise 85% and 95% of the volume and value of the tree respectively[41].

The balance of the tree, including industrial logs and residues have a low intrinsic value, but provide important feedstocks to other industries. Expansion of solid wood processing creates more by-products to support other industries such as pulp and paper, composites and energy production.

Low profitability of the wood processing industry is a global issue. Various studies[41] have identified a need to improve operational excellence, develop new products from wood and ensure a sustainable supply of timber. Such strategies include:

- Developing biorefineries.
- Improving productivity and new manufacturing technologies for wood products.
- Tailoring feedstocks for end use.
- Building with wood/wood systems aligned with sustainability.

Timber has been the dominant construction material used in the housing and light commercial building sector in New Zealand. However, it has been losing market share steadily over the last 10 years, particularly in house components such as flooring and cladding. The recent earthquakes in Christchurch has provided a unique opportunity to regain that market share as New Zealand needs a robust solution to high hazard environments – an application in which wood excels. New Zealand must also address its housing shortage and the need to upgrade houses to meet minimum energy performance standards. A new timber-based building platform will be needed to meet modern requirements of performance, cost and sustainability, which can also provide an opportunity to optimise the use of wood produced from New Zealand forests. As building system developments also have spin-off export opportunities, the positive effect for New Zealand could be measured in hundreds of millions of dollars per annum.

The second major challenge for New Zealand solid wood processing is to address the variability of wood, a particular problem for radiata pine. The variability within and between trees is one of the major challenges facing the wood processing industry. In particular, radiata pine exhibits variable strength and stiffness and contains defects such as resin pockets. The ability to segregate material in its green form before adding the cost of processing will substantially enhance wood processing efficiency. Early segregation of the worst 5% of warp-prone timber can deliver savings of $250,000 per 100,000$m^3$ production through rejecting material before being dried, planed and graded[42].

Key research approach:

- Use lessons from the recent earthquakes to identify where wood products could replace current construction materials which failed under extreme stress conditions.
- Develop wood-based building solutions to counteract these failings which meet modern cost and performance requirements (research approach to be identified in the first year of the programme).
- Develop non-destructive technologies to segregate material based on stability, stiffness and other material properties.
- Develop high performance wood products utilising material enhancement technologies.

[41] The Wood Processing and Manufacturing Science and Innovation Plan, March 2011. Wood Processors Association of New Zealand and the New Zealand Pine Manufacturers Association Inc.
[42] The Forest Products Industry Technology Roadmap and Seven Technology Platforms www.agenda 2020.org/tech/htm

IO2 - Solid wood processing and products

By 2026, the New Zealand wood processing and products industries have reduced operational costs by at least $70 million per annum and have increased potential returns from wood based building solutions by at least $500 million per annum (both over 2010 costs), by:

- Embedding high margin building and consumer products into the New Zealand construction industry.
- Implementing new tools and technologies to improve processing efficiency, productivity and profitability.

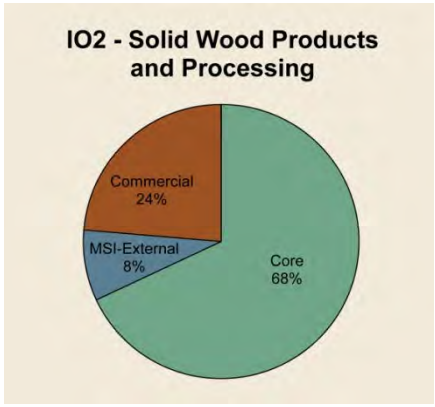
These outcomes will be achieved in collaboration with the New Zealand solid wood processing and construction industries.

Impact Key Performance Indicators

5.	By 2016, in collaboration with the New Zealand wood products sector and other science and technology providers, Scion has increased the use of wood in the New Zealand built environment by at least 10% by introducing a novel engineering build solution with performance and productivity advantages suitable for New Zealand's special building environment.
6.	By 2014, in collaboration with Solid Wood Innovation and the New Zealand wood processing industry, wood segregation technologies have demonstrated the potential to improve the productivity of the New Zealand wood processing industry by at least $70 million per annum.

Total investment: $4.83 million

Distribution of investment: Core ($3.28m), MSI/Scion ($0), MSI/External ($0.4m), other government (0) and commercial ($1.14m)



Intermediate Outcome / Impact 3 (IO3):
Expand opportunities in the wood fibre, biopolymer and biochemical industries

Products from the New Zealand wood fibre based processing industries including pulp, paper, liner board, newsprint, chemical and mechanical pulp, medium density fibre board (MDF) and particleboard, currently consume about 4 billion m^3 of roundwood (2010)[43]. Processing plants for these materials are very capital intensive. Small improvements in yield, or realisation of value from co-products (e.g. chemicals), can substantially improve profitability. For example, a 1% improvement in yield in a kraft mill will increase net profit by about $12 million per annum[5].

The production of plastics from biomass (bioplastics) is a rapidly growing global opportunity[44]. These materials, developed from renewable feedstocks, have comparable properties to non-renewable oil based plastics. Global production of bioplastics is currently about 1 million tonnes per annum (in a 200 million tonne per annum plastic market[45]) but is growing at more than 10% per annum[46]. New Zealand has the ability to produce these plastics from forest resources and waste fibre from biomass processing thus avoiding competition with food crops.

Radiata pine is well suited to the above industries and applications, with excellent fibre characteristics, low extractives content and a light colour. Processing of biological products demands water resources and energy. Unlike many other nations, New Zealand has relatively abundant water resources to support such industries, and wood processing industries can generate much of their own energy needs. New Zealand must capitalise on these strategic comparative advantages.

The adoption of the biorefinery concept in New Zealand, where multiple products are produced in wood processing, such as fibre for paper, composites and packaging, chemicals (e.g. plastics) and energy, provides an opportunity to maximise product outcomes and the overall value from logs.

New Zealand must also provide high quality packaging materials to enable our primary produce exports, such as horticultural products and fish, to satisfy the requirements of increasingly more sophisticated international markets. Typically, packaging materials must be disposable (challenging traditional packaging materials such as expanded polystyrene), but must also maintain the quality and safety of the transported material. To address these needs new packaging solutions are required, providing a dual benefit to New Zealand by: developing new materials from our forest fibre resources; and providing an essential technology platform to support our high value food export industry.

Key research approach:

- Using laboratory and pilot scale processes, identify key bottlenecks preventing efficiency improvements in existing pulp, paper and panel production operations.
- Develop a fundamental understanding of wood-fibre-water interactions and how variations in wood fibre composition affect end-use.
- Create new material properties through the smart modification of wood fibres with novel additives.
- Create novel bio-based products and formulations from wood.
- Develop novel packaging solutions based on the material properties developed within the programme.

[43] Wood Processing and Manufacturing Science and Innovation Plan, March 2011, Wood Processors Association of New Zealand and the New Zealand Pine Manufacturers Association Inc.
[44] "Bioplastic industry remains strong despite recession: Durability under pressure" (22 March 2010), ICIS Chemical Business www.icis.com/Articles/2010/03/22/9344130/bioplastic-industry-remains-strong-despite-recession.html
[45] Plastics News: "World Plastic Resin Consumption" (7, January 2008) plasticsnews.com/fyi-charts/materials.html?id=1199483786
[46] "Bioplastic market expands despite recession: A Healthy Stretch" (24 June 2009), ICIS Chemical Business www.icis.com/Articles/2009/06/29/9226987/bioplastic-market-expands-despite-recession.html

IO3 – Wood fibre, biopolymer and biochemical products

By 2026, the New Zealand fibre processing industry has generated at least $500 million in returns through new products and import substitution, by:

- Improving productivity and developing new products in the pulp, paper and panels industries.
- Adopting new bio-based material and bio-based chemical technologies that have the potential to provide new revenue or avoid chemical imports.
- Enabling New Zealand food export industries to meet the requirements of the world's most discerning purchasers through development of new, competitive, bio-based packaging solutions.

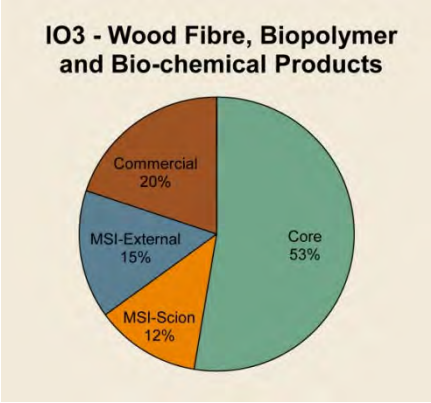
These outcomes will be achieved in collaboration with the New Zealand pulp and paper industry, the wood composites industry, the developing bio-chemical industries and the packaging and primary produce industries.

Impact Key Performance Indicators

7.	By 2016, the New Zealand pulp, paper and composite products industries have improved profitability by implementing productivity improvements and enhanced product opportunities into existing operations.
8.	By 2016, a New Zealand company has commenced commercial production of new fibre-based composites for application in manufactured products.
9.	By 2014, a biorefinery process has demonstrated, to proof of concept, the potential to replace at least 1% of current imported non renewable chemicals with chemicals derived from forest biomass.
10.	By 2014, a New Zealand company has commercially trialled a new packaging product, incorporating novel IP, which meets the standards of the most discerning and influential product purchasers, thus demonstrating the potential to (i) produce new revenue opportunities of at least $5 million per annum to the New Zealand packaging manufacturing industries; and (ii) enhance acceptance of New Zealand produce in overseas markets.

Total investment: $9.03 million

Distribution of investment: Core ($4.75m), MSI/Scion ($1.11m), MSI/External ($1.37m), other government (0) and commercial ($1.8m)



Intermediate Outcome / Impact 4 (IO4):
Improve New Zealand's preparedness for biosecurity incursions, fire and climate change

New Zealand forests are subject to a range of biotic (insects and pathogens) and abiotic (fire and wind) risks. Climate change is expected to increase the susceptibility of our forests to these risks. Scion must support the forestry sector and rural fire authorities in sustaining a high level of preparedness to combat fires and their spread.

The impacts of pests are currently estimated to cost in the order of $200 million per annum. In addition to sustaining log exports (10 million m^3 in 2010) New Zealand must meet international phytosanitary protocols, which adds cost and risk to log exporting[47].

In a worst case scenario, should radiata pine be affected by disease throughout the country with the consequential banning of log imports from New Zealand by major trading partners, returns to New Zealand would be seriously affected (in excess of $1 billion in export earnings per annum). To illustrate the importance of managing such threats, Scion's early detection in 2003 of pine pitch canker on imported Douglas-fir cuttings from the USA[48] represented a potential $565 million avoidance of value loss to New Zealand.

Every year there are on average 3,000 wildfires in New Zealand destroying about 6,000 hectares of rural land and forests costing in the order of $97.7 million per annum (2008 dollars)[49]. Climate change is expected to increase the fire risk. Currently there is no wind research relating to New Zealand forests. Scion's role in this area will be reviewed in 2011.

Key research approach:

- Develop methods for pest risk analysis, pathway blocking, improved surveillance and effective eradication to exclude new pests from New Zealand.
- Develop novel approaches to reduce the impact of pests on radiata pine, and other commercial species, such as biological control using endophytes or viruses, chemical control, or modified silviculture.
- Improve knowledge and understanding of fire in the New Zealand environment to provide effective guidance for the mitigation of the risks and impacts of fire.
- Predict the impact of climate change on the severity of the threats facing New Zealand's forest estate by combining current knowledge with existing global projections.

[47] Self, N.M. and Turner, J.A. New Zealand Journal of Forestry Science 39 (2009): 15-27.
[48] Protecting our Borders, Scion Impact Study (2007).
[49] The Economic Cost of Wildfires: A report to the New Zealand Fire Service Commission BERL #4730. www.berl.co.nz 2009.

IO4 – Risk and Adaptation

By 2026, New Zealand forest owners and key forestry stakeholders have sustained a high level of preparedness against biosecurity incursion, fire and climate risks to the forest estate and sustained New Zealand's ability to export forest products to key markets, by:

- Providing tools and expert advice to mitigate risk.
- Reducing costs associated with preparedness and risk management.

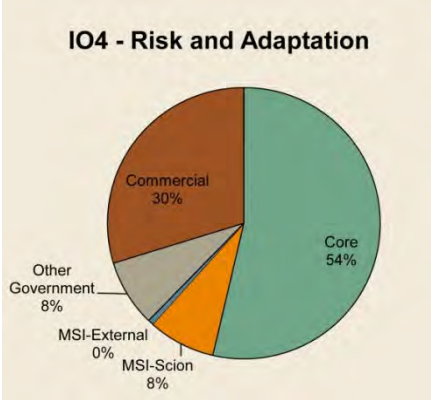
These outcomes will be achieved in collaboration with other science providers and key risk assessment agencies.

Impact Key Performance Indicators

11.	By 2016, in collaboration with the Forest Biosecurity Committee, the Ministry of Agriculture and Forestry (MAF) and the Better Border Biosecurity group (Plant and Food Research, AgResearch, Lincoln Biosecurity CORE, MAF and Department of Conservation), Scion's research has contributed to the maintenance of New Zealand's forest assets under present and future climate scenarios by (i) influencing forest management practices to reduce pest and disease occurrences; (ii) contributing to or changing MAF protocols and standards; (iii) providing science advice or data to negotiate with trade partners, and (iv) supporting incursion responses.
12.	By 2016, in collaboration with the Rural Fire Authority, Forest Owners Association, Department of Conservation and others, Scion's research has contributed to the mitigation of risks (across the spectrum of reduction, readiness, response and recovery) under present and future climate scenarios, by (i) improving fire management readiness strategies; and (ii) enhancing the capability of the rural fire workforce to respond to fire thereby reducing the impact of fire in New Zealand's rural landscape.

Total investment: $5.7 million

Distribution of investment: Core ($3.06m), MSI/Scion ($0.45m), MSI/External ($0.04m), other government (0.45m) and commercial ($1.7m)



Intermediate Outcome / Impact 5 (IO5):
Ensure the New Zealand forest industry's licence to operate domestically and internationally and enhance environmental performance

The ability to expand New Zealand's forests and to sustain or grow the New Zealand forest industry's domestic and export markets requires compliance with national and international environmental regulations and practices. In supporting the forest industry's compliance with these requirements, Scion's role is to:

1. Provide authoritative technical advice and develop (invent or adapt) technologies for the forest and wood processing industries and government agencies.

2. Develop tools and technologies supporting forest and land decisions thereby minimising resource use and environmental impacts of processing.

New Zealand must ensure it meets (at a minimum) best practice protocols for forest growing and harvesting. A good example of such protocols is provided by Forest Stewardship Council Certification (FSC)[50].

Ensuring that New Zealand can avoid non tariff barriers for market access is crucial to maintaining continued access to national and international markets. Examples include meeting strict phytosanitary standards to export logs, or meeting code acceptance requirements to satisfy domestic and international construction or wood products markets.

New Zealand's wood processing industry must minimise use of resources such as water and energy in order to achieve best practice environmental standards and maximise their efficiency.

New Zealand can also exploit the potential of forests to protect land and water and create value streams from timber and ecosystem services.

Key research approach:

- Identify factors impacting on the forestry and wood processing industries' ability to meet national and international environmental standards.
- Develop or adapt technologies to allow the industries to meet those standards and maximise operating efficiency.
- Develop tools to determine the best combination of value creation and environmental protection for a particular land use.

[50] www.fsc.org.

IO5 - Licence to operate

By 2026, New Zealand has avoided resource costs of at least $300 million per annum, and enabled growth in key export and domestic markets (compared to 2010), by:

- Providing decision systems supporting forestry expansion onto marginal land, thereby reducing costs associated with land erosion and water protection.
- Providing authoritative technical support to meet required international standards and ensure market acceptance in domestic and overseas markets.
- Providing tools and technologies to reduce resource consumption (energy, water, chemicals) per tonne of product.

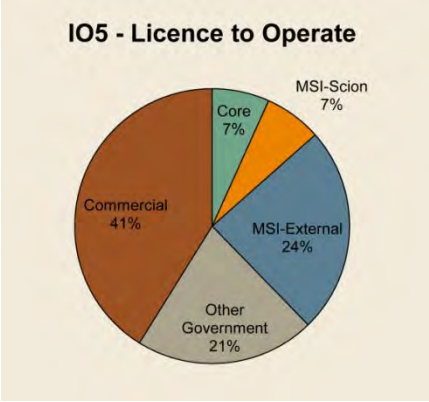
These outcomes will be achieved in collaboration with the Government, forest and wood processing associations, and regional and environmental authorities.

Impact Key Performance Indicators

13.	By 2016, in collaboration with Future Forests Research and the forest growing industry, in order to help sustain acceptance of New Zealand forests under recognised international forestry protocols, Scion has provided decision support tools to (i) minimise resource use; (ii) minimise the environmental impact of forestry; and (iii) enable informed choice over the role of genetic engineering in forestry's future.
14.	By 2016, in collaboration with Solid Wood Innovation and other representatives of the wood processing industry, Scion has developed tools and technologies that provide economic benefits of at least $50 million per annum by (i) reducing water and energy use per tonne and (ii) developing technologies that enable the wood processing industry to adopt best practice resource and waste management (Best Available Technology Economically Achievable, BATEA).
15.	By 2016, in collaboration with the wood processing industry and Government, Scion has provided robust technical information to support increased utilisation of solid wood products from New Zealand's forest resources in domestic and international markets.
16.	By 2016, Scion has demonstrated a decision support system, to proof of concept, which enables users to (i) incorporate forests into land use management decisions; (ii) capture the value of ecosystem services; and (iii) manage dual purpose forests, thereby avoiding at least $100 million per annum in land and water environmental impacts.

Total investment: $8.32 million

Distribution of investment: Core ($0.56m), MSI/Scion ($0.56m), MSI/External ($2.02m), other government ($1.76m) and commercial ($3.42m)



Intermediate Outcome / Impact 6 (IO6):
Increase New Zealand's energy security through the expanded utilisation of forest biomass for energy

Wood is already a significant part of New Zealand's energy landscape producing approximately 55PJ of New Zealand's total 776PJ of energy consumption[51]. This is derived from combustion of black liquor, a by-product of the wood pulping process, and wood residues associated with wood processing. There is potential for a significant increase in the contribution of forest biomass to meet New Zealand's renewable energy needs. In particular, there is opportunity for:

1. Increasing the energy and fibre efficiency of the current wood processing industry that would enable more energy or fuels to be produced for external use.
2. Increasing utilisation of forest residual biomass which could increase bioenergy's contribution to nearly 10% of New Zealand's total energy demand.
3. Establishing forests in the future where a large proportion of the harvest is directed to the production of heat, electricity and transport fuels.

This potential is reflected in the industry-developed Bioenergy Strategy for New Zealand, which states "Economic growth and employment built on New Zealand's capability and expertise in forestry, wood processing and bioenergy production [will lead] to new business opportunities which by 2040 supply more than 25% of the country's energy needs, including 30% of the country's transport fuel" [52].

In its "Changing Gears" scenario, the Ministry of Economic Development (2010)[53] predicts higher international oil prices ($US 180/barrel in 2030), higher emissions prices ($100/tonne carbon post 2012), falling demand for oil, coal and gas in favour of non-fossil alternatives, and improvements in energy efficiency. Under this scenario, biomass would make up almost 25% of the country's primary energy supply including: 1000 million litres of petrol and diesel equivalent, resulting in a permanent improvement in New Zealand's oil security by 30% in 2040; and a fall in energy sector greenhouse gas emissions below 1990 levels by 2040.

There are, however, many issues that must be addressed in creating this opportunity, including:

- Securing investment in new energy technologies.
- Future competing demands for feedstock causing increased cost and reduced availability of biomass for energy generation plants.
- Resolving logistics and continuity of feedstock supply.

Key research approach:

- Evaluate and adapt technologies to produce bioenergy from both woody biomass and organic waste streams for the New Zealand context.
- Develop new energy options that are integrated with current wood processing processes and infrastructure.
- Evaluate New Zealand species and feedstocks for fuel production and improve the logistics and harvesting options for biomass recovery.
- Develop decision support tools to evaluate the bioenergy opportunity for land owners.

[51] New Zealand Energy Datafile MED (2009) www.med.govt.nz
[52] New Zealand Bioenergy Strategy, Bioenergy Association of New Zealand, Forest Owners Association ,NZ Farm Forestry Association ,NZ Institute of Forestry, NZBIO, Forest Industry Contractors Association, and Future Forest Research.
[53] Ministry of Economic Development, "Changing gear scenario" in New Zealand's Energy Outlook (2010).

IO6 – Bioenergy

By 2026, bioenergy's contribution to New Zealand's primary energy supply has increased to 9% (an increase of 24 PJ), including 5% (350 million litres) of New Zealand's liquid fuels, by:

- Developing New Zealand relevant technologies for the production of heat, power and liquid fuels from woody biomass.
- Creating new options for the supply of woody biomass for energy through decision support tools and feedstock/supply chain development.
- Developing technologies to extract energy from organic waste streams.
- Facilitating uptake of bioenergy through provision of authoritative technical support to national and regional authorities.

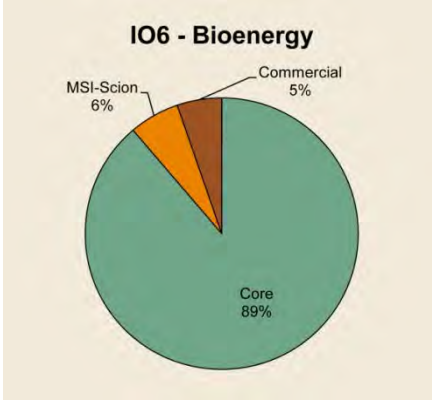
These outcomes will be achieved in collaboration with wood processors, Bioenergy Association of New Zealand, New Zealand Trade and Enterprise/Ministry of Economic Development, Ministry of Agriculture and Forestry, iwi and other investors.

Impact Key Performance Indicators

17.	By 2014, Scion in collaboration with industry and international researchers, has (i) adapted and tested to pilot scale at least one bioenergy technology concept with a demonstrated commercial niche in New Zealand; and (ii) contracted a commercial partner to undertake further scale-up.

Total investment: $2.76 million

Distribution of investment: Core ($2.61m), MSI/Scion ($0.18m), MSI/External ($0), other government (0) and commercial ($0.15m)



Other investment in Scion

Scion has a range of government investments directly from the Ministry of Science and Innovation (through their contestable science pool), from the Ministry of Agriculture and Forestry and from the Ministry for the Environment. These contracts typically have a term of between one to four years.

Scion also has contracts through other parties including Future Forests Research, the Biopolymer Network and MSI Consortia. Scion works closely with all these parties and MSI to ensure the research is focussed on a nationally accepted strategy. Where a greater emphasis on research and development is identified in that national strategy, Scion will work with industry and Government to secure further investment to address such gaps.

Reinvestment of surpluses to support initiatives

A range of initiatives outside the scope of 'business as usual' and critical to fulfilling Scion's strategy have been identified which meet the required eligibility criteria. These are:

- Direct alignment with Core Purpose.
- Ability to create national benefit.
- Development of science and technology capability to meet nationally important needs in the 'lead areas' identified in Scion's Statement of Core Purpose.
- Enhanced end-user engagement.
- Strengthening of Scion's capacity to deliver.

Proposals will be presented every year as part of the annual refreshing of Scion's strategy, preparation of the Annual Operating Plan and the updating of the five year Statement of Corporate Intent.

The following areas for reinvestment of surpluses will continue from 2010/11 or commence during 2011/12.

- Upgrading the Rotorua campus infrastructure including laboratory facilities and remedying deferred maintenance.
- Implementing information and communication technology systems to support increased end-user engagement, access to data and its re-use and supporting organisational productivity.
- Supporting implementation of Scion's Maori plan and Vision Matauranga.
- Improving the speed of technology transfer and update.
- Supporting secondments of researchers into industry to build first hand knowledge of user needs and operations.
- Enhancing Scion's foresight and economics capability.
- Developing organisational leadership and capability.

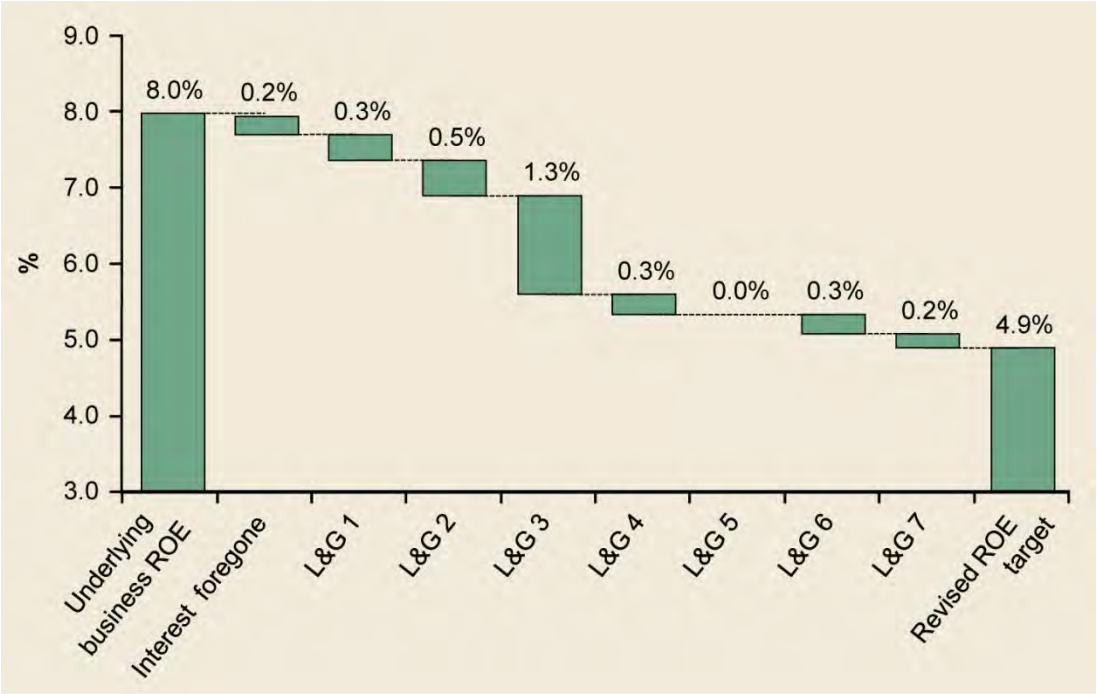
New initiatives will be introduced in 2012/13 in response to the outcomes of the WoodCo Strategy Project and progress made during 2011/12.

The projected investment over the next five years in these areas is presented in the table below.

Table 4: Projected reinvestment

	2012			2013			2014			2015			2016		
Reinvestment project ('000)	**Capex**	**EBIT**	**RoE**	**Capex**	**EBIT**	**RoE**	**Capex**	**EBIT**	**RoE**	**Capex**	**EBIT**	**RoE**	**Capex**	**EBIT**	**RoE**
L&G 1 - Develop our People and Culture to be high performing and customer focussed		130	(0.5%)			0.0%			0.0%			0.0%			0.0%
L&G 2 - Operational Systems and Process Excellence		175	(0.6%)		95	(0.3%)			0.0%			0.0%			0.0%
L&G 3 - Workplace and Facilities Enhancement	4000	495	(1.8%)			0.0%			0.0%			0.0%			0.0%
L&G 4 - Business Development and Relationship Management		100	(0.4%)			0.0%			0.0%			0.0%			0.0%
L&G 5 - Establish National and International Science Collaborations		0	0.0%	900		0.0%			0.0%			0.0%			0.0%
L&G 6 - Foresight, Technology Translation and Commercialisation Outcomes		100	(0.4%)		140	(0.5%)			0.0%			0.0%			0.0%
L&G 7 - Maori Capacity and Capability Building		71	(0.3%)			0.0%			0.0%			0.0%			0.0%
Future initiatives - Opex			0.0%		875	(3.1%)		1200	(4.0%)		1250	(4.0%)		1250	(3.8%)
- Capex			0.0%	500		0.0%	800		0.0%	800		0.0%	2500		0.0%
Sub-total	4,000	1,071	(3.9%)	1,400	1,110	(3.9%)	800	1,200	(4.0%)	800	1,250	(4.0%)	2,500	1,250	(3.8%)
Interest foregone		95	(0.3%)		44	(0.2%)		33	(0.1%)		34	(0.1%)		68	(0.2%)
Total reinvestment	4,000	1,166	(4.3%)	1,400	1,154	(4.1%)	800	1,233	(4.1%)	800	1,284	(4.1%)	2,500	1,318	(4.0%)
Tax		-327	1.2%		-323	1.1%		-345	1.1%		-360	1.1%		-369	1.1%
Profit Impact of Reinvestment		**840**	**(3.1%)**		**831**	**(2.9%)**		**888**	**(3.0%)**		**924**	**(2.9%)**		**949**	**(2.9%)**
Initial Target ROE			8.0%			8.0%			8.0%			8.0%			8.1%
Revised ROE Target after impact of Reinvestment			4.9%			5.1%			5.1%			5.1%			5.2%

The impact of the above investments on Scion's return on equity is illustrated in the waterfall diagram below (Figure 7).



Final allocation of funds will be subject to Board approval of the final business cases for each initiative.

Figure 7: Impact of investments on return on equity

6. Operating indicators and financial performance

In this section, Scion's financial projections through to 2016 are presented and the financial and non-financial performance indicators are described. Scion will report progress quarterly against these indicators, along with its achievements in delivering impact factor KPIs for each Intermediate Outcome outlined in Section 5.

Financial performance indicators

Scion Group (New Zealand Forest Research Institute Limited)
Projected Income Statement
for the five years ended 30 June 2016

	30/06/2011 $000	30/06/2012 $000	30/06/2013 $000	30/06/2014 $000	30/06/2015 $000	30/06/2016 $000
Revenue						
Crown	20,393	20,014	20,214	20,416	20,825	21,241
Commercial and Other	23,305	25,689	27,404	29,639	32,627	36,466
Total Revenue	43,698	45,703	47,618	50,055	53,452	57,707
Operating Expenditure						
Personnel	25,017	25,211	25,846	27,010	28,765	30,980
Other Operating Costs	16,658	17,651	18,633	19,701	21,185	23,045
Total Operating Expenditure	41,676	42,862	44,480	46,711	49,951	54,025
Scion margin	**2,023**	**2,841**	**3,139**	**3,344**	**3,501**	**3,683**
Loss on disposal of Fixed Assets	0	0	0	0	0	0
Restructuring Costs	-200	-100	-100	-100	-100	-100
EBIT-R*	**1,823**	**2,741**	**3,039**	**3,244**	**3,401**	**3,583**
Reinvestment	-216	-1,071	-1,110	-1,200	-1,250	-1,250
EBIT	**1,607**	**1,670**	**1,929**	**2,044**	**2,151**	**2,333**
Net Interest Income/(Expense)	297	114	20	20	20	20
Profit before tax	**1,904**	**1,784**	**1,949**	**2,064**	**2,171**	**2,353**
Tax	-604	-512	-565	-599	-630	-682
Group Profit after Tax	**1,300**	**1,272**	**1,384**	**1,466**	**1,542**	**1,670**
Share of after tax profit from Assoc. Coys	0	0	0	0	0	0
Profit attributable to Shareholders	**1,300**	**1,272**	**1,384**	**1,466**	**1,542**	**1,670**

**EBIT-R is EBIT before reinvestment*

Scion Group (New Zealand Forest Research Institute Limited)
Projected Consolidated Statement of Cashflows
for the five years ended 30 June 2016

	30/06/2011 $000	30/06/2012 $000	30/06/2013 $000	30/06/2014 $000	30/06/2015 $000	30/06/2016 $000
Cashflow from Operating Activities						
Cash received from operations						
Crown	19,749	20,014	20,214	20,416	20,825	21,241
Other Clients	24,277	25,275	27,309	29,542	32,528	36,365
Interest	294	131	20	20	20	20
Total cash received from operations	**44,320**	**45,420**	**47,543**	**49,978**	**53,373**	**57,626**
Cash disbursed on operations						
Personnel	24,795	25,307	25,849	27,009	28,762	30,974
Suppliers	14,266	15,953	16,327	17,273	18,661	20,293
Interest on debt	5	0	0	0	0	0
Taxation	1,213	454	546	587	619	665
Total Cash disbursed on operations	**40,279**	**41,714**	**42,723**	**44,870**	**48,043**	**51,931**
Projected Net Cashflows from Operations	**4,041**	**3,707**	**4,820**	**5,108**	**5,330**	**5,695**
Cashflow from Investment Activities						
Repayment of advance	76	0	0	0	0	0
Purchase of fixed assets	-4,427	-8,027	-5,400	-4,400	-4,900	-5,700
Purchase of intangibles	-511	-335	-400	-400	-400	-400
Net Cash Received/(Disbursed) from Investing Activities	**-4,862**	**-8,362**	**-5,800**	**-4,800**	**-5,300**	**-6,100**
Cashflow from Financing Activities						
Increase in term debt	0	0	0	0	0	0
Repayment of term debt	0	0	0	0	0	0
Capital Increase	0	0	0	0	0	0
Dividend paid	0	0	0	0	0	0
Total Cash Disbursed on Financing Activities	**0**	**0**	**0**	**0**	**0**	**0**
Net Increase (decrease) in cash	**-821**	**-4,656**	**-980**	**308**	**30**	**-405**
Exchange Rate effect	**0**	**0**	**0**	**0**	**0**	**0**
Opening cash balance	6,580	5,759	1,103	123	432	462
Closing Cash Balance	**5,759**	**1,103**	**123**	**432**	**462**	**57**

Scion Group (New Zealand Forest Research Institute Limited)
Projected Consolidated Balance Sheet
as at 30 June 2012, 2013, 2014, 2015, 2016

	30/06/2011 $000	30/06/2012 $000	30/06/2013 $000	30/06/2014 $000	30/06/2015 $000	30/06/2016 $000
Current Assets						
Short term investments and cash	5,759	1,103	123	432	462	57
Debtors	4,403	4,765	4,860	4,957	5,056	5,157
Prepayments	608	562	562	562	562	562
Inventory	60	60	60	60	60	60
Advance	0	0	0	0	0	0
Total Current Assets	**10,830**	**6,489**	**5,605**	**6,010**	**6,140**	**5,836**
Less Current Liabilities						
Creditors	2,578	2,650	2,782	2,921	3,067	3,221
Personnel liabilities	3,244	3,248	3,346	3,446	3,550	3,656
Income in Advance	1,902	1,867	1,867	1,867	1,867	1,867
Provision for tax	112	170	188	200	210	227
Total Current Liabilities	**7,836**	**7,935**	**8,184**	**8,434**	**8,694**	**8,971**
Net Working Capital	**2,994**	**-1,446**	**-2,579**	**-2,424**	**-2,554**	**-3,136**
Investments						
Investments in subsidiaries & associates/Intangible Assets	146	146	146	146	146	146
Intangible Assets	803	896	863	735	1,135	1,535
Total Investments	**949**	**1,042**	**1,009**	**881**	**1,281**	**1,681**
Fixed Assets						
Fixed Assets	25,623	31,242	33,791	35,230	36,502	38,354
Total Fixed Assets	**25,623**	**31,242**	**33,791**	**35,230**	**36,502**	**38,354**
Long Term Assets						
Deferred tax benefit	0	0	0	0	0	0
Total Long Term Assets	**0**	**0**	**0**	**0**	**0**	**0**
Term Liabilities						
Provision for Staff Liabilities	1,826	1,826	1,826	1,826	1,826	1,826
Deferred tax liability	2,320	2,320	2,320	2,320	2,320	2,320
Term Debt	0	0	0	0	0	0
Total Term Liabilities	**4,146**	**4,146**	**4,146**	**4,146**	**4,146**	**4,146**
Projected Total Net Assets	**25,420**	**26,691**	**28,074**	**29,540**	**31,083**	**32,752**
Represented by						
Share Capital	17,516	17,516	17,516	17,516	17,516	17,516
Capital Increase	0	0	0	0	0	0
Retained earnings b'fwd	6,556	7,855	9,127	10,511	11,977	13,518
Revaluation Reserve	48	48	48	48	48	48
Current profit (loss)	1,300	1,272	1,384	1,466	1,542	1,670
Projected Closing Shareholders Funds	**25,420**	**26,691**	**28,075**	**29,540**	**31,082**	**32,752**
Shareholders funds to total assets	**0.68**	**0.69**	**0.69**	**0.70**	**0.71**	**0.71**

Scion Group (New Zealand Forest Research Institute Limited)
Performance Targets
for the five years ended 30 June 2016

	Forecast	Target	Target	Target	Target	Target
Efficiency:	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Operating margin	9.4%	9.7%	10.9%	11.1%	10.8%	10.7%
Operating margin per FTE	$12,880	$13,938	$16,391	$17,072	$17,163	$17,472
Risk:	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Quick ratio	1.71:1	0.97:1	0.79:1	0.82:1	0.81:1	0.73:1
Interest coverage	N/A	N/A	N/A	N/A	N/A	N/A
Operating margin volatility	39.3%	21.2%	12.1%	12.3%	14.3%	12.1%
Forecasting risk	(0.5)%	0.3%	(0.7)%	(2.2)%	(0.1)%	0.1%
Growth/Investment:	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Adjusted return on equity	5.3%	4.9%	5.1%	5.1%	5.1%	5.2%
Revenue growth	0.5%	4.6%	4.2%	5.1%	6.8%	8.0%
Capital renewal	2.0x	3.0x	1.8x	1.4x	1.5x	1.6x

Progress in meeting the above financial measures together with a projected cashflow will be reported on quarterly to the Ministry of Science and Innovation.

Non-financial performance indicators

Scion will adopt and monitor the key performance indicators tabulated below. These measures will complement other information collected on Scion's performance such as the indicators in its balanced scorecard, the composition of its workforce and development of its capabilities. In addition, Scion plans to continue working closely with MSI to refine and enhance these measures.

Scion has developed a framework for monitoring science quality. This framework builds on the tertiary sector performance-based research fund and other science quality measurement systems. It will enable Scion to track progress in a range of areas such as publications in the top 25 journals for the forest industry; the level of industry engagement; and technology transfer.

Table 5: Non-financial performance indicators

Category	Measure	Report
End-user collaboration	Percentage and number of relevant funding partners and other end-users that have a high level of confidence in Scion's ability to set research priorities, and the effectiveness of the collaboration or partnership	Annual survey agreed between MSI and Scion
	Total dollar value of revenue (in cash and in-kind), and dollar value subcontracted out to other organisations from CRI, Non CRI Government, TEO, Firms , overseas and other per annum from rolling five years	Quarterly
	Formal collaborations with Maori	Report
Research collaboration	Percentage of relevant national and international research providers that have a high level of confidence in the CRI's ability to form the best teams to deliver on the CRI's outcomes	Annual survey agreed between MSI and Scion
	Number and percentage of joint scientific peer-reviewed publications and IP outputs with other New Zealand or international research institutions per annum	Quarterly
Technology and knowledge transfer	Total number and percentage of licensing deals of CRI-derived IP (including technologies, products and services) with New Zealand and international partners per annum	Quarterly
	Percentage of relevant end-users who have adopted knowledge and/or technology from CRIs	Annual survey agreed between MSI and Scion
	Percentage change in the number of requests and enquiries for the CRI's publicly available collections	Quarterly
	Commissioned reports accepted by users	Baseline to be established
	Web site hits	Baseline to be established
Science quality	Total number of international awards, invitations to participate on international committees, and editorial boards for the CRI's published papers per annum.,	Annually
	Average number of citations per CRI published paper.	Quarterly
	Proportion of published papers in the top 25 international journals relevant to the scope of the CRI (as outlined in the SCP) per annum.	Annually
	H-index	Baseline to be established

7. Scion's business policies

Scion aims to remain a high quality, financially viable research organisation with an exemplary international reputation, while providing relevant outputs to the highest standards of professionalism and maintaining prudent business practices.

Below is a brief summary of Scion's business policies. Further details can be found at www.scionresearch.com.

Statutory requirements policy

Scion will operate in accordance with relevant legislative requirements, including the Crown Research Institutes Act 1992, Companies Act 1993, and the Crown Entities Act 2004. In doing so, Scion will undertake business according to the following commitments.

Policy on acquisitions, mergers and divestments

Scion will strive to continuously add value to its activities and improve the net worth of the company and its shareholders. It will ensure that all new investments within core business, expansions of core business and diversification away from core business, will ordinarily provide shareholders with additional economic value commensurate with the risks involved. Scion will seek shareholder consent where the value of the proposed acquisition or divestment is greater than 30% of the total assets (taken as a whole) or $5 million whichever is the lesser.

Business strategies

In order to achieve its Statement of Core Purpose, Scion will:

- Adopt a 'customer centric' approach to develop strong long-term partnerships with key stakeholders in the firms, representative bodies, iwi and government agencies working with and supporting the forest industry.
- Establish collaborative relationships with research providers both within New Zealand and overseas to enhance the impact and quality of Scion's science.
- Build public understanding of the implications of our science and the economic, social and environmental value it creates.
- Seek early commercial investment to support the development and uptake of Scion invented technologies.
- Reinvest operating surpluses to develop Scion's research capabilities, infrastructure, collaborations and to accelerate the rate of innovation along the wood-fibre value chain.

Human resources policies

Scion aims to be a good employer. It will recruit people whose competencies match the requirements to achieve its strategy and vision. The organisation's policies and procedures aim to ensure equal opportunity for all, that people are developed to their full potential, achieve an appropriate 'work-life' balance and that there is compliance with employment, health and safety and associated legislation. Scion will remunerate staff on the basis of performance and the company's ability to pay through a combination of organisational and individual merit based payments. A competency-based appraisal system and objective performance output measures will be applied to assess both individual and team performance.

Intellectual property policies

The primary goal of the Intellectual Property (IP) management policies is to ensure that the interests of both the Crown and Scion and any client IP with which Scion is entrusted are protected, that knowledge and expertise are managed appropriately, the health of the IP portfolio is monitored continuously, and technological innovations are commercialised effectively.

Risk policy

Scion has risk management and compliance processes in place and operating effectively across the organisation. The risk management framework identifies, classifies, reports on and mitigates business risk. Risk reporting is undertaken on a quarterly basis to the Scion Board or as a risk arises.

Accounting policies

Scion will manage cash prudently and ensure that any surplus cash is invested within delegations approved by the Board. New Zealand equivalents to International Financial Reporting Standards approved by the New Zealand Institute of Chartered Accountants for the measurement and reporting of profit and financial position have been adopted by Scion. (Refer to Appendix 1.)

Dividend policy

The Scion Board will detail in a submission to shareholding Ministers, within three months of the end of each financial year:

- The amount of dividend (if any) recommended to be distributed to the shareholders.
- The percentage of tax-paid profits that the dividend represents.
- The rationale and analysis used to determine the amount of any dividend.

Treatment of land claims

Scion monitors the progress of, and will seek to provide input as appropriate into, land claims or other matters affecting the land occupied by Scion in Rotorua.
Two land claims affecting the Rotorua campus currently exist:

1. Ngati Whakaue – covering the total site.

2. Ngati Wahiao – covering the southern end of the site.

8. GLOSSARY

Applied science	Original investigation to acquire new knowledge directed towards a specific practical aim and developed into operational form.
BANZ	Bioenergy Association of New Zealand
Biomass	A renewable energy source - biological material from living or recently living organisms, e.g. trees.
Bioplastics	Plastics derived from renewable biomass sources.
Biopolymers	Polymers produced from renewable biomass sources.
Biorefinery	A facility that integrates biomass conversion processes and equipment to produce fuels, power, heat, and value-added chemicals from biomass.
Black liquor	The spent cooking liquor from the kraft process when digesting pulpwood into paper pulp removing lignin, hemicelluloses and other extractives from the wood to free the cellulose fibres.
Collaborators	Individuals or entities that work closely with Scion in undertaking science and innovation to deliver the technological outcomes.
Composites	Products produced through mixing different materials, e.g. medium density fibreboard.
Core Funding	Money devolved to Scion supporting its activities towards achieving its Core Purpose.
Core Purpose	Scion's purpose, i.e. to drive innovation and growth from New Zealand's forestry, wood product and wood-derived materials and other biomaterial sectors, to create economic value and contribute to beneficial environmental and social outcomes for New Zealand.
First rotation forestry	Forestry crops being grown on land for the first time.
Foresight	Analysis of trends in science and markets used to inform current actions.
Forest industry	All sectors involved in growing, managing and processing wood and wood-derived products (including energy) from New Zealand's plantation forests.
Impact Key Performance Indicators (KPI)	Underpinning each Intermediate Outcome are Key Performance Indicators (achieved within a 3 to 5 year timeframe) to gauge progress towards achieving the Intermediate Outcomes / Impacts.
Intermediate Outcomes / Impacts (IO)	Science outcomes delivered by Scion.
MSI	Ministry of Science and Innovation
Mean Annual Increment	The annual increase in tree volume per hectare per year.

National Outcomes	Defined in the Statement of Core Purpose: • Increase the value and productivity of the forestry, wood product and wood-derived materials and other biomaterial industry sectors to the New Zealand economy through improved forestry practices and production systems and increased diversification of New Zealand's biological industry base to meet current and future global market needs. • Protect and enhance market access and improve risk management in the forestry industry. • Increase renewable energy production and energy security by growing New Zealand's ability to produce sustainable bioenergy and liquid biofuel products. • Enhance New Zealand's opportunity to benefit from forestry-based ecosystem services to improve both the global market position of industry and the environmental sustainability of forestry production in New Zealand.
NZTE	New Zealand Trade and Enterprise
Phytosanitary	Relates to the health of plants usually in the context of demonstrating freedom from pests.
PJ	The petajoule (PJ) is equal to 10^{15} joules. A joule is a derived unit of energy or work in the International System of Units.
Polyphenolics/phenolics	Materials containing phenols – aromatic materials used to create chemicals such as resins.
REDD+	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries.
Second generation bioenergy	Energy derived from lignocellulosic (e.g. wood) sources.
SCI	Statement of Corporate Intent
Science and Innovation Framework	A map aligning ultimate outcomes achieved to short-term activities.
SCP	Statement of Core Purpose
Solid wood	This includes timber and engineered wood products such as laminated timber, laminated veneers and finger-jointed wood (also called engineered wood products).
Stakeholders (Scion)	Individuals, organisations, companies, associations, groupings, national and local government entities, all of whom derive direct or indirect benefit from the forest industry.
Taonga	Most treasured possession
Tikanga	Customs and traditions
Terpenes	Organic compounds – a major component of rosin
Value chain	The various processes that are involved in producing goods (and services), starting with raw materials and ending with the delivered product (also known as the supply chain).

APPENDIX 1 - Statement of Accounting Policies

Reporting entity

New Zealand Forest Research Institute Limited is a Crown Research Institute registered under the Companies Act 1993. The registered office is Te Papa Tipu Innovation Park, 49 Sala Street, Rotorua. The group consists of New Zealand Forest Research Institute Limited and its subsidiaries.

New Zealand Forest Research Institute Limited (the Company) is a reporting entity for the purposes of the Financial Reporting Act 1993. It is domiciled and incorporated in New Zealand and is wholly owned by the Crown.

The Financial Statements of New Zealand Forest Research Institute Limited for the year were authorised for issue in accordance with a resolution of the directors on the date as set out on the Statement of Financial Position.

The activities of New Zealand Forest Research Institute Limited include a range of research and development programmes aimed at using plant-based renewable resources and waste streams to create new materials, energy sources and environmentally sustainable products and processes.

New Zealand Forest Research Institute Limited trades as Scion and these names have identical meaning in this report.

1.1 Summary of Significant Accounting Policies

a) Basis of Preparation

The financial statements have been prepared in accordance with generally accepted accounting practice in New Zealand (NZ GAAP) and the requirements of the Companies Act 1993 and the Financial Reporting Act 1993. The financial statements have also been prepared on a historical cost basis, except for forestry assets and certain heritage assets that have been measured at fair value.

The financial statements are presented in New Zealand dollars and all values are rounded to the nearest thousand dollars ($000).

b) Statement of Compliance

The financial statements have been prepared in accordance with NZ GAAP. They comply with New Zealand equivalents to International Reporting Standards, and other applicable Financial Reporting Standards, as appropriate for profit-oriented entities. The financial statements comply with International Financial Reporting Standards (IFRS).

c) Basis of Consolidation

The consolidated financial statements include the parent company and its subsidiaries. All intercompany transactions and unrealised profits and losses between the group of companies are eliminated from the financial statements on consolidation. In the parent company financial statements, investments in subsidiaries are stated at cost less any impairment charges.

d) Associate Companies

These are companies in which the group holds substantial shareholdings but does not have control and in whose commercial and financial policy decisions it participates.

Associate companies have been reflected in the consolidated financial statements on an equity accounting basis which shows the group's share of surpluses in the Consolidated Statement of Comprehensive Income and its share of post acquisition increases or decreases in net assets, in the Statement of Financial Position.

e) Intangible Assets

Intangible assets acquired separately are capitalised at cost and from a business combination are capitalised at fair value as at the date of acquisition. Following initial recognition, the cost model is applied to the class of intangible assets.

The useful lives of these intangible assets are assessed to be either finite or indefinite.

Where amortisation is charged on assets with finite lives, this expense is recognised in profit and loss.

Intangible assets created within the business are not capitalised and expenditure is charged to profit and loss in the year in which the expenditure is incurred.

Intangible assets are tested for impairment where an indicator of impairment exists, and in the case of indefinite life intangibles, annually, either individually or at the cash generating unit level. Useful lives are also examined on an annual basis and adjustments, where applicable, are made on a prospective basis.

A summary of the policies applied to the group's capitalised intangible assets is as follows:

	Software
Useful lives	Finite
Method used	4 years – Straight line
Internally generated/Acquired	Acquired
Impairment test/Recoverable amount testing	Amortisation method reviewed at each financial year-end; Reviewed annually for indicators of impairment

Gains or losses arising from derecognition of an intangible asset are measured as the difference between the net disposal proceeds and the carrying amount of the asset and are recognised in the profit and loss when derecognised.

f) Biological Assets

Biological assets consist entirely of tree plantations which are measured at fair value less any point of sale costs. Gains and losses arising on initial recognition or change in fair value, less estimated point of sale costs, are included in profit and loss in the period in which they arise.

The fair value of tree plantations is determined by an independent valuer.

The valuation method for immature trees is the net present value of future net harvest revenue less estimated costs of owning, protecting, tending and managing trees. For mature trees fair value is deemed to be the net harvest revenue value.

g) Property, Plant and Equipment

All items of property, plant and equipment are valued at the cost of purchase from the Crown as at 1 July 1992 adjusted for subsequent additions at cost, disposals and depreciation. Plant and equipment are recorded at cost less accumulated depreciation. Land and capital work in progress are recorded at cost. Some library books have been identified as heritage assets and are recorded at fair value as determined by an independent valuer. Valuations are obtained every five years or more often where circumstances indicate that a significant change in fair value has occurred.

Expenditure incurred on property, plant and equipment is capitalised where such expenditure will increase or enhance the future benefits provided by the asset. Expenditure incurred to maintain future benefits is classified as repairs and maintenance.

When an item of property, plant and equipment is disposed of the difference between the net disposal proceeds and the carrying amount is recognised as a gain, or loss, in profit and loss.

Depreciation is provided for using the straight-line method to allocate the historical cost, less an estimated residual value, over the estimated useful life of the asset.

The useful lives of the major classes of assets have been calculated as follows:

Buildings and Land Improvements	40–60 years
Plant and Equipment	4–15 years
Furniture and Fittings	10 years
Motor Vehicles	3–7 years
Library Books	20 years

h) Recoverable amount of non-current assets

At each reporting date, the group assesses whether there is any indication that an asset may be impaired. Where an indicator of impairment exists, the group makes a formal estimate of recoverable amount. Where the carrying amount of an asset exceeds its recoverable amount the asset is considered impaired and is written down to its recoverable amount.

Recoverable amount is the greater of fair value less costs to sell and value in use. It is determined for an individual asset, however, if the asset's value in use cannot be estimated to be close to its fair value less costs to sell and it does not generate cash inflows that are largely independent of those from other assets or groups of assets it is determined for the cash-generating unit to which the asset belongs.
In assessing value in use, the estimated future cash flows are discounted to their present value using a pre-tax discount rate that reflects current market assessments of the time value of money and the risks specific to the asset.

i) Trade Receivables

Trade receivables are initially recognised at fair value and subsequently valued at amortised cost less impairment allowance.

Collectability of trade receivables is reviewed on an ongoing basis. Debts that are known to be uncollectible are written off when identified. An allowance for doubtful debts is

raised when there is objective evidence that it is probable the group will not be able to collect the debt. Financial difficulties and payment defaults without explanation are considered objective evidence of impairment.

j) Inventories

Consumable stores are valued at the lower of cost, on a weighted average price of stock on hand, and net realisable value.

Nursery stocks are valued at lower of cost or net realisable value. Changes in net realisable value are recognised in the profit and loss account in the period in which they occur.

k) Research Costs

Research costs are expensed in the period incurred.

l) Provisions and Employee Benefits

Provisions are recognised when the group has a present obligation (legal or constructive) as a result of a past event, it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation and a reliable estimate can be made of the amount of the obligation.

Provisions are measured at the present value of management's best estimate of the expenditure required to settle the present obligation at the Statement of Financial Position date using a discounted cash flow methodology.

(i) Wages, Salaries and Annual Leave

The liability for wages, salaries and annual leave recognised in the Statement of Financial Position is the amount expected to be paid at balance date. Provision has been made for benefits accruing to employees for annual leave in accordance with the provisions of employment contracts in place at balance date.

(ii) Long Service Leave

The liability for long service leave is recognised and measured as the present value of expected future payments to be made in respect of services provided by employees up to the reporting date using the projected unit credit method. Consideration is given to expected future wage and salary levels, experience of employee departures, and periods of service. Expected future payments are discounted using market yields at the reporting date on national government bonds with terms to maturity and currencies that match, as closely as possible, the estimated future cash outflows.

(iii) Defined Benefit Plan

The defined benefit plan is unfunded. The cost of providing benefits under the defined benefit plan is determined using the projected unit credit actuarial valuation method. Actuarial gains and losses are recognised in the profit and loss account in the period in which they arise.

The defined benefit liability recognised in the Statement of Financial Position represents the present value of the defined benefit obligations.

Long service leave and retirement leave provisions are based on an actuarial valuation.

m) Leases

Group as a Lessee

Operating lease payments, where the lessors effectively retain substantially all the risks and benefits associated with ownership of the leased items, are included as an expense in the profit and loss in equal instalments over the lease term.

Group as a Lessor

Leases in which the group retains substantially all the risks and benefits of ownership of the leased asset are classified as operating leases. Initial direct costs incurred in negotiating an operating lease are expensed as incurred.

n) Cash and Cash Equivalents

Cash and short-term deposits in the Statement of Financial Position comprise cash at bank and in hand and short-term deposits with an original maturity of four months or less.

For the purposes of the Statement of Cash Flows, cash and cash equivalents consist of cash and cash equivalents as defined above, net of outstanding bank overdrafts.

o) Goods and Services Tax (GST)

The financial statements are prepared on a GST exclusive basis.

p) Foreign Currencies

Functional and presentation currency

Both the functional and presentation currency of New Zealand Forest Research Institute Limited and its subsidiaries is New Zealand dollars.

Transactions and balances

Transactions in foreign currencies are initially recorded in the functional currency by applying the exchange rates ruling at the date of the transaction. Monetary assets and liabilities denominated in foreign currencies are retranslated at the rate of exchange ruling at the Statement of Financial Position date.

Non-monetary items that are measured in terms of historical cost in a foreign currency are translated using the exchange rate as at the date of the initial transaction. Non-monetary items measured at fair value in a foreign currency are translated using the exchange rates at the date when the fair value was determined.

q) Revenue Recognition

Research Revenue

Research revenue from both Government and commercial sources is recorded when earned based on the percentage of work completed. Percentage of work completed is based on management judgement, after considering costs incurred and other contracted commitments. Work completed but not invoiced is recorded as accrued revenue while work invoiced but not completed is recorded as revenue in advance.

Government Revenue includes revenue received from the Foundation for Research, Science and Technology and from the Ministry of Research Science and Technology under the Capability Fund, Public Good Science and Technology Investment, and Preseed Accelerator Fund programmes. Funding includes both devolved and milestone related programmes. Government revenue has only been recognised after all appropriate conditions have been met.

Sale of Goods

Revenue is recognised when the significant risks and rewards of ownership of the goods have passed to the buyer. Risk and reward are considered passed to the buyer at the time of delivery.

Interest Revenue

Interest revenue is recognised when earned based on applicable interest rates applied to the group's cash deposit balances.

r) Taxation

The income tax expense charged to the profit and loss includes both the current year's provision and the income tax effects of temporary differences calculated using the liability method.

Tax effect accounting is applied on a comprehensive basis to all temporary differences. A debit balance in the deferred tax account, arising from temporary differences or income tax benefits from income tax losses, is only recognised if it is probable there will be taxable profits available in the future against which the deferred tax asset can be utilised.

Subsequent realisation of the tax benefit is subject to the requirements of income tax legislation being met.

s) Borrowing Costs

Borrowing costs are recognised as an expense when incurred except for those borrowing costs determined as directly attributable to the acquisition, construction or production of a qualifying asset (i.e. an asset that necessarily takes a substantial period of time to get ready for its intended use or sale).

t) Interest-bearing Loans and Borrowings

All loans and borrowings are initially recognised at the fair value of the consideration received net of issue costs associated with the borrowing.

After initial recognition, interest-bearing loans and borrowings are subsequently measured at amortised cost using the effective interest method. Amortised cost is calculated by taking into account any issue costs, and any discount or premium on settlement.

For the purpose of valuing bank borrowings, the bank interest rate is taken as the discount rate. As such the bank borrowings are carried at the value of the debt with the bank.

u) Trade and Other Payables

Trade and other payables are carried at amortised cost and due to their short term nature they are not discounted. They represent liabilities for goods and services provided to the group prior to the end of the financial year that are unpaid and arise when the group becomes obliged to make future payments in respect of the purchase of these goods and services. The amounts are unsecured and are usually paid within 60 days of recognition.

1.2 Significant Accounting Judgements, Estimates and Assumptions

a) Revenue Recognition

Revenue is recognised based on the percentage of work completed on a project basis. Percentage of work completed is based on management judgement after considering such things as hours completed, costs incurred, milestones achieved and actual results to date.

b) Heritage Assets

The group holds several heritage assets which have significant value due to being both rare, and having importance to the nation. Where a heritage cost can be measured reliably they are revalued at least every five years and included as part of property plant and equipment.

Due to the nature of some heritage assets, management does not believe they can be valued reliably. These assets have been identified as disclosed. Details of heritage assets can be found in note 11 and 22.

c) Biological Assets

The group's biological assets consist of tree plantations. These are valued at the net present value of future net harvest revenue less estimated costs of owning, protecting, tending and managing trees. The valuation process includes several judgements and estimations around discount rates, future costs, and future prices. Management used the experience of a registered forestry valuer to reduce the risk of misstatement resulting from these judgements and estimates.

d) Defined Benefit Scheme

The group operates an unfunded defined benefit plan. Significant assumptions used involving the plan include the discount rate and future salary increases as set out in the notes to the financial statements. Management used the experience of a registered actuary to reduce the risk of misstatement resulting from these judgements and estimates.

www.scionresearch.com