

## 2015-2020 STATEMENT OF CORPORATE INTENT



Prosperity from trees *Mai i te ngahere oranga*



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Prosperity from trees *Mai i te ngahere oranga*

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# 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 (2010); Deputy Chair, Judith Stanway (2010); Directors, Sheldon Drummond (2008), Elizabeth Chambers (2012), Barry O'Neil (2012), Colleen Neville (2014).

**Executive Management** Chief Executive, Warren Parker; General Manager Research and Investments, Russell Burton; General Manager Manufacturing and Bioproducts, Elspeth MacRae; General Manager Forest Science, Brian Richardson; General Manager Business Development and Commercialisation, Steve Sopora; General Manager People and Performance, Keri-Anne Tane; Chief Financial Officer and Company Secretary, Rob Trass.

**Staff** 283 full-time-equivalent staff at four sites: Rotorua (260), Christchurch (21), Wellington (1), Dunedin (1).

**Shareholder Funds** Total book value of \$32.118 million at 30 June 2014.

**Vision** Prosperity from trees - *Mai i te ngahere oranga*

**Core Purpose** 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** Ingenuity, Collaboration, Excellence, Manaakitanga.

**Reporting** Financial and non-financial performance against SCI targets is reported to the Shareholder quarterly and to the public via a six month and annual report.

## Shareholdings

COMPANY	COMPANY TYPE	SCION SHAREHOLDING %
Te Papa Tipu Properties Ltd	A land-holding subsidiary	100.00
Biopolymer Network Ltd	An incorporated joint venture	33.30
WQI Ltd (Solid Wood Innovation)	An MBIE-industry partnership in wood processing	5.95
Terax (2013) Ltd	The General Partner in Terax Limited Partnership	50.00
Forest Research Holdings Ltd	Non-trading	100.00

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# CHAIRMAN AND CHIEF EXECUTIVE OVERVIEW

We are pleased to present Scion's 2015-20 Statement of Corporate Intent (SCI). Building on last year's SCI we set out Scion's strategy, science and innovation plan, and investment priorities and describe how Scion will fulfil its Statement of Core Purpose.

Scion's strategic framework has been maintained while taking account of significant developments in our operating environment over the past 12 months. These include:

- Re-election of a **third National-led government** with an ongoing commitment to achieving business growth agenda targets; lifting GDP growth in under-performing regions (all have large forestry sectors) and raising business investment into research and innovation to 1% of GDP by 2018.
- New global impetus for addressing **climate change** by setting meaningful 2030 individual country commitments to decarbonise.
- The **2014 National Framework for Freshwater Management** and associated need for more forestry in order to meet water quality limits.
- Heightened concerns about **biosecurity risks to plantation forests** triggered by the third Queensland fruit fly border breach, detection of the brown marmorated stink bug at ports and further spread of kauri dieback disease. Further, with only five years to find a cost-effective alternative to **methyl bromide** fumigation of export logs, product innovation for domestic processing of bark and wood residues is growing.
- Impending **global shortage of long fibre softwood**, which is essential for packaging and lightweight material substitutes for fossil oil products such as plastics.
- **Record harvest of 30 million tonnes** of logs, expected to reach 32-36 million tonnes over the next decade, countered by wood processors concerns over security of log supply from the late 2020s owing to continuing deforestation.
- Rapid uptake of 'smart connected products' for **precision forestry (remote sensing), robots and process automation** is enabling productivity gains and essential improvements to worker health and safety across the value chains Scion works with.
- Demand confirmed for **more than 20,000 new houses per year in New Zealand** over the next decade and an

The forest industry incorporates forest production, solid wood and fibre processing; and the rapidly emerging industrial bioproducts sector (renewable lightweight materials, bioenergy and 'green' chemicals). It is New Zealand's third largest exporter and a major contributor to the domestic economy through the construction and housing sector, regional employment, and the provision of ecosystem services such as flood and erosion mitigation. Māori own 40% of the land on which plantation forests grow. Collectively the forest industry's value chain generates about \$12 billion of sales annually. Forestry also produces environmental services worth an estimated further \$600-800 million per annum and is pivotal to addressing climate change achieving land-use within environmental limits.

imperative to improve housing affordability through mechanisms like pre-fabrication, better standards and gains in supply chain efficiency.

- **Iwi leaders' aspiration to plant up to 1 million hectares of forests** on under-utilised land with potential for both indigenous and non-radiata pine exotic species. Māori trusts and incorporations also want to own more of the forests growing on their land and are investigating institutional arrangements that will realise the potential of fragmented land assets.
- **China** continues as the dominant market for logs and is investing in new mills that will compete for the already limited supply of good quality pruned radiata.

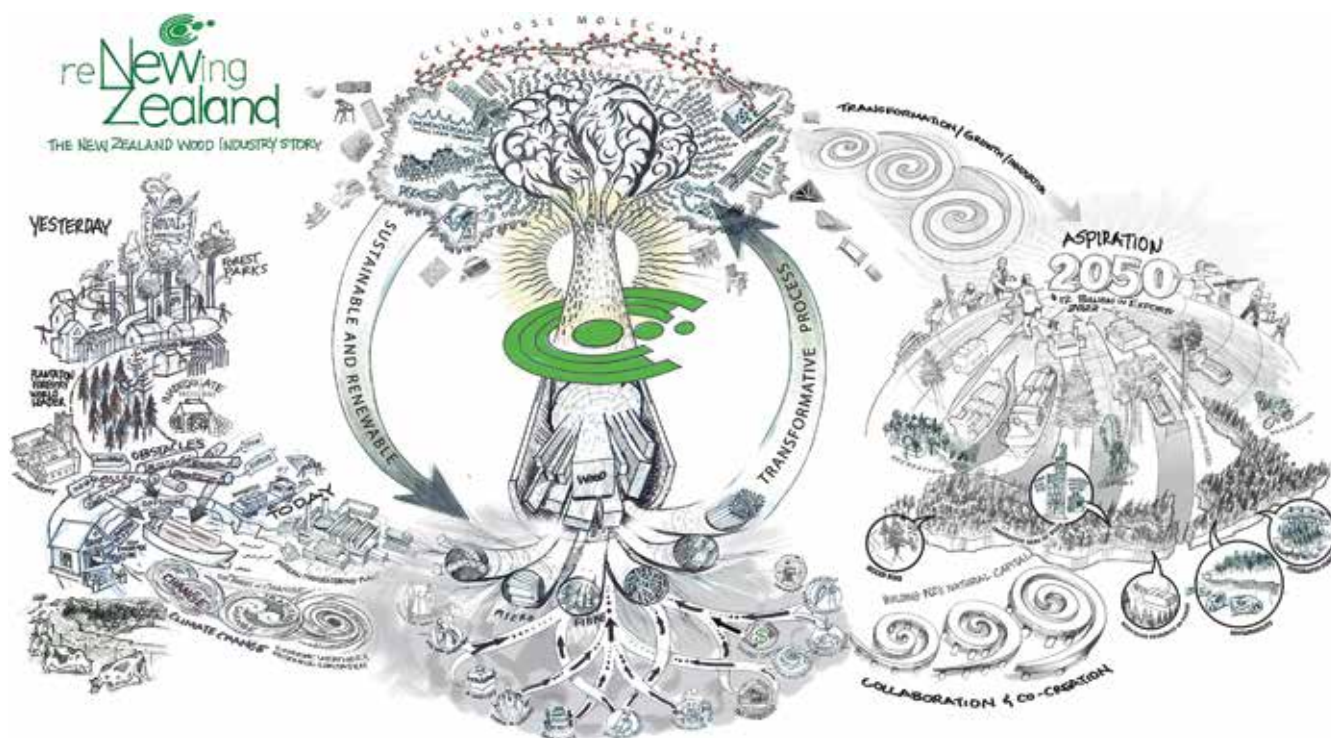
- Impacts of **fracking and geopolitics** on oil (and other commodity) prices and rapid advances in the performance and cost competitiveness of electric vehicles and other renewable energy technologies.
- **Volatility** in the price of commodities such as milk powder and logs affirms the need to diversify and add value (and margin to export products).

These international and domestic developments reaffirm the positive future for forestry and forest products, and Scion's vital role in growing New Zealand's bioeconomy, meeting the aspirations of Māori and using natural resources within agreed limits.

Large new investments announced over the past 12 months in domestic mills and manufacturing plants and waste re-use technologies, combined with increasing harvest volumes, are encouraging steps toward the Woodco (New Zealand Wood Council) "New Zealand forest and wood products industry strategic action plan" goal to grow exports from a baseline of \$4.5 billion in 2011 to **\$12 billion by 2022**. The formation of the Wood Processors Manufacturing Association (WPMA) in 2014 and release of its 2050 ReNewing New Zealand vision (see next page) provides a stronger national voice for its members and platform for securing long-term investment for post-forest research and development. The WPMA strategy reflects increased use of low carbon industrial products (such as those manufactured from renewable forest biomass) and depicts co-location of processing plants near to forests that are integrated with other land uses.

Lifting the proportion of logs processed onshore from the current 45-50% to 70% is critical to achieving Woodco's

THE NEW ZEALAND WOOD INDUSTRY STORY



\$12 billion goal. This requires a combination of efficiency gains in mills (especially those producing solid wood products), modernisation of building standards, increased returns from sawmill residues, and improved integration across the forest industry value chain. Increased use of engineered wood products, particularly in commercial buildings, would also be a catalyst for more onshore processing of logs.

With an estimated further **8,000 hectares not replanted in 2014** the entire industry must work hard to arrest deforestation by reshaping the 'traditional' framing of forestry investment. Land-owners' and investors' confidence to replant and establish new forests must be rebuilt through higher yields and returns, improving early cash flow through, for example, secondary crops, meaningful carbon prices and further monetisation of other forest ecosystems services.

Other challenges ahead are: assuring the **safety of forestry** workers, increasing log supply security, improving market access and trade terms for wood products, and reducing the dependence on China. Also, industry investment in innovation needs to more than double (particularly in wood processing) if the transformational elements of the Woodco strategy are to be achieved. And, further rationalisation of old mills is needed to improve scale, productivity and specialisation.

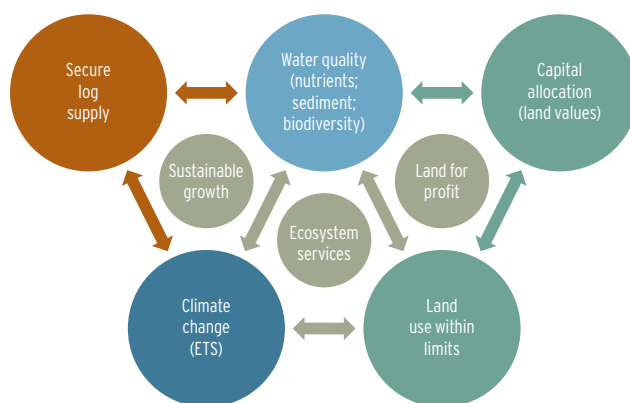
Improving **water quality** is a significant national challenge. Forestry has a primary role in improving land productivity within environmental limits. The Lake Taupo experience, and the Waikato/Waipara Rivers modelling analyses, confirm afforestation is essential for the 2030 quality targets for these waterways to be met.

A forestry solution is within reach. Forestry generates

multiple benefits as illustrated in the diagram below. Increased plantings will provide long-term log supply security, improve New Zealand's capacity to respond to climate change (through carbon sequestration) and restore endangered biodiversity. Concurrently, **complementarity between and across industry value chains**, such as those for forestry and dairy will improve and, in time, this should help redirect capital from land into higher performing infrastructure and manufacturing assets.

Scion is already active on this front: working with industry and central and local government policy makers and is an investing participant in the 'Our land and water' National Science Challenge.

PUBLIC POLICY AND STRATEGY CONNECTIONS



This collaborative, customer-centric approach to the way Scion works features strongly in all our six Intermediate Outcomes (IOs). These are to:

1. Maximise the value and profitability of commercial forests and their ecosystem services.
2. Increase the profitability of solid wood processing through customer solutions and supply chain innovations.
3. Expand opportunities in the wood fibre, pulp, biopolymer, packaging and biochemical industries and from their biomass side streams.
4. Increase New Zealand's energy security through the use of forest and waste biomass for bioenergy.
5. Protect and enhance market access and improve risk management in the forest industry including forest health and preparedness for biosecurity incursions, fire and climate change.
6. Ensure forest industry and bioeconomy businesses' licence to operate (and reputation) through workers' safety and capabilities, verifiable environmental performance, product traceability and modern standards; and, by anticipating long-term change.

Scion's business model continues to evolve towards achieving these outcomes. For example, we are stepping up our focus on:

- developing international linkages in order to rapidly adapt and co-invent technologies for New Zealand and access larger markets for our forest and industrial bioproducts and services;
- building partnerships with Māori who are large and increasingly influential stakeholders in forestry;
- growing our capabilities in resource economics, value chain optimisation and informatics;
- investing in specialist equipment and pilot plant infrastructure to assist technology scale-up; and
- developing talent and other capabilities to support earlier and faster transfer of new knowledge and technology to users.

Core Funding (\$17.7 million) is invested across the IOs. About 45% of this will be for strategic research. Our customers want to see that outcomes from the National Science Challenges effectively align with industry's vision and priorities (such as protecting forests assets from fire risk).


Our programme of re-investment of surpluses into Learning and Growth (L&G) initiatives to build Scion's future revenue resilience and an attractive workplace is bearing fruit. We propose reinvesting \$1.3 million of surpluses in 2015/16 (increasing to \$1.7 million by 2019/20) to accelerate technology transfer and commercialisation; continue staff secondments into firms; support development of the Māori economy through the forest industry; and exploit the potential of 'big data' tools to access and re-use data from Scion and other parties. This work complements our 10-year capital asset plan to modernise buildings, laboratories and equipment and to install pilot plants to support the scale-up and de-risking of our most promising technologies. Now, in the plan's fifth year, we are embarking on major works to refurbish our wood engineering laboratories and pilot plant facilities at an estimated cost of \$8-10 million over the next two years.

Market volatility and the risk of a 'global shock' remains relatively high in historic terms. Accordingly, prudent top line growth, cost control and balance sheet flexibility are all reflected in Scion's financial projections to June 2020. Revenue is budgeted to increase in 2015/16 by 3.4% to \$49.078 million, and earnings before interest and tax and after reinvestment to be \$2.302 million. This generates a return on equity before reinvestment of 7.3% and a tailored rate of return of 4.7%.

Achievement of these returns is predicated on revenue gained through the National Science Challenges, success with commercialisation initiatives, new Primary Growth Partnerships being secured and partnership programmes with Māori being funded. Notwithstanding these uncertainties, with the commitment of our staff and on-going industry support, we expect Scion to sustain its financial performance and capacity to invest in initiatives to assist the forest industry to achieve \$12 billion of exports by 2022.



Tony Nowell CNZM  
Chairman



Warren Parker  
Chief Executive



The New Zealand Forest Research Institute (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 is New Zealand's leading provider of science and technology to New Zealand forest-based companies.

In October 2010 Scion's Statement of Core Purpose (SCP) was adopted. This 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"**<sup>1</sup>. Scion is responsible, in partnership with industry, Government and Māori for achieving four national outcomes:

- 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.

Scion's development has paralleled the evolution of commercial forestry and its associated industries in New Zealand over the past 100 years. For example, Scion, and its predecessors from the 1920s, developed the genetics of trees whose progeny now populate over 90% of the commercial forest estate. In 1947, the forest health group was formed and its successful control measures for dothistroma needle blight and sirex woodwasp developed in the 1960s still apply today. In the late 1950s, research into wood manufacturing and wood products commenced, and this led to the development of many technologies (e.g. drying, preservation, fibre production) that are now widely used by New Zealand's wood manufacturing companies. In 2000, Scion extended its focus to the development of renewable chemicals, materials and energy from forest

resources and, later, into ecosystem services (such as payments for carbon storage) to further extend the portfolio of revenue streams available from forests. These changes reflected the rapidly increasing international interest in developing substitutes for petrochemicals and to enhance New Zealand's environmental resilience and energy security.

These achievements have built Scion's reputation as a world leader in forest industry research and development. It has developed a distinct multi-disciplinary capability across the value chain from germplasm generation to the design and application of wood, fibre and other forest resources in commercial products and services. These capabilities have established knowledge and technology platforms that can be applied to other non-forest biomaterials such as in the packaging and waste sectors. Scion also fulfils an important role in providing the evidence base for public policy on forestry and working internationally to formulate, for example, new biosecurity protocols and standards for wood products, packaging and new bio-based products.

### Scion's business model

Scion's business model is designed to create economic, environmental and social value for New Zealand. This is achieved by working closely with our stakeholders to identify their needs and where their largest opportunities lie, developing new knowledge and technology to meet these needs, and ensuring that the outputs from Scion's work are readily and optimally inserted into the forest industry and wider biomaterial sector value chains (see Figure 1). The foundations of this model are high quality partnerships with

customers and Māori; an extensive national and international research network to access new ideas, intellectual property for direct adoption or adaption to New Zealand; internationally competitive science and support staff; and, modern research laboratories, plant, equipment and ICT systems. Recurring revenue streams, mostly for contract services, are built through the above activities. In the future, a larger proportion of income (aspiration 20%) will be derived from the licensing and sale of technologies Scion has commercialised with partners. A customer-centric culture, strong science translation capability and a value chain perspective imbues this model. Collectively, this business model design generates critical mass, supports efficient technology translation and leverages stakeholder expertise to deliver solutions to problems and value to the New Zealand forest industry.



<sup>1</sup> The full Statement of Core Purpose is available at <http://www.scionresearch.com>

Scion is actively shaping a Rotorua-based 'Forest Industry Centre of Excellence' in order to attract new investment into the sector and facilitate regional economic growth (see page 21). Our North Drive Innovation Park, industry tenants (27 firms) and the Bay of Plenty tertiary education initiative are central elements of this. To boost the formation of a regional 'hub', an interest free loan has been secured from the Bay of Plenty Regional Infrastructure Fund to enable the construction of a multi-functional 'innovation centre' building. The aim is to have this occupied in 2016. Companies involved in innovation in the manufacturing, services (e.g. IT, engineering) and learning and development

will be preferentially sought as tenants for this new facility.

Scion's other major site is within the School of Forestry at the University of Canterbury, Christchurch. Close contact is being maintained with the University of Canterbury (and the School of Forestry) regarding its rejuvenation plan, and also with the Lincoln 'hub' development, to ensure the forest industry is well placed with regard to these developments.

This SCI describes how this business model will be applied to support the forest industry to meet its goals and, in so doing, enable Scion to achieve the national outcomes in its Statement of Core Purpose.

**SCION'S BUSINESS MODEL CANVAS**

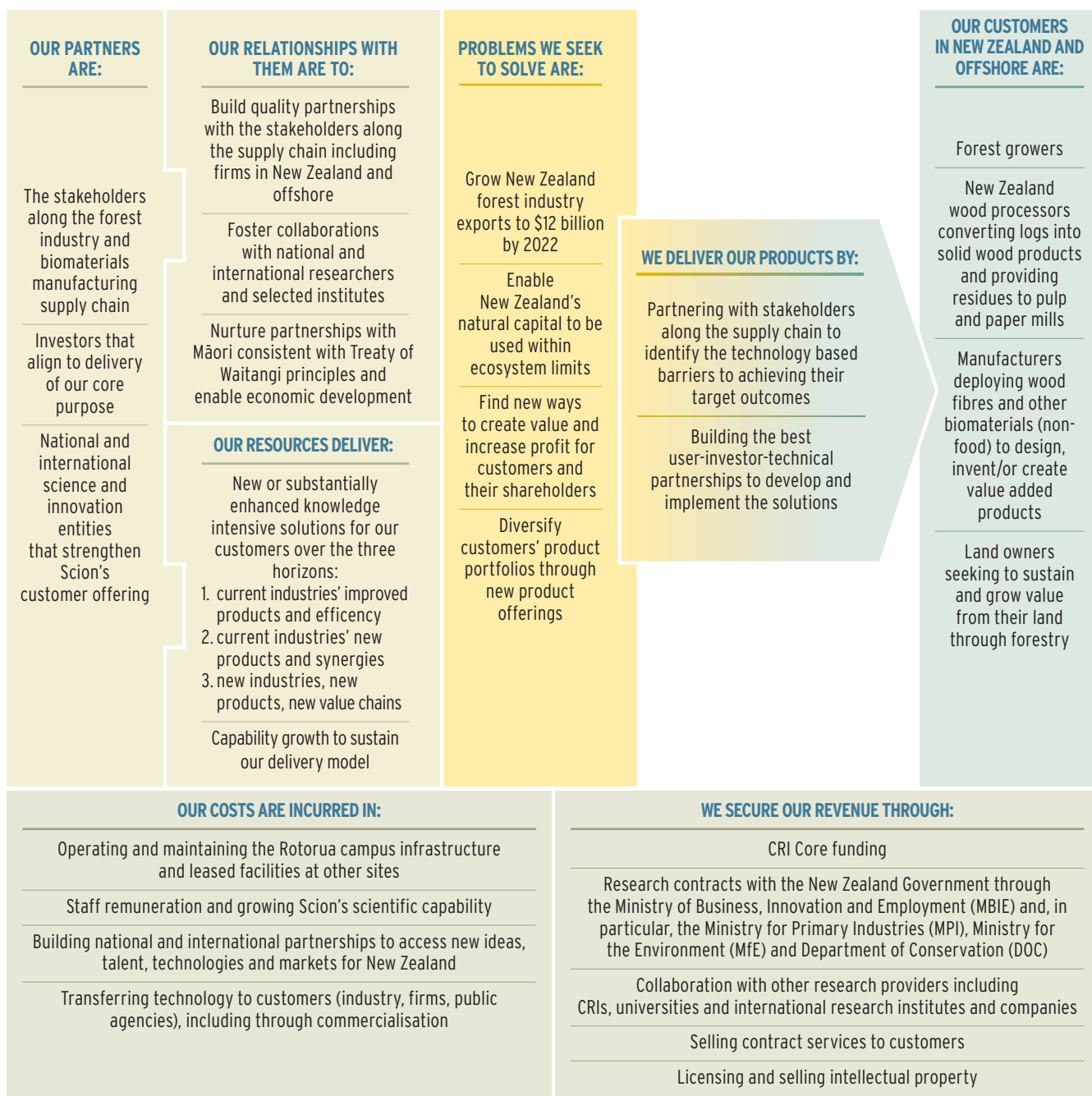


Figure 1: Scion's business model canvas<sup>2</sup>.

<sup>2</sup> Adapted from Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers* (pp. 18-19). New Jersey, USA: John Wiley & Sons, Inc.

# 2

# GROWING AND TRANSFORMING THE NEW ZEALAND FOREST INDUSTRY

The New Zealand forest industry's overarching goal is to increase exports of wood based products and logs to \$12 billion (from a \$4.8 billion baseline in 2011). Concurrently, the value of related forest technologies is expected to grow by at least \$2 billion annually by 2022<sup>3</sup>. National energy security will be improved by creating 24 petajoules (PJ) of energy; and climate change effects mitigated in a small way by sequestering 26.7 million tonnes of carbon per annum<sup>4</sup>.

The foundation of the industry is 1.73 million hectares of plantation forests. These generate the log flows illustrated in Figure 2. Further information describing the characteristics and performance metrics of the forest growing and post-forest 'gate' sectors is presented in Appendices 1 and 2, respectively.

owned by the Crown (3%), local government (3%), state owned enterprises (1%) and public companies (2%). An estimated 43,000 hectares of replanting and 3,000 hectares of new planting occurred in 2014. Some 54,000 hectares were harvested in the year to April 2014, representing an average age of 27.5 years.

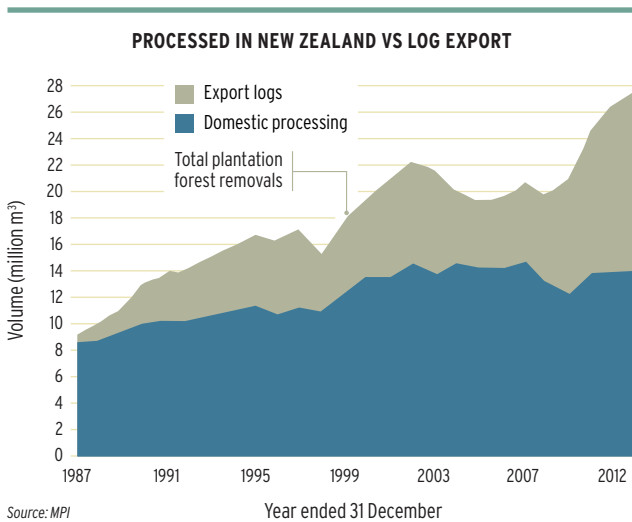


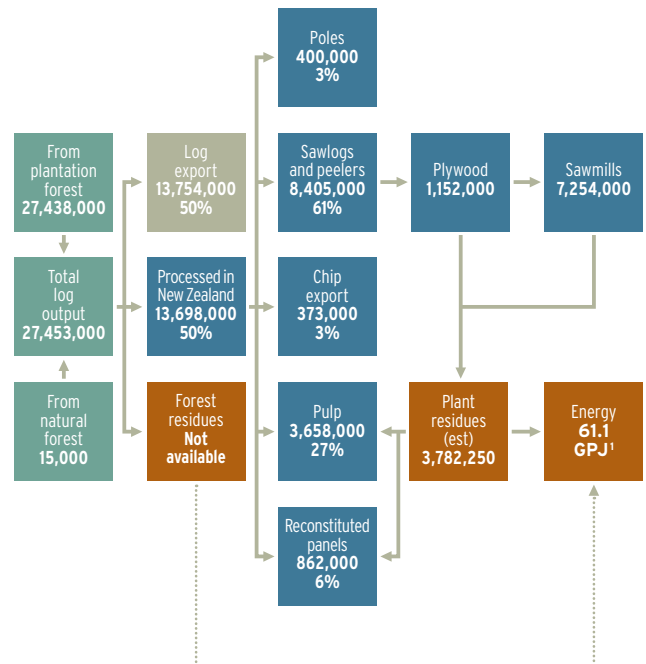
Figure 2a: Processed in New Zealand vs log export<sup>5</sup>.

## New Zealand's commercial forests (see also Appendix I)

New Zealand's 1.73 million hectares of commercial forests have a standing volume of 512 million m<sup>3</sup> of timber as at 1 April 2013. 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

## NEW ZEALAND FOREST INDUSTRY SCALE AND LOG FLOW

Volumes in (m<sup>3</sup>) roundwood equivalent. Year ended 31 December, 2012.\*



GPI: Gross Petrajoules  
<sup>1</sup> Source: NZ Energy Datafile 2012, Woody Biomass  
<sup>\*</sup> Source: MPI and FOA

Figure 2b: New Zealand forest industry scale and log flow<sup>5</sup>.

Trees create value for New Zealand in many ways, both directly and indirectly. During its growth a tree stabilises land, enhances water and air quality, absorbs carbon and provides a back-drop to amenity activities such as recreation and eco-tourism. On maturity it can be disassembled to

<sup>3</sup> Wood Council of New Zealand Inc. (2012). *New Zealand Forest and Wood Products Industry Strategic Action Plan*. Retrieved 23 April 2014 from <http://www.woodco.org.nz>  
<sup>4</sup> Ministry for the Environment. (2014). *New Zealand's Greenhouse Gas Inventory 1990-2012*. <http://www.mfe.govt.nz/publications/climate/greenhouse-gas-inventory-2014/greenhouse-gas-inventory-2014-year.pdf>  
<sup>5</sup> Forest Owners Association. (2011/2012). *New Zealand Forest Facts & Figures*. [http://nzfoa.org.nz/images/stories/pdfs/nz8135\\_factsfigures.pdf](http://nzfoa.org.nz/images/stories/pdfs/nz8135_factsfigures.pdf)

provide materials for construction, interiors and landscaping; fibre for packaging and paper; and a growing array of chemicals and energy products. In conjunction with this supply chain, companies produce furniture and other high value manufactured goods, and develop and supply technologies and machinery such as timber drying kilns, harvesting machines, biorefinery plant and process automation equipment. Forests are typically the environment for New Zealand's fast growing ecotourism industry.

Forest growing, processing, design and construction companies within the forestry industry produce about \$6.4 billion of sales per annum<sup>6</sup>. Adding sales from furniture manufacture, resins, carbon, kilns and other parts of the forest value chain at least doubles this value<sup>7</sup> with exports of pulp, paper, wood manufactured products and logs being New Zealand's third largest merchandise export earner<sup>8</sup>. The forest industry generates high value per full-time worker (on average about \$215,000 of GDP/FTE in the Bay of Plenty<sup>9</sup> region) and about 4 to 6 'downstream' jobs per employee. Thus, while the industry comprises many small to medium and a few large firms, it has a powerful influence on regional development and community well-being, especially in smaller urban centres and rural districts of New Zealand. As well, there are an estimated 100,00 investors in forests (many are from urban areas).

## An industry in transformation

The forest industry, by the mid 2020s, will be very different from that of today as it responds to and supports a world where assets such as materials (for construction and consumer goods), energy, and water availability are scarcer and much more highly valued than at present<sup>10</sup>.

The cost and the availability of energy and water are already creating international concern as are the effects of climate change, biosecurity outbreaks and security of food supply. With a world population expected to be about 9 billion (currently 7 billion)<sup>11</sup> by 2050, and overall wealth increasing, especially in fast growing emerging economies, global food and fibre production will need to dramatically increase off a smaller base of natural resources. An estimated 75% of all new market growth will occur in cities with the largest 100 of these being responsible for 35% of future demand. At the same time, society must adapt to a **likely 1.5-3°C warmer and more hazardous climate and associated changes in pests and diseases**<sup>12</sup>. Many 'advanced' economies will be confronting the challenges of an aging population with fewer workers, and in Europe, Russia and Japan, in particular, negative population growth. This mix of factors will dramatically alter New Zealand's future markets and could increase regional political instability and the flow of migrants. By 2030, New Zealand will be more ethnically diverse

with more Māori (25%), Pacifica and Asian (perhaps 20-25%) populations, and concentrated in the upper North Island.

### The New Zealand forest industry encompasses companies that:

- Grow and manage forests for economic, environmental and amenity purposes.
- Convert trees into multiple products including logs, timber for construction, and manufactured products (e.g. pulp, paper, panels and fit out, and furniture) and engineered products (e.g. laminated timber).
- Produce renewable chemicals (e.g. biopolymers and extractives), composite products (e.g. fibre plastic componentry), adhesives and coatings, packaging and energy (e.g. wood pellets, biofuels) from wood and forest resources.
- Manufacture machinery and equipment for forest management (e.g. harvesting) and forest resource processing (e.g. drying kilns, biorefining plant).
- Provide support services that supply systems to protect forests, treat timber, software, engineering and logistics.

These global drivers are underpinning very large public and private sector investment into technology that will enable a transition to a new biobased future during the twenty-first century. In Europe, the Americas and Asia energy, water and food security are much more pressing issues than in New Zealand. Nations within these regions are planning for and transitioning to a new knowledge-based bioeconomy<sup>13</sup> future through the installation of biorefineries, land use change and prioritising 'green economy' research and development investment. Additive manufacturing utilising 3-D printing is transforming how and where goods are produced.

Many economies are also strongly promoting the use of clean technologies (recycling, renewable energy, process efficiencies to reduce waste and eliminate emissions), industrial biotechnology<sup>14</sup> and the judicious use of genetic modification (such as for disease and drought tolerance) to find solutions to food and fibre supply and energy security and at the same time, improve environmental protection.

The forest industry can play a significant role in helping New Zealand to meet its targets to **grow export revenue, create high wage jobs** and improve **environmental resilience**,

<sup>6</sup> Wood Processors Association of New Zealand and New Zealand Pine Manufacturers Association. (nd). *Wood Processing and Manufacturing Science and Innovation Plan*. <http://www.pine.net.nz/resources/LatestNews/WoodProcessingandManufacturingScienceandInnovationPlan.pdf>

<sup>7</sup> Based on data (including forestry, wood processing, paper manufacturing, wood buildings, furniture, kilns and forest machinery) sourced from the 2009 Annual Enterprise Survey, New Zealand Department of Statistics.

<sup>8</sup> Wood Council of New Zealand Inc. (2012). *New Zealand Forest and Wood Products Industry Strategic Action Plan*. Retrieved 23 April 2014 from <http://www.woodco.org.nz>

<sup>9</sup> John Galbraith personal communication, May 2012.

<sup>10</sup> Winston, A. (2014, April). Resilience in a hotter world. *Harvard Business Review*, 56-64.

<sup>11</sup> United Nations. (2004). *World Population to 2300*. <http://www.un.org/esa/population/publications/longrange2/WorldPop2300final.pdf>

<sup>12</sup> International Panel on Climate Change. (2014). *Climate change 2014: Impacts, adaptation, and vulnerability*. Retrieved 24 April 2014 from [www.ipcc.ch/report/ar5/wg2/](http://www.ipcc.ch/report/ar5/wg2/)

<sup>13</sup> The term 'bioeconomy' includes all industries and branches of the economy that produce, manage or otherwise harness biological resources (and related services, supply or consumer industries), such as agriculture, food, fisheries and other marine resources, forestry. Source: European Union. (2012). *FP7 Cooperation Work Programme Food, Agriculture and Fisheries, and Biotechnology*. [http://www.ec.europa.eu/research/participants/data/ref/fp7/132093/b-wp-201301\\_en.pdf](http://www.ec.europa.eu/research/participants/data/ref/fp7/132093/b-wp-201301_en.pdf)

<sup>14</sup> Industrial biotechnology enables industries to deliver novel products that cannot be produced by conventional industrial methods; in addition it will make possible replacing chemical processes by more resource efficient biotechnological methods with reduced environmental impact (Source: ibid.).

including reaching New Zealand's international greenhouse emissions reduction targets. It will also contribute to better social outcomes for New Zealanders, **build the manufacturing sector** and **strengthen the Māori economy** by adding to their more than \$2 billion forest asset base.

## Global trends shaping the forest industry

The macro environment for the forest industry is distilled in the ESTEMPLE analysis presented in Table 1. Major trends and drivers of the industry's future are described in more detail below.

### ESTEMPLE ANALYSIS OF THE MACRO-ENVIRONMENT FOR THE NEW ZEALAND FOREST INDUSTRY

<b>Economic</b>	<ul style="list-style-type: none"> <li>• New Zealand well aligned to growing and emerging economies, including North Asia, India and ASEAN block</li> <li>• Export demand for logs boosts prices and forest grower returns; global shortfall in softwoods by 2020 or earlier</li> <li>• Demand for solid wood and wood fibre products improving with domestic and US economies; log prices squeeze margins</li> <li>• Deforestation-afforestation sensitive to carbon prices and competing land use (dairy) returns</li> <li>• Māori are increasing (e.g. Central North Island) and reducing (Ngāi Tahu) investment in forestry</li> <li>• New Zealand currency overvalued on fundamentals creating pressure for exporters; volatility (3-5 year) dissuades investors</li> <li>• New 2030 greenhouse gas (GHG) reduction target confirmed late 2015; ETS review 2015</li> </ul>
<b>Social</b>	<ul style="list-style-type: none"> <li>• Forestry worker health and safety a major concern; impacts attractiveness of forest industry careers</li> <li>• Closure of (mostly) older, smaller mills impacts rural regions</li> <li>• Low skills, high (Māori) youth unemployment in forestry regions - Northland, East Coast, Western Bay of Plenty</li> <li>• Social licence to operate adversely impacted by harvesting log debris and sediment in waterways</li> </ul>
<b>Technological</b>	<ul style="list-style-type: none"> <li>• Global trend towards low 'carbon' renewables; natural products; lightweighting and zero waste</li> <li>• Engineered wood products, prefabrication building systems grow demand for solid wood; reduce labour constraints</li> <li>• ICT - broadband, hand-held devices, big data, sensors - integrate across value chain and enable precision systems</li> <li>• 3-D printing, robots and automation, design and logistics redefine manufacturing</li> <li>• Biotechnologies - primary and industrial - tap the latent potential of genomes and enables sustainability</li> </ul>
<b>Ecological</b>	<ul style="list-style-type: none"> <li>• Climate change forecast to elevate average temperature by 2°C by 2050 with more extreme events (wind, drought, floods)</li> <li>• Global trend towards renewable energy and green chemicals; clean technologies and zero waste</li> <li>• Natural resources (forests) become scarce as world population and wealth grows to increase fibre and energy insecurity</li> <li>• Bans on illegal logging and requirement for certification is reducing tropical log hardwood supply</li> <li>• Valuation and monetisation of forest ecosystem services for carbon, biodiversity, avoided erosion (polluter pays)</li> <li>• Weed and pest control costs rising; NGO certification systems constrain use of proven chemicals and new breeding technology</li> </ul>
<b>Media</b>	<ul style="list-style-type: none"> <li>• Social media has powerful influence on licence to operate and public perceptions of forestry</li> <li>• Anti-science lobby achieves disproportionate media 'voice' reflecting weak citizen science, e.g. genetic engineering technology</li> <li>• News is global, real-time and easily accessed (information age)</li> </ul>
<b>Political</b>	<ul style="list-style-type: none"> <li>• Government Business Growth Agenda to increase exports to 40% of GDP by 2025; Regional Growth Studies</li> <li>• Treaty of Waitangi settlements nearing completion; rapid growth of the Māori economy including in forestry</li> <li>• Australia-New Zealand Closer Economic Relations and new Federal legislation provides scope for increased forest industry R&amp;D collaboration</li> <li>• China-New Zealand Free Trade Agreement has profoundly increased trade and investment flows</li> </ul>
<b>Legal</b>	<ul style="list-style-type: none"> <li>• New national framework for freshwater management set nutrient limits that will drive land management change</li> <li>• Changes to Resource Management Act will strengthen Hazardous Substances and New Organisms Act (and national governance of introduced organisms; new breeding technologies)</li> <li>• Race to own-secure intellectual property for the renewable bioeconomy including forest biomass technologies</li> <li>• Ban on illegal logging; supply chain traceability becoming mandatory</li> </ul>
<b>Ethical</b>	<ul style="list-style-type: none"> <li>• Advocacy group concerns about new technology such as genetic engineering and nano-technology</li> <li>• Protection of privacy, information security and cyber-espionage in a digital age</li> </ul>

Table 1: An ESTEMPLE analysis of the macro environment for the New Zealand forest industry.

**Global transition to renewable, low carbon substitutes for petroleum products; the 'greening' of business:** The potential for wood fibre to be converted into chemicals and polymers and thereby substitute for petrochemicals is

now well recognised. The production of renewable polymers and composite materials from biomass is a rapidly growing global opportunity<sup>15</sup>. These materials, developed from renewable feed stocks, such as from forests, have properties

<sup>15</sup> European Bioplastics. (2013). *Bioplastic facts and figures*. Retrieved 23 April 2014 from <http://en.european-bioplastics.org>

comparable to non-renewable oil-based plastics. Global production of bioplastics, for example, is currently about 1.4 million tonnes per year (in a 200 million tonne per annum plastic market) and is forecast to expand to 6.2 million tonnes per annum by 2017. New Zealand has the ability to produce these plastics from trees and waste fibre from other biomass processing and local companies are increasingly seeking to take up this opportunity.

Multi-nationals such as Unilever, Procter and Gamble, IKEA, Nestlé and other members of the Sir Richard Branson initiated B Team<sup>16</sup> are driving a change to procurement of renewable inputs to their products and services. Automobile companies too are moving toward lightweight, renewable materials to improve energy efficiency, safety and reduce GHG emissions and other adverse environmental impacts. Demand for bioproducts continues to expand rapidly in both the OECD and emerging economies. In some jurisdictions polystyrene products are banned. This is supporting the growth of New Zealand companies involved in developing bio-based products such as composites, renewable chemicals and packaging based on forest (plant) extracts. Renewable chemicals markets are projected to reach US\$59 billion next year. The bioproducts category is forecast to expand to €200 billion in seven years. Several bioproducts were identified in the WoodScape study<sup>17</sup> as having the potential to support a step change in economic returns from a tree. This understanding is directing Scion's investment into bioproducts and bioenergy.

**A growing need for affordable housing and resilient commercial building solutions:** Demand continues to grow for improved and affordable housing in New Zealand and developing economies in Asia, India, the Middle East, Africa and South America. Over the decade to 2022 new flooring equivalent to the land area of Austria will be laid in response to population growth, urbanisation and increased wealth<sup>18</sup>. Multi-rise and in-fill building within cities will increase. Wood is a proven construction material for these purposes and in earthquake prone regions. As outlined in the Woodco Strategic Action Plan, there is the potential to substantially extend the application of wood and wood-derived materials into future houses.

**Bans on illegal logging and certification of forests will change global markets:** Australia<sup>19</sup> and the EU introduced legislation to ban 'illegal' logging in 2012. Only authenticated logs will be able to enter these markets. This will further reduce supplies of illegally harvested tropical hardwoods and presents an opportunity for New Zealand's certified plantation forests and expansion of the area planted in hardwoods such as eucalypts and indigenous species. This also adds impetus to Scion's (and others) work on log traceability in the supply chain and automatic scaling; and opportunity to adapt technology and practice from the livestock industries (e.g. NAIT) and Global Standards (GS1) initiative.

**Big data<sup>20</sup>, information communication technologies and smart connected technologies are transforming business and science:** The rapid evolution of 'data intensive science' - sensors, robotics, geospatial mapping - is dramatically and rapidly changing both the landscape under which science is conducted and the manner in which science engages with industry and policy agencies. Data intensive science represents a paradigm shift from hypothesis/experimentation based science, to one of identifying patterns in data; and using modelling and simulation tools with increasingly large volumes of data. These developments are allowing science providers to use existing science data resources more efficiently as well as with datasets available nationally and internationally. This can help drive productivity improvements through information sharing along value chains, faster genetic gains and tree growth in forests, increased log conversion rates in mills and higher quality consumer solutions (e.g. high quality, energy positive, prefabricated homes).

**Meeting greenhouse gas emission reduction and forest conservation (biodiversity) targets:** The United Nations sponsored REDD+ scheme (which, from a New Zealand perspective, will beneficially reduce log supply from tropical hardwood forests), land use change and the protection of biodiversity are means to meeting these targets. A greater use of wood and wood-derived products in buildings will also support a reduction in greenhouse gases and aligns to the international trend toward using materials with low-embodied energy. Forest plantings are highly sensitive to Government policy, such as the Climate Change Response Act 2002. The 2012 amendment to this Act has significantly reduced forest planting intentions during winter 2013<sup>21</sup> and for 2014. The outlook for 2015 shows continued decline in planting rates. Low carbon returns also affect Māori who are considering whether to continue land lease arrangements or manage their own forests. A study<sup>22</sup> published in 2013 suggests a further 39,000 hectares of deforestation may occur by 2020. A reduced area in plantation forests decreases New Zealand's ability to benefit from impending global shortfalls in softwood supply and to meet its GHG emissions reduction targets. Poorer security of log supply by the late 2020s may also deter new investment in processing. Growing the competitiveness of forestry as a land use, including through short rotation special purpose species, therefore remains a high priority for Scion.

**Ensuring energy security and safety:** Higher oil exploration costs in environmentally sensitive zones (such as national parks and deep oceans), growing concerns about air pollution due to coal, the rapid deployment of fracked gas (especially in the US), and political unrest in the major oil producing regions are leading economies to implement energy security strategies to reduce both sovereign risk and GHG emissions. Also nuclear power plants, once foreseen as a

<sup>16</sup> The B Team. (2013). *People, planet and profit: doing business for the wellbeing of the planet and people*. <http://bteam.org/>

<sup>17</sup> Woodco. (2013). *WoodScape Study - Technologies and Markets*. Retrieved 18 March 2014 from <http://www.woodco.org.nz>

<sup>18</sup> Dobbs, R., Remes, J., Manyika, J., Roxburgh, C., Smit, S., & Schaer, F. (2012). *Urban World: cities and the rise of the consuming class*, (p. 3). McKinsey Global Institute.

<sup>19</sup> Australia passed laws in 2012 to ban the import and trade of illegally logged timber, joining the United States and European Union in clamping down on a global trade in stolen timber that Interpol says is worth about \$30 billion a year.

<sup>20</sup> The term 'big data' is used for a collection of data sets so large and complex that it becomes difficult to process using on-hand database management tools or traditional data processing applications. The challenges include capture, curation, storage, search, sharing, transfer, analysis and visualisation. The trend to larger data sets is due to the additional information derivable from analysis of a single large set of related data. Source: [http://www.en.wikipedia.org/wiki/Big\\_data](http://www.en.wikipedia.org/wiki/Big_data)

<sup>21</sup> Provisional estimates of tree stock sales and forest planting in 2013. Source: <http://www.mpi.govt.nz>

<sup>22</sup> Manley, B. (2012). *Deforestation Survey 2011: Final report*. (Technical Paper 2012/11). Wellington, New Zealand: Ministry of Agriculture and Forestry.

lead option for improving energy security, are either closing (Japan, Germany) or their construction is being delayed (France, Finland, China). These trends are particularly pressing for countries with a high dependence on imported energy, such as China, India, South Korea and Japan, which are important trading partners for New Zealand. The New Zealand Government's energy strategy seeks to generate 90% of electricity from renewable sources by 2025 and have a 50% reduction in greenhouse gas emissions by 2050<sup>23</sup>. Wood already provides some 7.2% of New Zealand's energy and, through technology advances in converting forest biomass to sugars and better use of forest and wood residues, has the potential to increase its contribution to New Zealand's energy supply by a further 24 petajoules. The Primary Growth Partnership 'Stump to Pump' programme is the largest current near-market initiative in New Zealand. The UK and EU in particular are continuing their focus on meeting 2020 greenhouse gas reduction targets through renewable energy technologies.

**New technologies such as genetic modification (GM), industrial biotechnology and precision production systems are helping to address the challenge of achieving sustainable growth from finite natural capital:**

The application of these technologies is accelerating to optimise resources (e.g. water and nutrient efficiency), reduce chemical use (e.g. herbicides and pesticides) and incorporate valuable commercial traits faster than by conventional breeding (e.g. the volume and quality of plant yields). Technologies such as drone derived LiDAR information for precision forest management and scanning to optimise log selection and conversion value are rapidly gaining wider acceptance for use in the New Zealand forest industry.

**New protocols and standards for packaging:** New Zealand must also provide high quality packaging materials to enable our primary produce exports, such as those from horticulture and aquaculture, to meet the new global packaging protocols and satisfy the requirements of increasingly sophisticated consumers in high value international markets. Typically, packaging materials must be disposable (challenging some traditional packaging materials such as expanded polystyrene), while also maintaining the quality and safety of the transported goods such as fruit, fish and dairy products. 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 an essential technology platform to support our high-value food export industry. The Green Growth Strategy noted the necessity for New Zealand export companies to reduce the carbon footprint of their products in order to stay competitive<sup>24</sup>. Hence, substitution of expanded polystyrene with a compostable bio-based packaging material<sup>25</sup> derived from wood fibre (such as for moulded or extruded products<sup>26</sup> within the fast-moving consumer goods sector) presents a significant new manufacturing opportunity for New Zealand.

**More enquiries for non-radiata forest species:** Radiata pine represents some 90% of New Zealand's commercial forests and will remain the dominant species for the foreseeable future. However, Māori and other forestry investors (and New Zealand's competitors) have a growing interest in other species to supply naturally durable timbers to expanding Asian markets, provide short fibre species for paper, and avoid the need for chemical treatments. KPMG (2013) estimated annual revenue streams from indigenous species could grow to \$285 million per annum. Reducing the health risk of a forest monoculture and adapting to climate change are other drivers of interest in non-radiata species. These drivers provide the impetus for Scion to increase effort in eucalypts, cypresses, Douglas-fir, kauri, beech and totara and to extend our understanding of export markets and supply chains for high-value wood product exports.

**The forest industry and Scion in 2025 - a preferred future<sup>27</sup>**

By 2025 the New Zealand forest industry is strongly capitalising on the global economic, environmental and societal changes described in the previous sections. The planted area of forests has expanded to 2.1 million hectares (including 0.3 million hectares of previously under-utilised Māori land) from the 2014 area of 1.7 million hectares. Compared to now, these plantations include a more diverse range of species (including indigenous), have genotypes matched to the environments they are most suited to (such as East Coast forests' exposure to severe drought owing to the effects of climate change); and the first commercial plantings of some new breeding technology/GM herbicide tolerant and sterile trees are growing well. Replacement and new forest plantings average 70,000 hectares per year. Owners of radiata pine forests achieve 10-25% productivity gains by optimising tree genetics to particular environments and sites and the use of clones; and the uniformity of these forests at harvest could be 25-40% greater than those planted in 2014.

Remote sensing for forest management is normal; harvesting, pruning and other operations are fully mechanised and almost 50% of all forest operations are automated; trees are fully traceable and segregated for their best use and highest value in the supply chain. Special purpose forests with an eight-year rotation and MAI of 40m<sup>3</sup> hectares per annum have been established for energy, green chemical and other purposes. These forests are sometimes established in high wind risk areas.

Wood processors have consolidated into internationally competitive clusters and are integrated across the value chain to exploit synergies in forest biomass

*Continued over page*

<sup>23</sup> Ministry of Economic Development. (2011). *New Zealand Energy Strategy 2011-2021*. <http://www.med.govt.nz/sectors-industries/energy/pdf-docs-library/energy-strategies/nz-energy-strategy-lr.pdf>

<sup>24</sup> Green Growth Advisory Secretariat. (2011). *Greening New Zealand's Growth*. Wellington, New Zealand. [http://www.med.govt.nz/sectors-industries/environment/pdf-docs-library/Greening New Zealand's Growth.pdf](http://www.med.govt.nz/sectors-industries/environment/pdf-docs-library/Greening%20New%20Zealand's%20Growth.pdf)

<sup>25</sup> Biopolymer Network; <http://www.biopolymernetwork.com>

<sup>26</sup> Woodforce; <http://www.woodforce.com>

<sup>27</sup> The 2025 vision comprises information from the Woodco Strategic Action Plan, industry association R&D plans, and science and technology trends.

flows; enable specialisation and grow the total value from all components of a log. Māori are co-investors with offshore investors in wood processing and directly manage some 25% of forests and own 50% of the land on which forests are grown. Geothermal energy provides significant competitive advantage to central North Island and Northland wood processors. Low emissions energy and water availability, together with at least 65% log conversion rates and profitable products from saw and pulp mill residues, contribute to more than 80% of log beings processed onshore.

The mix of processed products and 'customer solutions' has expanded to include new wood-based composites, plastics, natural preservatives; packaging that doubles food shelf life; green chemicals and renewable energy products, including a 'drop-in' biodiesel. Several automobile and homeware companies have extensively adopted Sonae's Woodforce™ technology (originally licensed from Scion in 2011) into their cars to exploit its light weight, strength and reusability. Prefabricated wood construction utilising a range of engineered wood technologies (produced to tight specifications) dominates the housing market; has a 25% share of the commercial building sector and earn \$1 billion in exports. Scion's dewatered wood technology is the preferred substitute for hardwood in three ASEAN economies. Dairy farmers use 40,000 tonnes of molasses (sugar) by-product from a new high performance pulp technology, and trees are highly valued on lowlands by non-forest land owners for their environmental benefits and income stream from the monetisation of carbon and biodiversity ecosystem services.

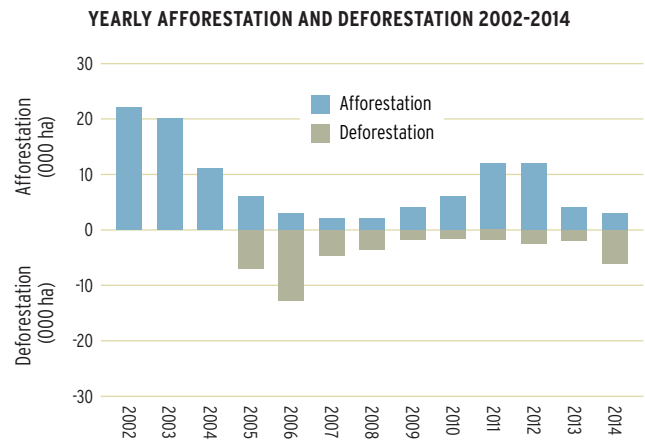
Scion is New Zealand's 'shop window' to the world's leading biomaterial-renewable futures research institutes; is a strategic partner with several multi-nationals that have a large influence on wood-wood fibre and 'wood-food-fed' value chains. More than 30% of Scion's revenues are derived from commercialisation; it has international eminence for thought leadership and science quality (H-index > 100); 15% of its staff are of Māori descent; the ICT section represents 20% of the workforce and its value chain economics, systems and design capability is national leading.

The New Zealand public holds the forest industry in high esteem for its environmental integrity, innovativeness and socially responsible corporate leadership. Companies regularly report 'zero' harm to their staff; top talent preferentially seek careers in forest-related firms.

## Scion's stakeholders' plans for the forest industry

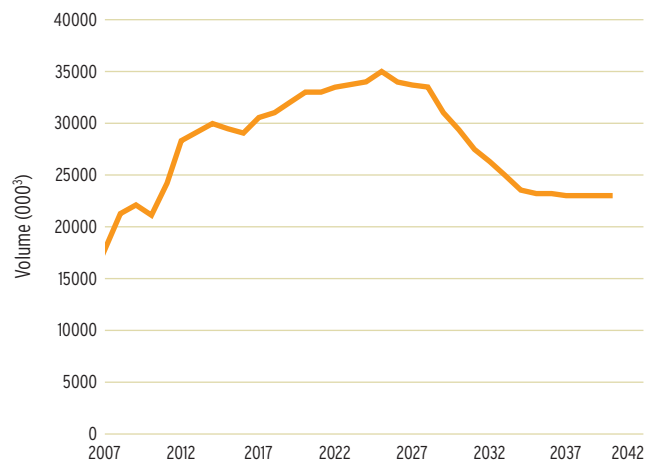
New Zealand forest industry organisations each have growth and development strategies and associated science and innovation plans. These provide critical direction to Scion and the focus of this SCI. They include:

<sup>28</sup> Wood Council of New Zealand Inc. (2012). *New Zealand Forest and Wood Products Industry Strategic Action Plan*. Retrieved 23 April 2014 from <http://www.woodco.org.nz>



Deforestation is occurring in New Zealand. Source: MPI - National Exotic Forest Description as at 1 April 2014.

## NEW ZEALAND RADIATA PINE HARVEST VOLUMES (actual and projected 2007-40)



Wood supply insecurity is a big concern for wood processors. New Zealand harvest volumes showing steep decline in log supply late 2020s. Source: Adapted from MPI 2010-20140 scenarios.

## The New Zealand Forest and Wood Products Strategic Action Plan<sup>28</sup>:

The New Zealand Wood Council's (Woodco) target is to grow wood-based products to \$12 billion (\$4.8 billion in 2010/11) and the value of forest technologies to at least \$2 billion annually by 2022. This will be achieved by:

- New Zealand wood becoming the preferred construction and finishing product in New Zealand and Australia.
- Expanding exports of New Zealand wood into Asia, India, USA and Australia.
- Delivering more value from the existing resource.
- Transforming the use of wood in building systems.
- Expanding new high-value fibre products and integrating new co-product value streams such as biochemicals, biofuel and other bioenergy options.
- Developing new fibre-based packaging products to support New Zealand growing high-value food exports.



**The New Zealand forest owners:** The New Zealand Forest Owners Association (NZFOA), in its Science and Innovation Plan<sup>29</sup> has stated an ambition to grow the forest sector by \$3 billion by 2030. The key to this will be improved profitability through the doubling of productivity (biomass production) on a per hectare basis while also improving wood quality (uniformity and stiffness) and increasing tree resistance to pests and diseases. Forest growers including those from the Farm Forestry Association (FFA) voted to support the introduction of a commodity levy in March 2013. Collection commenced on 1 January 2014 and raised an estimated \$7.7 million (with approximately 50% allocated to research) in the 2014 calendar year. New industry structures (e.g. a Trust Board and R&D Committee) established to oversee the use of levy funds are working well. The levy, while modest in scale compared to the sector's earnings, provides more certainty and flexibility for industry good research such as increasing forest productivity and protecting tree health.

**The Wood Processors Association/Pine Manufacturers Association (WPA/PMA) Science and Innovation Plan<sup>30</sup>:** targets annual gains of \$100 million per annum through increases in export revenue and improvements in manufacturing processes. The Wood Processors Association and the Pine Manufacturers Association merged from July 2014 to form a single point of co-ordination for wood and wood fibre processors. They adopted a new 2050 vision "ReNewing New Zealand (illustrated on page 5) in August 2014. This will place them in a better position to also introduce a levy and coordinate with forest growers. Woodco continues as the forest industry's umbrella organisation.

Important factors implicit to the NZFOA (and FFA) and WPA/PMA plans are:

- Reversing deforestation and assuring future log supply security is a high priority.
- While the genetic make-up of trees to be harvested over the next 20-30 years is already determined, annual replanting of up to 50,000 hectares<sup>31</sup> provides significant scope to now influence the genetic quality and diversity of species in New Zealand's future forest estate.
- The value trees generate, owing to the trends outlined above, is expected to change significantly over the next two decades. Forest ecosystem values include carbon, fibre, energy, chemicals, land use optimisation, biodiversity, recreation and nutrient reduction and more of these are expected to be monetised over the next decade.
- Wood offers superior environmental credentials and hazard resilience compared to steel and concrete in a carbon-constrained world and in earthquake-prone zones, respectively.
- Forestry strongly complements New Zealand's other primary production sectors providing wind shelter,

carbon, erosion and nutrient mitigation and sustainable packaging. Increased integration of land use, genetic improvement and manufacturing would be beneficial.

- A more prosperous future for the forest industry requires integration and traceability along the value chain, and the matching of feed stocks with end uses.
- Smaller-scale investor foresters from the 1990s (estimated to be up to 100,000 people) are unlikely to reinvest for a second rotation requiring the recruitment of a new cohort of investors and improved confidence in returns than their predecessors.

**Māori aspirations for the forest industry:** The Crown/Māori strategy for economic development, *He Kai Kei Aku Ringa*, was released in October 2012. The associated action plan (2012-2017) emphasised the importance of Māori building meaningful science collaborations with CRIs and universities, and of improving the performance of their land and other assets. A 2013 report on *Growing the productive base of Māori freehold land* indicates that at least 470,000 hectares is best suited to forestry. Both opportunities are aligned with Scion's Māori Plan (see Figure 7) to grow the Māori economy through forestry. Māori have more than \$2 billion of assets in forestry<sup>32</sup> with about 500,000 hectares of pre-1990 forests. As Treaty settlements conclude, Māori ownership of land and forests will increase. However, Māori have challenges with:

- fragmentation of land ownership (circa 550,000 hectares of Māori land has no formal administration);
- remoteness from processing sites and associated transport costs;
- accessing working capital for forest establishment;
- managing intergenerational investment;
- implementation of the ETS; and,
- developing local employment opportunities for their people.

Proposed changes to the Te Ture Whenua Māori Act 1993 should assist Māori to realise their aspirations<sup>33</sup>.

Some Māori forest owners wish to diversify species and, in some cases, re-establish land in species other than radiata pine (including kauri, totara and beech). Their desire to re-establish taonga species is part of their cultural reinvigoration, for carbon revenue and ngahere for traditional uses. They are also interested in creating multi-layered forests to generate several income streams (from ginseng, honey, essential oils, wood and carbon for example).

In considering the use of forest resources, Māori also strongly want to incorporate Mātauranga Māori (traditional knowledge) and increase the education and skills of iwi/hapū members. Science and innovation are seen as enablers

<sup>29</sup> Forest Owners Association. (2012). *New Zealand Science and Innovation Plan*. Wellington, New Zealand. Retrieved from 23 April 2014 from <http://www.nzfoa.org.nz>

<sup>30</sup> Wood Processors Association of New Zealand and New Zealand Pine Manufacturers Association. (nd). *Wood Processing and Manufacturing Science and Innovation Plan*. <http://www.pine.net.nz/resources/LatestNews/WoodProcessingandManufacturingScienceandInnovationPlan.pdf>

<sup>31</sup> Provisional estimates of tree stock sales and forest planting in 2013. Source: <http://www.mpi.govt.nz>

<sup>32</sup> Nana, G., Stokes, F., & Molano, W. (n.d.). *The Asset Base, Income, Expenditure and GDP of the 2010 Māori Economy*. Wellington, New Zealand: Māori Economic Taskforce. <http://berl.co.nz/assets/Economic-Insights/Economic-Development/Maori-Economy/BERL-2011-The-Asset-Base-Income-Expenditure-and-GDP-of-the-2010-Maori-Economy.pdf>

<sup>33</sup> Te Puni Kokiri. (2013). *Discussion document: Te Ture Whenua Māori Act 1993 Review Panel*. <http://www.tpk.govt.nz/en/in-print/our-publications/publications/te-ture-whenua-maori-act-1993-review-panel-discussion-document/download/TTWMA-discussion-document.pdf>

of a strengthened future Māori economy. A number of iwi/Māori 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.

As Māori increase their influence over land and forests they will play a greater role in shaping the future New Zealand forest industry than in the past. Accordingly, through forestry “*There is enormous potential for the Māori economy to lead aspects of growth in the New Zealand economy*”<sup>34</sup>.

**Central Government:** The Government’s goal is to foster economic development that will deliver greater prosperity, security and opportunities to all New Zealanders. The centrepiece for this is the Business Growth Agenda<sup>35</sup>, which constitutes six inter-linked ‘ingredients’ for business growth: export markets, innovation, infrastructure, skilled and safe workplaces, natural resources, and capital. Each of these has its own programme of work, and they impact the way Scion works with government departments such as:

- The Ministry for Primary Industries (MPI), which has responsibility for forest and trade policy, implementation of the ETS, biosecurity, and administers the Primary Growth Partnership (PGP).
- The Ministry of Business, Innovation and Employment (MBIE) and New Zealand Trade and Enterprise (NZTE). MBIE has responsibility for business growth (including increasing exports to the equivalent of 40% GDP by 2025), building and housing, timber and wood treatment standards, energy policy, development of key markets such as China and India, and science and innovation policy and implementation.
- The Ministry for the Environment (MfE), which is responsible for environmental policy and regulation regarding forests (e.g. the national policy statements for forestry, water and biodiversity, the Land and Water Forum), climate change policy, aspects of local government; and, through the Environmental Protection Authority (EPA), the HSNO Act which is central to the approval of Scion’s genetic modification research.
- The Department of Conservation (DOC) in forest conservation management, biodiversity protection, weed, fire and pest management.
- The Ministry of Foreign Affairs and Trade (MFAT) in addressing forest biosecurity risks, global standards and market access protocols, and access to international markets through science diplomacy.
- The Government to Government joint initiative between MFAT and NZTE provides a new, low risk avenue for Crown intellectual property to be licensed and applied off shore.

**Regional Growth Studies**, overseen by MBIE and MPI, have

been released for Northland, Bay of Plenty, East Coast and Manawatu/Whanganui. These identify and prioritise forestry and wood processing as the best opportunities for economic growth in these regions.

**Callaghan Innovation**<sup>36</sup> was established as a Crown Agent on 1 February 2013 and represents a fundamental shift in the Crown’s focus for growing the high-value manufacturing sector and innovation by firms. Scion signed an MOU with Callaghan Innovation in June 2013. Scion is now the largest provider of manufacturing research and development among the CRIs, which represents a significant opportunity to boost its “high end” wood and wood fibre manufacturing and bioproduct development research. Callaghan Innovation will also assist Scion to translate its expertise and technology (such as for renewable packaging and bioenergy products for household consumer goods) into other industries.

**National Science Challenges launched:** The Government announced 10 National Science Challenges on 1 May 2013<sup>37</sup>. These challenges provide new impetus to connect science providers to tackle ‘big’ national problems. Scion is participating in five of the challenges including ‘New Zealand’s biological heritage’, ‘Our land and water’, ‘Science for technological innovation’, ‘Resilience to nature’s challenges’, and ‘Building better homes, towns and cities’. As outlined later, these will begin to impact Scion’s programmes and core funding investment from 2015.

**Local Government:** Local government has a significant role in forestry owning 3% of the national estate. The local government sector consists of 11 regional councils, 61 territorial authorities (11 city councils and 50 district councils) and six unitary councils, which are territorial authorities with regional council responsibilities. Research priorities for regional councils<sup>38</sup> relevant to the forest industry include integrated land and freshwater management, nutrient and contaminant management, hazard management including climate change mitigation and adaption; and hazard risk mapping, air quality, valuation of ecosystem services, planning and monitoring tools for the management of cumulative effects and for integrating decision making across scales (from the forest (or farm) to catchment to region). The Bay of Plenty, Northland and Waikato Regional Councils’ plans with regard to forestry are especially significant in the near term for Scion. For example, Scion has helped shape the Bay of Connections Strategy pertaining to forestry<sup>39</sup> and energy development<sup>40</sup>. Improving water quality, whether for the Waikato River, Rotorua Lakes or Northland waterways, is a significant challenge for these regions. In Northland, there is considerable potential to add economic value to totara and utilise geothermal energy at Ngawha for wood processing. Scion will continue to work closely with the local government sector to address these needs, including via initiatives arising from the Regional Growth Studies.

<sup>34</sup> Te Puni Kokiri. (2013). *Discussion document: Te Ture Whenua Māori Act 1993 Review Panel*. <http://www.tpk.govt.nz/en/in-print/our-publications/publications/te-ture-whenua-maori-act-1993-review-panel-discussion-document/download/TTWMA-discussion-document.pdf>

<sup>35</sup> Ministry of Business, Innovation & Employment. (n.d.). *Business Growth Agenda*. Retrieved 18 March 2014 from [www.mbie.govt.nz/what-we-do/business-growth-agenda](http://www.mbie.govt.nz/what-we-do/business-growth-agenda)

<sup>36</sup> Callaghan Innovation; <http://www.callaghaninnovation.govt.nz>

<sup>37</sup> Ministry of Business, Innovation & Employment. (n.d.). *National Science Challenges*. Retrieved 18 March 2014 from <http://www.msi.govt.nz/update-me/major-projects/national-science-challenges/>

<sup>38</sup> Envirolink. (n.d.). *Research Strategy*. Retrieved 18 March 2014 from <http://www.envirolink.govt.nz/Research-Strategy/>

<sup>39</sup> Bay of Connections. (2011). *Bay of Plenty Forestry and Wood Processing Strategy*. [http://www.bayofconnections.com/downloads/Forestry\\_and\\_Wood\\_Processing\\_Strategy\\_September\\_2011.pdf](http://www.bayofconnections.com/downloads/Forestry_and_Wood_Processing_Strategy_September_2011.pdf)

<sup>40</sup> Bay of Connections. (2011). *Bay of Plenty Energy Strategy*. [http://www.bayofconnections.com/downloads/Energy\\_Strategy\\_December\\_2011.pdf](http://www.bayofconnections.com/downloads/Energy_Strategy_December_2011.pdf)

## Forest industry stakeholder priorities

Forest industry stakeholders' priorities have been distilled from industry and government department input into Scion's strategy workshops, discussions with industry leaders, the ESTEMPLE analysis and industry association R&D plans presented earlier, the Shareholders' Outlook Letter to CRIs,

the Government's Business Growth Agenda and public sector requirements. These are summarised in Table 2 and highlight commonality of purpose in areas such as forest plantings, log supply security and climate change adaptation. Other priorities are distinct to a sector, such as the need to find an acceptable, cost effective alternative to methyl bromide for fumigation of export logs.

### FOREST INDUSTRY KEY STAKEHOLDER PRIORITIES

<p><b>Forest owners/ Farm foresters</b></p> <ul style="list-style-type: none"> <li>• Make forestry more competitive as a land use</li> <li>• Value and monetise forest ecosystems services</li> <li>• Forest protection (biosecurity; wind, fire hazards)</li> <li>• Improve operating/supply chain efficiency</li> <li>• Improve worker health and safety</li> <li>• Licence to operate-steepland harvesting</li> <li>• Reduce dependence on China log market; credit risk</li> <li>• A cost effective alternative log fumigant to methyl bromide</li> <li>• Alternative species diversification options</li> </ul>	<p><b>Wood processors</b></p> <ul style="list-style-type: none"> <li>• Log supply security and pricing</li> <li>• Increased profitability (new products; efficiency; customer solutions)</li> <li>• Modernise building standards for wood products and keep them current</li> <li>• Improve international market access and trade terms (level playing field)</li> <li>• Economic 'stability' to encourage investment in mills, plant and equipment</li> <li>• Raise earnings through design-led and IP protected innovation</li> </ul>
<p><b>Māori - tangata whenua</b></p> <ul style="list-style-type: none"> <li>• Finalise Treaty settlements</li> <li>• Generate sustainable wealth from primary sector assets; develop under-utilised land</li> <li>• Employment and higher living standards for Māori</li> <li>• Vision Mātauranga Māori integrated into R&amp;D; partnerships with Scion-research providers</li> </ul>	<p><b>Forest investors (domestic-foreign)</b></p> <ul style="list-style-type: none"> <li>• Meet Weighted Average Cost of Capital and target portfolio returns</li> <li>• Forest protection (biosecurity, wind, fire hazards)</li> <li>• Increase asset (forest) value</li> <li>• Enable liquidation of assets</li> <li>• Confidence in long-term returns relative to other investments</li> </ul>
<p><b>Government</b></p> <ul style="list-style-type: none"> <li>• Meet business growth agenda targets</li> <li>• More jobs and higher wages</li> <li>• Action Regional Growth Studies</li> <li>• Land-use intensification within limits</li> <li>• Affordable housing</li> <li>• Rebuild Christchurch</li> <li>• Value for money (impact) from R, S&amp;T and increased collaboration (NSC) across science system</li> <li>• Callaghan Innovation formed to accelerate the commercialisation of innovation by firms</li> </ul>	<p><b>NZ Wood Council (Woodco)</b></p> <ul style="list-style-type: none"> <li>• Achieve \$12 billion exports by 2022 by processing 70% logs onshore</li> <li>• Improve regional infrastructure to reduce logistics costs</li> <li>• Encourage (and enable) wood use domestically</li> <li>• Establish clear and consistent policies for land use and land investments</li> <li>• Support a skilled and safe workforce</li> <li>• Agriculture introduced to the EST post the 2015 review</li> </ul>

Table 2: Forest industry key stakeholder priorities.

## Shareholders' 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 business agenda. This is complemented by Regional Growth Studies which identify the best prospects for lifting growth in "sub-performing" regions. Shareholding Ministers expect Scion to clearly articulate how it will achieve its Statement of Core Purpose outcomes, work openly and collaboratively with open science providers, establish a performance framework for core funding, ensure easy access and reuse of data held by CRIs, ensure early and high uptake of new knowledge and

technology to maximise its impact in regional development and for New Zealand, and maintain financial viability.

## Scion's response

With this strategic and operating context in mind, Scion has developed its strategy and science and innovation plan to directly address the priorities above and, in so doing, support forest growing, wood and wood-derived products manufacturing companies, new investors and new companies meet their growth and other performance targets. Scion's strategy and science and innovation plan are described in the following section.

# 3

# SCION'S STRATEGIC PRIORITIES

Scion's 2015-20 strategy builds on the proven foundations laid in 2012. It was formatted in the balanced scorecard approach as shown in Figure 3. The strategy is designed to deliver the science and technologies required by Scion's stakeholders to address their critical challenges

and priorities (see Section Two and summary in Table 2), respectively. In particular the strategy seeks to:

1. Support the forest industry to achieve its long-term potential and contribution to New Zealand.

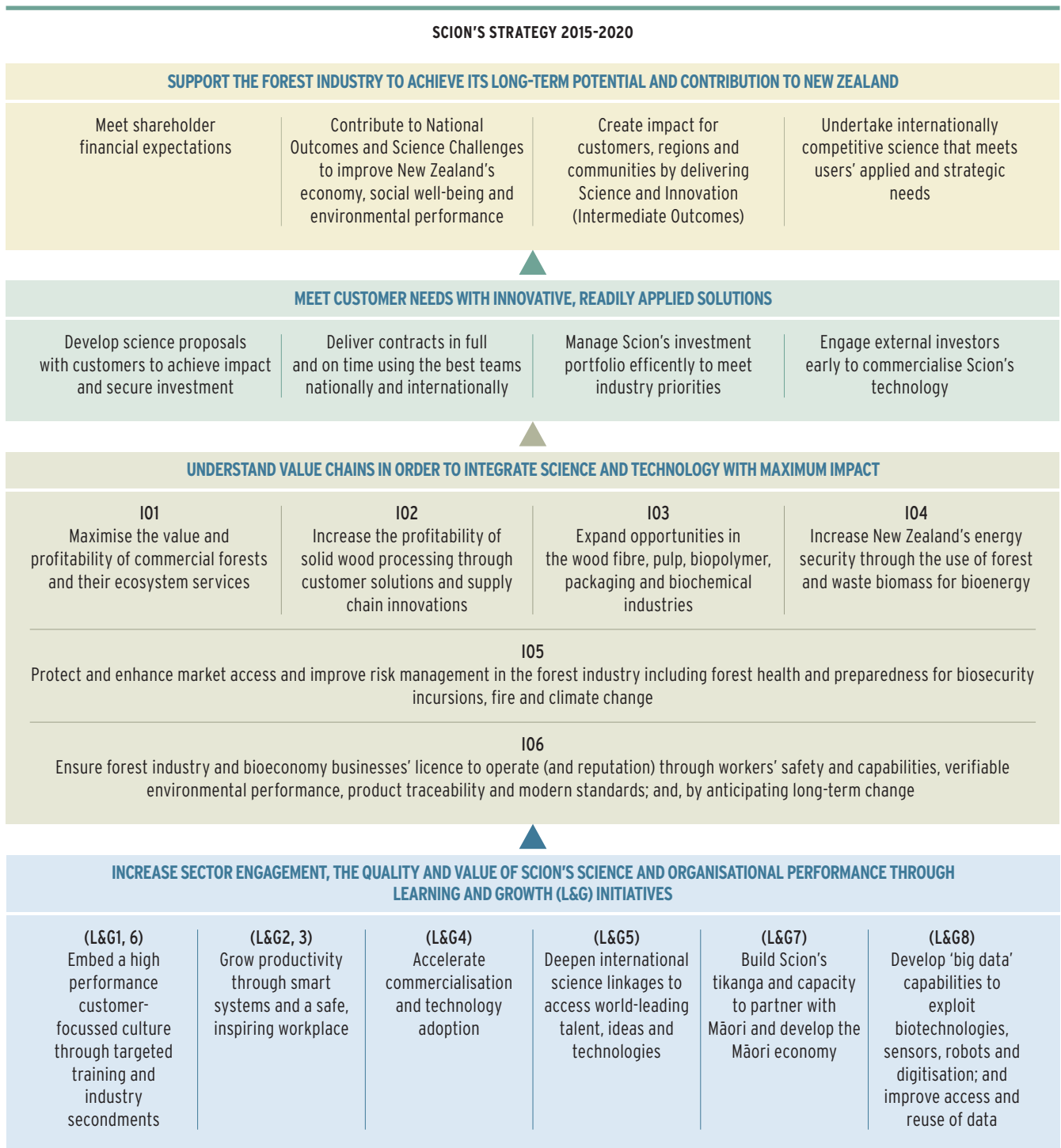


Figure 3: Scion's strategy mapped in a balanced scorecard format.

2. Meet customers' needs in the forest industry and bioproducts sector with innovative, readily applied solutions.
3. Understand value chains in order to integrate the new knowledge and technology arising from Scion's six Intermediate Outcomes (IOs) with maximum impact.
4. Increase Scion's engagement with forest industry sectors, the quality and value of Scion's science and organisational performance through Learning and Growth (L&G) initiatives.

Specific initiatives within each of these four inter-related themes are shown in the text boxes. For example, with respect to science quality, Scion's goal is to "Undertake internationally competitive science that meets users' applied and strategic needs", and with respect to increasing technology transfer through commercialisation Scion will "engage external investors early to commercialise Scion's technology". L&G initiatives are areas where Scion needs to develop its capabilities, infrastructure, systems, networks and relationships in order to fulfil its strategy. L&G4, for example, to "accelerate commercialisation and technology adoption" builds skills in commercialisation. Scion's operating plan, prepared annually, specifies objectives to be completed for each of these initiatives during the financial year concerned. Monitoring and reporting to the Board is via a scorecard set of performance indicators that mirror the strategy.

### Phasing the execution of Scion's strategy

Each year, particular areas of Scion's strategy are prioritised for additional management focus and investment through the Annual Operating Plan. Since the introduction of the CRI Taskforce (including core funding) reforms in 2011, Scion has progressed from building its internal capabilities - culture, systems and capacity (2011-2012) - to increasing the alignment and impact of its research through more effective transfer and commercialisation of technology, building national and international collaborations, and supporting regional development (2012-) as illustrated in Figure 4. Matching the pace of organisational change, and prioritising investment accordingly is a critical success factor in increasing Scion's contribution to the forest industry and New Zealand, and building its reputation as a world-class research provider.

Scion's priorities over the 2015-20 period are described below. In several cases these are supported by the reinvestment of Scion surpluses (see page 44 for an overview of the proposed reinvestment portfolio). Progress in achieving these priorities is monitored through the scorecard presented in Section 8 (Table 12).

**Priority 1. Value chain optimisation.** The New Zealand forest industry has a highly fragmented value chain, and information flows are generally poor between the main actors. This leads to inefficiency, averaging of prices and lack of improvement in quality. The main challenge for manufacturers of high price (>\$3,000/m<sup>3</sup>) and high margin radiata pine products is their wood supply not meeting specification. Increased capacity to supply to specification is essential<sup>41</sup> if New Zealand is to de-commoditise from

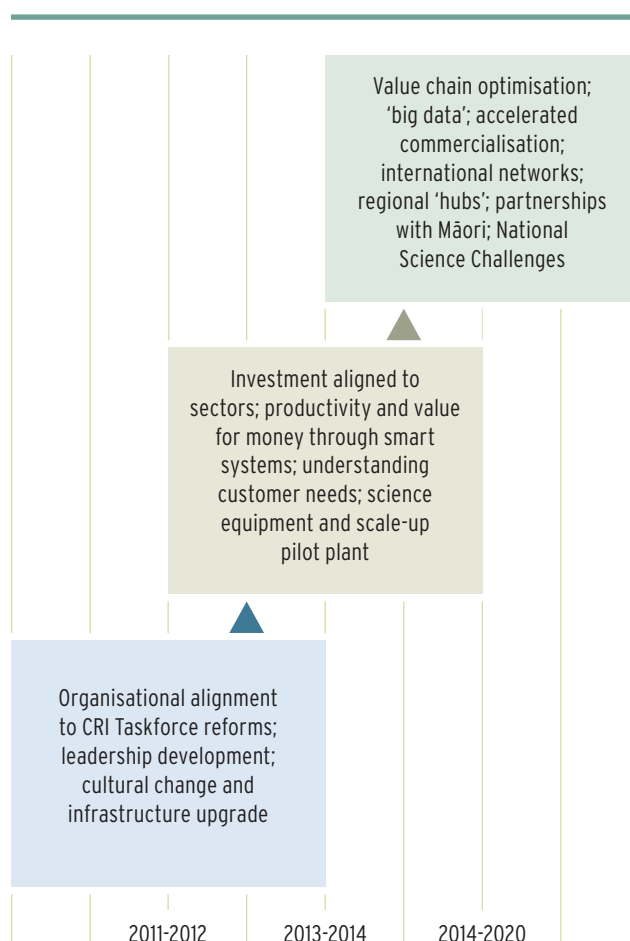


Figure 4: Evolution of Scion's strategy and implementation priorities.

logs and 'old style' wood products. Also a culture change within the industry is required, and that is a challenge when the ability to apply pricing signals within value chains is poor. Further, supply chains are increasingly global and non-linear; and logistics considerations, such as port hubs and forms of storage, are critical for export success. Understanding who captures value ('makes money') in order to target science and technology interventions where innovation may be most successful is a prerequisite to lifting the impact of Scion's research.

To support a value chain approach Scion proposes to:

1. Appoint staff with specialist, quantitative analysis and translation expertise in value chain research and market analysis.
2. Adopt tools and frameworks to help science project teams understand the value chain context in which their work is to be placed. This includes expanded techno-economic modelling such as that applied to the bioenergy, biosolids waste (TERAX™) and WoodScape studies; and adoption of new methods such as Discrete Event Simulation.
3. Work with an industry/policy steering groups to identify supply chain research priorities and collaborators; and secure investment to undertake this work.

<sup>41</sup> Jacobides, M. G., & MacDuffie, J. P. (2013, Jul-Aug). How to drive value your way. *Harvard Business Review*, 94-99.

4. Work closely with firms and customers in order to understand the 'real' world of prices, costs, barriers and enablers within the supply chains they function. This includes reassessing practices such as multiple re-measurement of logs (JAS scaling) and almost three times as many log grades as the Chileans.

**Priority 2. Accelerate commercialisation.** More effective commercialisation of Scion's technologies will increase its research impact and financial resilience. In addition to lead technologies TERAX™ (reducing municipal wastes) and Woodforce (Sonae; wood plastics<sup>42</sup>), Scion has a pipeline of more than 40 technologies across the value chains it is engaged with. These include modified wood products, renewable energy technology, composite materials, superior genotypes and decision support tools. Customers and investors are engaged with us in all of these technologies. We have adopted a charter with Callaghan Innovation to assist with the commercialisation of technologies and their application to sectors Scion does not normally work with.

To further improve commercialisation and rapid uptake of its technologies, Scion will:

1. Adopt best practice pipeline management of technologies to ensure resources are aligned to the commercialisation of products and services with the greatest potential impact.
2. Invest in 'larger' game changing technologies such the Woodforce wood plastic pellets and TERAX™ biosolids waste technologies (L&G4, Figure 3) as well as technologies that contribute to 'smaller-scale, incremental gains' in forest and mill productivity (e.g. decision support tools for smaller scale forests such as drone-enabled LiDAR, camera vision technology for forestry worker safety).
3. Seek new sources of investment for technology commercialisation along with Callaghan Innovation and Bay of Plenty investors such as Te Arawa Group Holdings, Quayside, Enterprise Angels and WNT.
4. Extend Scion's pilot plant infrastructure (such as a supercritical CO<sub>2</sub> plant for modified wood) in order to scale-up and de-risk technologies for investors.
5. Develop staff expertise in technology commercialisation through workshops tailored to Scion's needs and via secondments to firms and mentoring (L&G1 and L&G6).
6. Improve the post-commercialisation management of Scion's licensed technologies.
7. Attract tenants with new technology, capital and expertise to Scion's North Drive Innovation Park and contribute towards building the Rotorua District's profile as a 'forest industry centre of excellence' (see Priority 5 overleaf).

**Priority 3. Develop international networks.** Building strong international linkages with world-leading research providers in the forestry, wood processing and bio-based products sectors provides significant strategic and technical advantages to New Zealand firms and ensures Scion can leverage its organisational capabilities with the resources of others. Scion will remain conscious of the ongoing choices between invention and adaptation and the implied cost implications. In addition, Scion offers a rare combination of

multi-disciplined skillsets spanning the value chain that are attractive to many non-New Zealand stakeholders.

Scion intends to implement a Learning and Growth initiative (L&G5, Figure 3) to deepen its international network through staff exchanges/sabbaticals, formal agreements at both a technical and strategic level, coordination of funding applications to leverage co-investment and cross-licensing opportunities, and establishing mechanisms to support the adaptation and co-invention of technology into the New Zealand forest industry and biomaterials sector. This includes:

1. Building relationships with international partners to share new ideas and opportunities; and develop foresight on global science and market trends to assist long-term planning of Scion science investment.
2. Providing seed investment (via L&G 5) to develop the best opportunities; support staff exchanges and sabbaticals; and secure external funding. This includes sustaining at least three - and some new - projects each year.

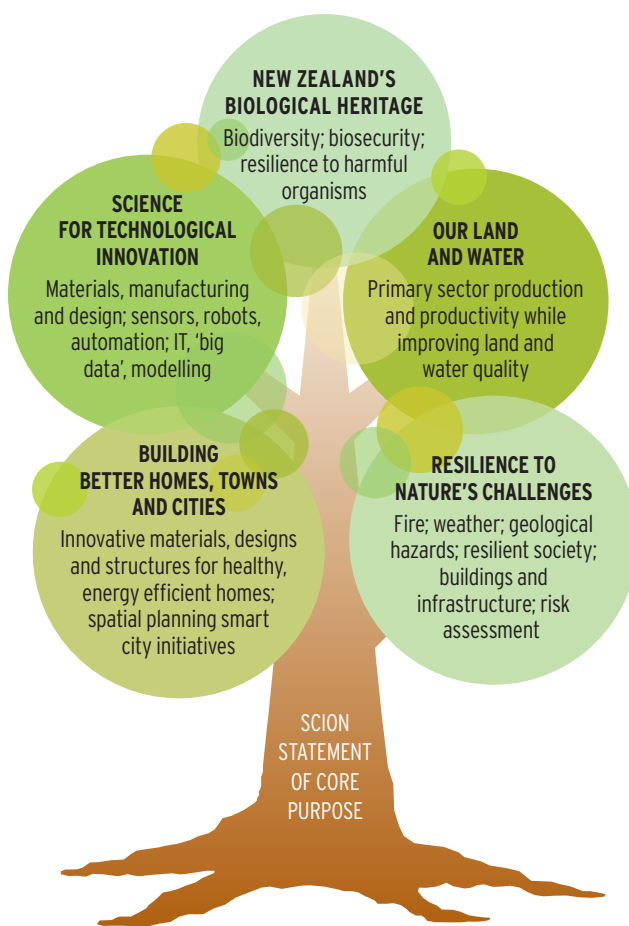


Figure 5: The five National Science Challenges most aligned to Scion's core purpose.

**Priority 4. National Science Challenges.** The National Science Challenges (NSC) represent a significant change in the operating model for New Zealand science. Scion is engaged in five of the NSCs as illustrated on the following page.

<sup>42</sup> See <http://www.woodforce.com/> for details about this product.

During the SCI planning period, Scion expects to:

1. Finalise its role within five NSCs; commence science contract delivery; and have clarity on the future of Scion-led MBIE contestable contracts mapped against NSCs, such as Rural Fire research (expiring in September 2016).
2. Ensure the forest industry and the bioproducts manufacturing sector, and Scion's customers are well-briefed on the NSCs and see pathways for realising the opportunities they present (e.g. apply fundamental *Phytophthora* research in the biological heritage NSC to mitigate threats to plantation forests and indigenous species with commercial potential such as kauri).
3. Utilise synergies between NSCs such as 3-D printing with new lightweight materials from the 'Science for technological innovation' NSC and building innovative, energy efficient, smart prefabricated homes.

**Priority 5. Regional hubs and development.** Scion is closely involved in forming a Rotorua 'forest industry cluster' to support district and regional economic development, and subsequent spill-over national benefits. The cluster concept draws together the Bay of Plenty tertiary education strategy, Rotorua District Council and GROW Rotorua economic development initiatives, forest industry firms, and iwi with substantial interests in forests in the central North Island. There is scope to integrate sciences for sustainable land use and improving freshwater quality within this hub. Scion has secured a \$2.5 million interest free loan from the Bay of Plenty Regional Council Infrastructure Fund to construct an 'Innovation Centre

Building' on its North Drive Innovation Park (Figure 6). Occupancy is expected in 2016.

During the planning period Scion expects to:

1. Fully tenant the new innovation centre building and generate synergies between the 27 companies already located on the Te Papa Tipu Campus.
2. Work closely with GROW Rotorua (and Rotorua District Council), Bay of Plenty Connections (and Bay of Plenty Regional Council) and Industrial Symbiosis Kawerau (ISK)<sup>43</sup> to support economic development initiatives identified in the Bay of Plenty Regional Growth Study. For example, 35% of all forest stocks are in the Bay of Plenty region. In 2010, forestry contributed to 10% of the Bay of Plenty's GDP and was a significant and positive attractant for employees<sup>44</sup>. By 2020, the region's annual harvest is forecast to be 2-3 million m<sup>3</sup> per annum greater than at present. This increase in log supply requires new processing capacity and, equally important, innovation to achieve export competitive wood and wood fibre products.
3. Work closely with the Bay of Plenty tertiary education alliance (Wairiki Institute of Technology, Bay of Plenty Polytechnic and the University of Waikato) to foster initiatives such as a university-led 'freshwater centre of excellence' centred on the successful restoration of water quality in the Rotorua Lakes and boost the number of postgraduate students studying at Scion.

**Priority 6. Partnerships with Māori.** As described in Section 2, Māori are increasing their ownership of forests and forest lands in New Zealand. An estimated 1.2 million hectares of this is underutilised and of this about 500,000



Figure 6: Concept drawing of the 'Innovation Centre Building' scheduled for construction on Scion's North Drive Innovation Park late 2015-early 2016.

<sup>43</sup> Kawerau District Council. (n.d.). *Industrial Symbiosis Kawerau*. Retrieved 24 April 2014 from [http://www.kaweraudc.govt.nz/Economic\\_Development/industrialsymbiosiskawerau.asp](http://www.kaweraudc.govt.nz/Economic_Development/industrialsymbiosiskawerau.asp)

<sup>44</sup> Ministry of Business, Innovation & Employment. (2013). *Regional economic development report*, (pp. 22-23). <http://www.mbie.govt.nz/pdf-library/what-we-do/business-growth-agenda/rear/REAR%20Publication.pdf>

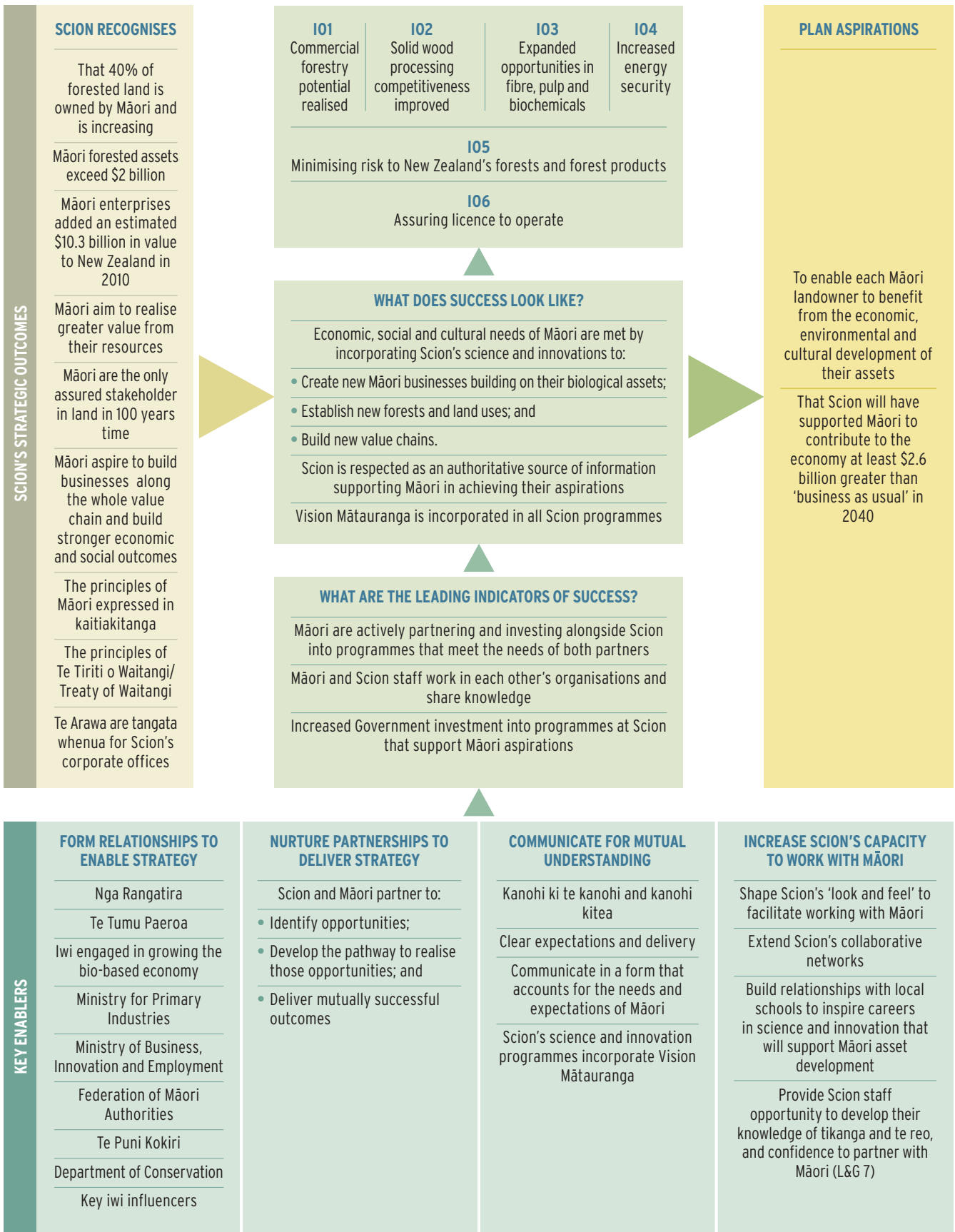


Figure 7: Scion's Te Papa Tipu Māori plan 2014-2020.



hectares is suitable for forestry<sup>45</sup>. The ability of Māori to realise economic value from such lands and forests is constrained by the parcels of land or forests they control typically being below economic critical mass, shortages of technical and governance expertise and insufficient working capital. Māori also want to undertake operations and develop products in a manner that respects Māori values, utilises Mātauranga Māori (traditional knowledge) and ensures environmental sustainability (Rai tiakitanga). Scion's Te Papu Tipu Māori Plan (Figure 7) addresses these primary issues. The plan and progress in implementing it is assessed annually by Scion's strategic Māori Panel (Ngā Rangatira Rōpu). The first two years of the plan focussed on building Scion's internal capabilities, relationships with iwi with forest assets, and implementing research projects.

Scion's priorities to grow the Māori economy through forestry are:

1. Build partnerships (including with 'cooperating clusters') to support greater economic returns for Māori from their participation in the forest industry, such as those highlighted by the Regional Growth Studies.
2. Develop communication channels within Māoridom to improve their uptake of Scion research outputs such as those generated by the "Growing Confidence in Forestry's Future" programme.
3. Customise technology translation to best meet Māori needs through a partnership approach.

These initiatives align fully with "*He Kai Kei Aku Ringa*"<sup>46</sup>, the strategy developed by the Crown Māori Economic Growth Partnership.

<sup>45</sup> Ministry for Primary Industries. (2013). *Growing the productive base of Māori freehold land*. Retrieved 18 March 2014 from <http://www.mpi.govt.nz/Default.aspx?TabId=126&id=1734>

<sup>46</sup> Māori Economic Development Panel. (2012). *Strategy to 2040, He kai kei aku ringa*, [http://www.tpk.govt.nz/\\_documents/medp/He-Kai-Kei-Aku-Ringa-Strategy.pdf](http://www.tpk.govt.nz/_documents/medp/He-Kai-Kei-Aku-Ringa-Strategy.pdf)

# 4

# SCION'S SCIENCE PLAN

## STATEMENT OF CORE PURPOSE OUTCOMES

Increase the value and productivity of the New Zealand forestry, wood products and wood derived materials and other biomaterial sectors, to create economic value and contribute to beneficial environmental and social outcomes for New Zealand

Protect and enhance market access and improve risk management in the forestry industry

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

Increase renewable energy production and energy security by growing New Zealand's ability to produce sustainable bioenergy and liquid biofuels.



## NATIONAL KPIS 10-15 YEARS

Grow forest and wood product exports to \$12 billion by 2022  
Over 70% of logs processed onshore by 2026

Māori investment in forestry will have at least doubled to \$4 billion by 2026

New Zealand has realised at least another \$870 million p.a. of revenue from fibre, pulp and biochemical products  
New Zealand packaging industry has grown by at least an additional \$140 million p.a.

Increased the contribution of bioenergy to New Zealand's consumer energy production and liquid fuels by 16% and 9%, respectively, by 2026

Support improvements in New Zealand Natural Capital through forest system ecosystem services (National index) greater than 100 (2011) by 2026



## SCIENCE INTERMEDIATE OUTCOMES (IOs) 5-15 YEARS

**I01**  
Maximise the value and profitability of commercial forests and their ecosystem services

**I02**  
Increase the profitability of solid wood processing through customer solutions and supply chain innovations

**I03**  
Expand opportunities in the wood fibre, pulp, biopolymer, packaging and biochemical industries

**I04**  
Increase New Zealand's energy security through the use of forest and waste biomass for bioenergy

**I05**  
Protect and enhance market access and improve risk management

**I06**  
Ensure licence to operate

**I05** Protect and enhance market access and improve risk management in the forest industry including forest health and preparedness for biosecurity incursions, fire and climate change

**I06** Ensure forest industry and bioeconomy businesses' licence to operate (and reputation) through workers' safety and capabilities, verifiable environmental performance, product traceability and modern standards; and by anticipating long-term change



## IMPACT KPIS 3-5 YEARS

1. Sustainably increase forest productivity  
2. Extract value from dispersed forest holdings  
3. Increase socio-economic and environmental outcomes from forests

4. New value chains for speciality wood products  
5. Expand opportunities for wood products and building systems

6. Develop new industrial bioproducts for existing and emerging manufacturing industries in New Zealand

7. Improve readiness for bioenergy and liquid biofuels in New Zealand

8. Ensure New Zealand forests are resilient to current and future natural threats

9. Sustain New Zealand forest industry and bioproducts manufacturers' licence to operate

Figure 8: Scion's Science Plan shows the inter-dependency between National and Intermediate Outcomes and performance measures (National and Impact KPIS, respectively).

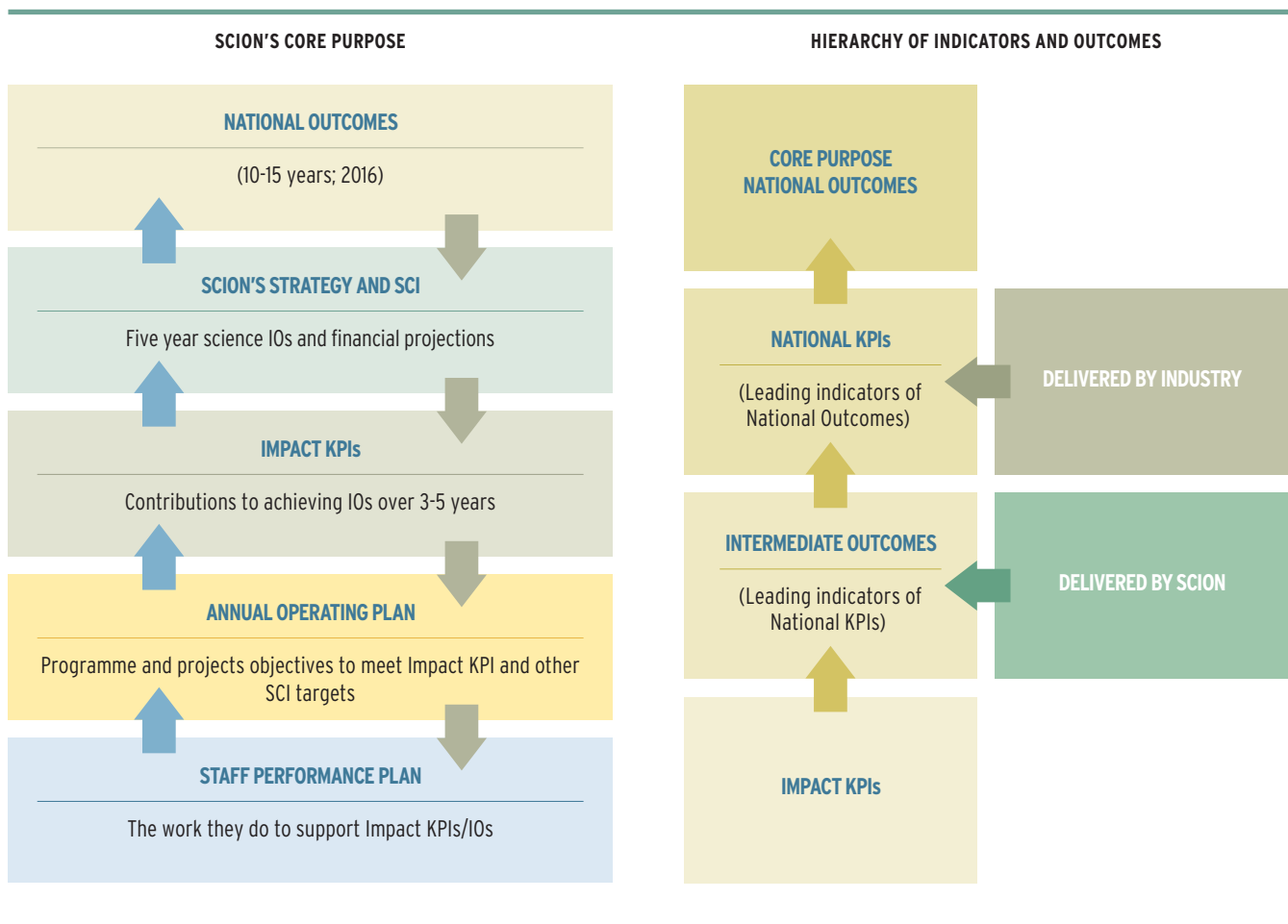
As described in the strategy map (Figure 3), Scion's science is focussed on delivering six interrelated Intermediate Outcomes (IOs)<sup>47</sup>:

- IO1:** Maximise the value and profitability of commercial forests and their ecosystem services.
- IO2:** Increase the profitability of solid wood processing through customer solutions and supply chain innovations.
- IO3:** Expand opportunities in the wood fibre, pulp, biopolymer, packaging and biochemical industries.
- IO4:** Increase New Zealand's energy security through the use of forest and waste biomass for bioenergy.
- IO5:** Protect and enhance market access and improve risk management in the forest industry including for forest health and preparedness for biosecurity incursions, fire and climate change.
- IO6:** Ensure the forest industry and bioeconomy businesses' licence to operate (and reputation) through workers' safety and capabilities, verifiable environmental performance, product traceability and modern standards; and, by anticipating long-term change.

Each IO is described more fully in the following section. The integrated delivery of these, as illustrated by Figure 8, will achieve Scion's Statement of Core Purpose national outcomes. Strategic Advisory Panels<sup>48</sup> to the Scion Board, established in 2011, provide independent and expert perspectives on science quality, user impact and Māori and assist with strategy formulation.

### Science plan alignment to Scion's Statement of Core Purpose outcomes

Scion's Science Plan (Figure 8) describes the inter-dependence between Core Purpose national outcomes and Intermediate Outcomes (IOs) that will be delivered by Scion. The IOs are targeted at a 5-15 year horizon. Scion and its research partners provide the enabling tools, technologies and knowledge that will enable users to achieve the impacts for industry and thus Scion's Core Purpose national outcomes. Each IO has 1-3 impact measures (Key Performance Indicators (KPIs)) that are to be achieved within a 3-5 year timeframe by which progress towards IO achievement is gauged. The hierarchy and performance framework for achieving national outcomes is illustrated in Figure 9 along with the principal stakeholder(s) responsible for delivering each output or outcome.



<sup>47</sup> These are the science outcomes that Scion can directly influence that support and lead to delivery of the industry targets.

<sup>48</sup> The terms of reference of these groups and their composition are available at <http://www.scionresearch.com>

Direct input of industry and policy agencies into the science programmes for each IO is a high priority for Scion. In recent years, a powerful mechanism for collating stakeholder needs and priorities has been facilitated through intervention logic mapping workshops. An

example for the forest growing sector, prepared in 2012 for the large, multi-year investment proposal to MBIE, is shown in Figure 10. Similar logic maps for other sectors have been prepared and are regularly reassessed with stakeholders.

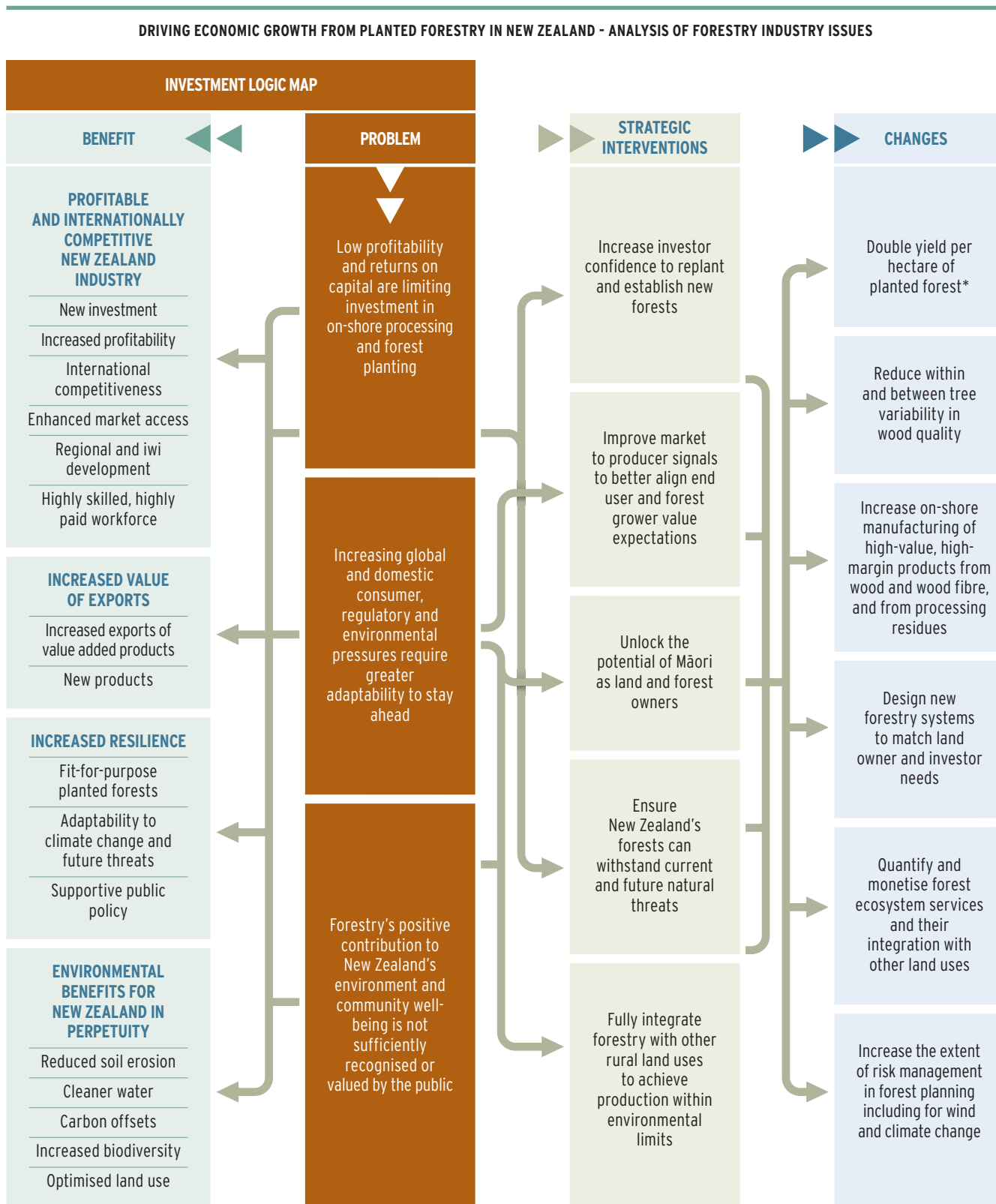


Figure 10: An investment logic map prepared with forest grower stakeholders during 2012 to design a proposal to MBIE for a six-year programme of research investment.

# 5

## SCION'S INVESTMENT PRIORITIES AND ALLOCATION OF CORE FUNDING

Scion receives \$17.73 million of CRI Core Funding (core funding) from the Government to invest in science programmes that will contribute towards the achievement of its Statement of Core Purpose national outcomes. The allocation of core funding is updated annually to reflect refreshed industry strategies, science progress and changes in the external operating environment.

Core funding is focussed on:

- Ensuring Scion's capability is aligned with the delivery of impact measures (KPIs) for each Intermediate Outcome (the IO Impact KPIs are summarised in the bottom row of Figure 8).
- Supporting activities where direct industry investment is unlikely until proof of concept is demonstrated and the risks are quantified.
- Growing industry co-investment through joint business cases.
- Improving the competitiveness of Scion's science capability and equipment.

Scion has a well defined process and criteria for allocating (and monitoring the performance of) core funding investments. Specifically:

- Allocations are made to science programmes, each of which contributes to the delivery of at least one Impact KPI and at least one IO.
- Investment is based on the contribution of the science, the balance of research and risk across the six IOs/Impacts and meeting special requirements such as the stewardship of nationally critical capability or databases and collections. From July 2014, core funding will be segmented into three categories: funds mapped into the National Science Challenges, funds allocated to the maintenance of databases, collections and underpinning infrastructure, and funds supporting Scion's Core Purpose research programmes.
- Up to 10% of Scion's total investment (within and between IOs) will be refreshed each year to provide for new opportunities, emerging science, collaborations and capability building.
- The investment process and monitoring of portfolio 'health' is managed by Scion's Research and Investments Office in conjunction with the Science General Managers, and, through the CEO, is accountable directly to the Scion Board.
- Programmes are broken down to objectives under each Impact KPI in the Annual Operating Plan and progress in meeting them is reported monthly through Scion's scorecard. In addition, performance is checked quarterly by the Research and Investments Office and formally reviewed by the Scion Board (annually) and Strategic

Advisory Science, User and Māori Panels. As well, internal science reviews are completed to varying degrees for all programmes to ensure they remain correctly targeted. From 2015, the Board's Strategic Advisory Panels will be constituted on an annual basis to provide in depth review of Scion's science and its commercialisation with experts in these fields.

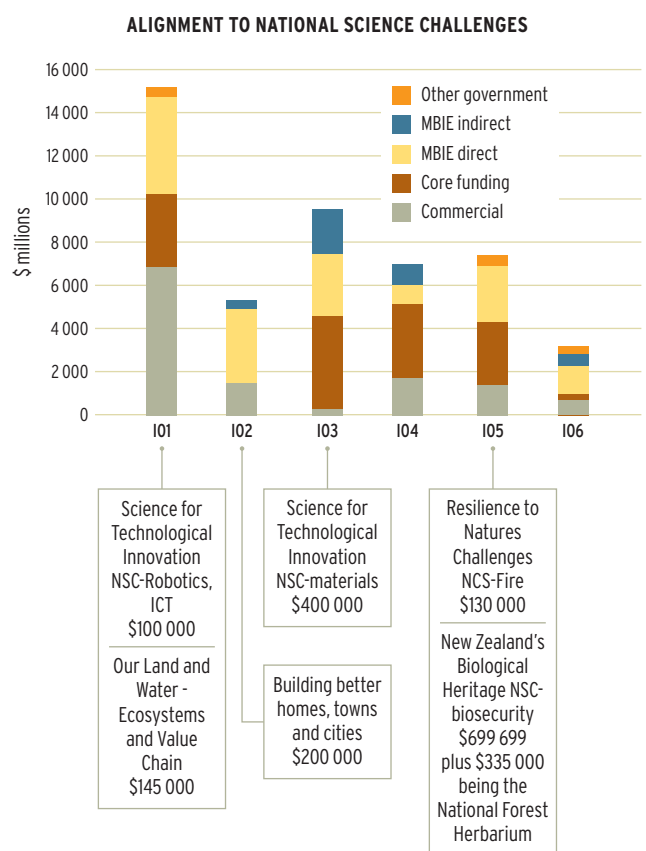


Figure 11: Investment (\$) directed to achieve each Intermediate Outcome (IO) and the investment Scion is making into the National Science Challenges.

### Investing in delivering Scion's strategic outcomes (Intermediate Outcomes)

In addition to core funding, Scion receives investment from the Ministry of Business, Innovation and Employment science investment funds directly (contracts that Scion holds with MBIE) and indirectly where Scion is a sub-contractor to an MBIE contract. Investment is also received from other government departments such as the Ministry for Primary Industries and from commercial firms.

All these investments are aligned to achieving Scion's strategic outcomes (IOs). The mapping of investment to these IOs is shown in Figure 11. Overlaps between investments and outcomes should be noted. For example, an investment into tree genetic improvement (linked to IO1) may also improve tree health and thus resistance to a biosecurity incursion (linked to IO5). Core funding is aligned to the IO where the investment has the largest impact. Figure 11 also indicates the value of core funding linked to a National Science Challenge.

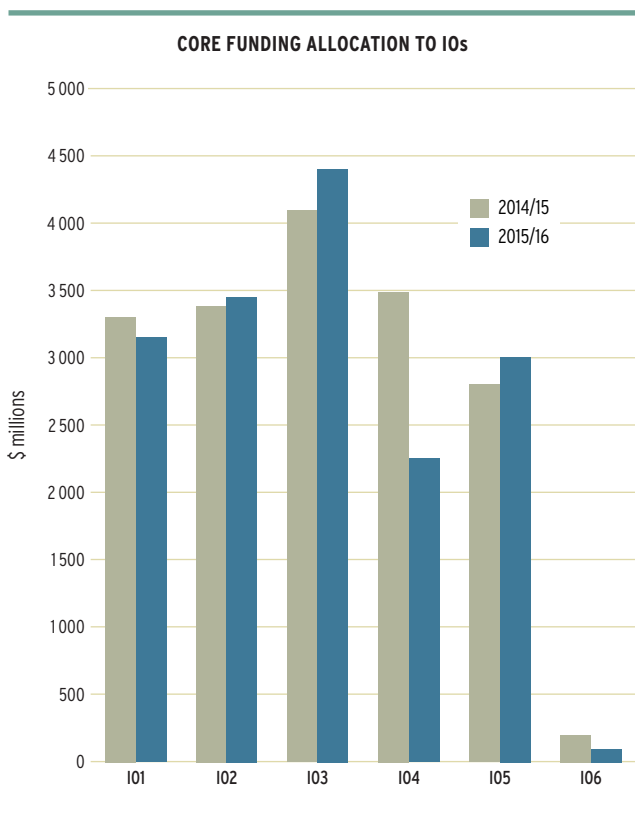


Figure 12: Core funding allocation to IOs showing between year changes.

Changes to the allocation of core funding occur both between and within IOs (Figure 12). The latter typically are more substantial (up to 20%) as science programmes are adapted for new findings from the research conducted at Scion (and the wider research community) and in response to changes in the market place and the priorities of firms. Programme leaders are encouraged to make changes as

the year progresses rather than rely on the annual review. Core funding is also targeted to strategic development of capability at Scion, notably at present in Value Chain Optimisation, Forest Industry Informatics and Resource Economics (forest ecosystem services and natural capital assessment). Some core funding is aligned to the National Forest Herbarium and Database (\$350,000), and, in 2015/16, the nationally significant Permanent Sample Plot (PSP) Database will receive \$50,000 to help mitigate the loss of MBIE contestable funding from 1 October 2013 of almost \$1 million for alternative forest species research.

The following section describes the Intermediate Outcomes, the approach underpinning delivery of each of these outcomes and the leading indicators (Impact KPIs) in delivering these outcomes.

### Intermediate Outcomes and Impact Key Performance Indicators

Scion's IOs, and the underpinning approach to deliver these, are derived from six key strategies developed by Scion's major stakeholder groups (described in Section 1). Specifically:

1. The New Zealand Forest and Wood Products Industry Strategic Action Plan. The Wood Council of New Zealand: [www.woodco.org.nz](http://www.woodco.org.nz)
2. New Zealand Forestry Science and Innovation Plan, New Zealand Forest Owners Association January 2012: [www.nzfoa.org.nz](http://www.nzfoa.org.nz); and the 2015 update to this.
3. The New Zealand Farm Foresters Association: [www.nzffa.org.nz](http://www.nzffa.org.nz)
4. *He Kai Kei Aku Ringa* The Crown Māori Economic Growth Strategy specifically focussing on realising greater value from Māori owned economic resources: [www.tpk.govt.nz](http://www.tpk.govt.nz)
5. Wood Processing Science and Innovation Plan; New Zealand Wood Processors and Manufacturers Association 2012: [www.nzwpa.org.nz](http://www.nzwpa.org.nz)
6. New Zealand Government's Business Growth Agenda: [www.mbie.govt.nz](http://www.mbie.govt.nz)

### Measuring progress against Scion's strategic outcomes

Progress in meeting the IO goals will be assessed through the achievement of nine leading performance indicators (Impact KPIs). The IOs are interdependent to varying degrees, as are the leading indicators. Thus, Impact KPIs contribute to one or more IOs as illustrated in Figure 13.

MEASURING PROGRESS AGAINST SCION'S STRATEGIC OUTCOMES

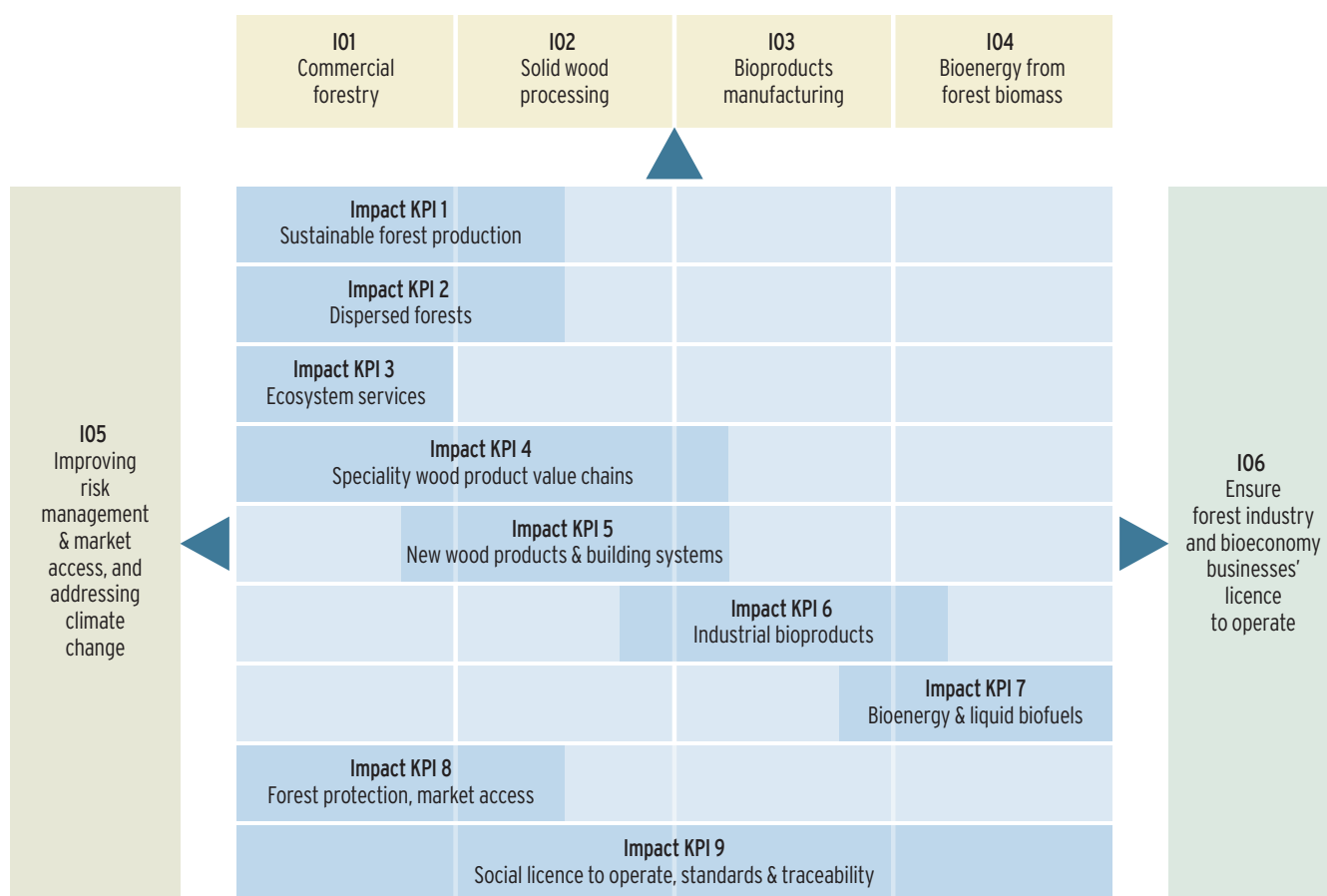


Figure 13: Map of Impact KPIs against Intermediate Outcomes showing their relative contribution to outcomes and interdependencies. A strong indicator is shown in 'dark blue'; a secondary indicator is shown in 'light blue'.

**IO1: Maximise the value and profitability of commercial forests and their ecosystem services**

By 2026 Scion will have provided technologies, tools and materials to support the industry to increase competitiveness of the commercial forest estate through at least a 50% increase in forest biomass productivity (Mean Annual Increment (MAI)) and at least \$70 million per annum reduction in operational costs over 2010 values, leading to growth in planted area from its present 1.7 million hectares.

We will support forest growers, farm foresters, Māori, wood manufacturers and government in their ambitions to enhance the value created and derived from forestry, and to expand and diversify New Zealand's forests. Specific aims are to:

- Increase the volume, value and diversity of exports derived from our forests.
- Encourage investment in forestry and wood processing by providing security of supply of high quality wood.
- Enable the profitable and environmentally sustainable recovery of logs from steep country and small woodlots where at least 40% of the wood supply will be sourced in the near future.
- Expand forests onto otherwise under-utilised land and,

in particular, support monetisation of the contribution that forests make to environmental and community well-being (ecosystem services).

- Enable higher and sustainable growth rate (MAI) to improve profitability of forestry along the value chain - from land use to market (Table 3 illustrates the impact of increasing MAI).
- Reduce the proportionately large cost of harvesting in the forest-to-mill forest-to-port supply chain.

**Alignment to the National Science Challenges**

- *Our land and water* - ascribing value to forestry to enhance the resilience of land and fresh water resources; understanding land-owners' decision-making and willingness to change land use to forestry and/or continue with forestry; and, describing and quantifying social licence to operate issues and community preferences for forestry as a land use (links to Impact KPI 9).
- *Science for technological innovation* - increasing use of 'big data', remote sensing, process automation and other precision technologies for productivity gains in forestry.
- *New Zealand's biological heritage* - improving forest biosecurity to avoid production loss; valuing ecosystem services to improve environmental performance (including protection and enhancement of biodiversity).

300 Index	Site Index (m)	Rotation age (years)	Total recoverable volume (m <sup>3</sup> /ha)	MAI (m <sup>3</sup> /ha/yr)	Carbon sequestered (t/ha)	Stumpage (\$/ha)	NPV (\$/ha)
28	27.9	25	577	27.2	786	36 555	3 094
28	27.9	30	758	29.8	1 003	50 579	2 755
28	27.9	35	923	31.1	1 204	63 452	2 001
32	30.4	25	675	31.8	911	41 482	3 740
32	30.4	30	863	33.9	1 131	54 981	3 119
32	30.4	35	1 033	34.7	1 333	66 998	2 167

Table 3: Impact of forest biomass accumulation rate (MAI) and age at harvest on returns by hectare (Stumpage and NPV at a discount rate of 8%) and carbon storage for a pruned radiata pine forest regime<sup>49</sup>.

### Impact KPI-1: Sustainably increase the productivity of New Zealand forests

By 2019 tools, novel forest management approaches and new plant material will be embedded into New Zealand's forests and forestry practices to support the industry's target to increase radiata pine MAI from an average of 20 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> to 35<sup>50</sup> m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> and in a way that enhances the sustainability of forest growing in New Zealand.

Leading indicators are:

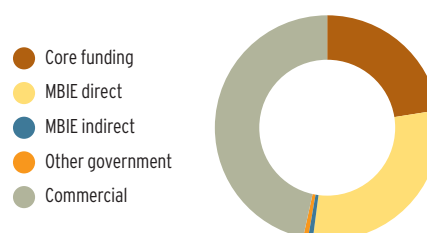
- By 2016 Scion will have quantified the gap between current productivity and potential productivity that could be achieved if key limiting factors could be overcome. These new insights will inform industry strategies to sustainably improve productivity, including breeding for growth and quality.
- By 2016 at least two new biotech trees are evaluated for traits (e.g. productivity and herbicide resistance) and reported to stakeholders.
- By 2017 remote sensing technologies are being used by forest growers to obtain quantitative information on the performance of their forests, and this is being used widely to inform management practices.
- By 2017 Scion will have operationalised at least two new information system technologies that will contribute to increasing forest productivity.
- A phenotyping platform has been used to identify outstanding individual trees for at least one key trait with superior germplasm and is being deployed by 2019.
- By 2019 at least two major forest growers have changed their management practices and are applying new treatments designed to increase productivity of mid-rotation stands.
- By 2019 next generation genetics will have delivered new trees with an additional 15% genetic gain compared with the average improvement of 2012 deployed genetic seedlots.
- On-going: the Forestry Library, Permanent Sample Plots (National Forest Tree Database) and Tree Genetic Archives

remain viable and provide valuable information about the national forestry position for New Zealand.

**Our key partners in delivery are:** the New Zealand forest growers operating through the Forest Growers Levy Trust Board Inc., the New Zealand Forest Owners Association, New Zealand Farm Forestry Association and Māori operating through their forestry trusts and other entities; supported by research and technical partnerships with the Radiata Pine Breeding Company Ltd, ArborGen, Forest Genetics Ltd and Landcare Research. Ministry for Primary Industries is the primary government agency involved in this research; this work is also of high value to Ministry for the Environment and the Department of Conservation.

**Technology transfer:** Scion will continue to work in partnership with industry, government agencies and iwi. This includes jointly developing plans, project methodology, exemplars and together implementing the outcomes. An important technology transfer tool is the Forecaster™ DSS, used by most of the forest growers, in which we will embed the new technical outcomes.

#### Investment



Core funding \$2.6, MBIE direct \$3.4, MBIE indirect \$0.1, Other government \$0.1, Commercial \$5.4. Total \$11.6 (millions)

**Alignment to National Science Challenges:** \$100,000 Core funding aligned to Science for Technological Innovation.

**Databases and Collections:** National Forest Library, National Forest Tree Database (PSP) and Tree Genetic Archives are supported to the value of \$1.65 million of which \$50,000 is from Core funding.

<sup>49</sup> John Moore personal communication, May 2014: *Forecaster scenario analysis*.

<sup>50</sup> In Scion's 2014-19 SCI, the MAI improvement goal was 40 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup>. Subsequent MAI results from Permanent Sample Plots and other data sources indicate that 35 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> would be a more realistic national average target.



## Impact KPI-2: Extract value from forests and dispersed forest holdings

By 2019 tools developed by Scion and its partners will be used by New Zealand forest growers and harvesting companies to reduce harvesting costs, improve safety of tree extraction and improve supply chain logistics.

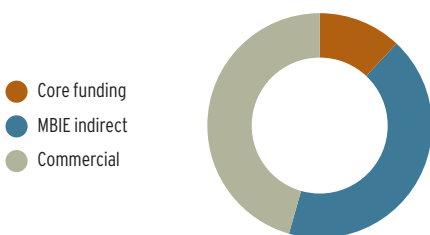
Leading indicators are:

- By 2016 prototypes of new harvesting tools and value chain approaches have been demonstrated that have the potential to save the forestry industry at least \$50 million per annum over 2010 costs.
- By 2017 Scion will have implemented a set of information tools that increase value recovery for the wood processing sector.
- By 2018 Scion will have developed tools and models for the forest products value chain that will be in use to determine where to intervene in order to maximise benefits from the existing forest resource. This work will have created better connectivity between growers and processors, and between small-scale forest growers.

**Our key partners in delivery are:** The New Zealand forest growers operating through the Forest Growers Levy Trust Board Inc., the New Zealand Forest Owners Association, New Zealand Farm Forestry Association and Māori operating through their forestry trusts and other entities; research and technical partnerships with the FOA Research Committee and Universities of Canterbury and Auckland. While the Ministry for Primary Industries is the primary government agency involved in this research, this work is also of high value to the Ministry for the Environment and the Department of Conservation.

**Technology transfer:** Scion will continue to work in partnership with industry, government agencies and iwi. This includes jointly developing plans, project methodology and prototypes; and jointly implementing the outcomes. We will continue to work with our commercialisation partners to refine harvesting tools (such as CHIPS) and similar to facilitate uptake of research outcomes.

### Investment



Core funding \$0.2, MBIE direct \$0, MBIE indirect \$0.8, MBIE direct \$0, Other government \$0, Commercial \$0.8. Total \$1.8 (millions)

## Impact KPI-3: Quantify the role of forests in increasing economic, environmental and social outcomes for New Zealand

By 2019 Scion and its partners will have compellingly demonstrated to key stakeholders (e.g. forest owners, Māori, regional councils, policy makers) the role of forests

in the landscape through economic, environmental and social contributions to regional economies and provision of ecosystem services (e.g. timber, climate change mitigation, recreation).

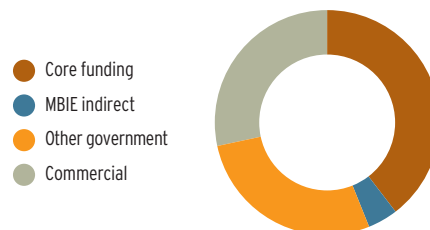
Leading indicators are:

- By 2016 a conceptual framework has been developed for the economic assessment of alternative forestry options, focused on indigenous forestry and Māori land holdings.
- By 2017 at least two regional councils will be using Scion's evidence-based information that quantifies forests' economic and natural capital contributions to New Zealand's growth, regional development and environmental performance targets.
- By 2017 Scion's information and capability will have contributed to New Zealand's post-2015 climate mitigation policy development and dialogue across primary industry sectors regarding complementarity.
- By 2019 at least two regional councils have integrated Scion's forest economics and ecosystem services approaches into landscape level planning for multiple land uses.
- By 2019 Scion's information will have contributed to New Zealand's national and international reporting obligations and the New Zealand Freshwater National Objectives Framework.

**Our key partners in delivery are:** the New Zealand forest growers operating through the Forest Growers Levy Trust Board Inc., the New Zealand Forest Owners Association, New Zealand Farm Forestry Association and Māori operating through their forestry and land holding entities, Tane's Tree Trust, the Northern Totara Working Group and local and regional authorities; and Department of Conservation (as a land owner). Supporting delivery of the above will be our research and technical partnership with Landcare Research. The main government agencies involved with the above are the Ministry for Primary Industries, Ministry for the Environment and Department of Conservation.

**Technology transfer:** Scion will work in partnership with the key stakeholders including iwi, regional councils and New Zealand Farm Forestry Association to develop business cases and exemplars. Key tools that will be used and continue to be developed with these stakeholders include MyLand, Forest Investment Finder and other tree and land use calculators.

### Investment



Core funding \$0.3, MBIE direct \$0, MBIE indirect \$0.03, Other government \$0.2, Commercial \$0.2. Total \$0.73 (millions)

**Alignment to National Science Challenges:** \$145,000 of Core funding aligned to Our Land and Water.

## IO2: Increase the profitability of solid wood processing through customer solutions and supply chain innovations

By 2026, Scion has supported the industry in achieving 6% year-on-year growth in the export of wood products to an estimated target value of at least \$6 billion per year.

We will support the industry and key stakeholders:

- Achieve operational efficiencies to enhance international competitiveness through the application of wood segregation technologies.
- Develop new and enhanced engineered wood products to support export growth into high-value niche markets.
- Increase exports of wood products, based on Douglas-fir, eucalypts, cypresses and indigenous timbers, into high-value niche applications.
- Increase the application of wood and wood-based products in building solutions to deliver greater economic, social and environmental outcomes.

### Alignment to the National Science Challenges

- Building better homes, towns and cities - building systems, including sustainable wood and fibre-based systems and integrated energy and waste management.

## Impact KPI-4: Facilitate new seed-to-market value chains for specialty wood products

By 2019 Scion and its partners will have provided tools, new product options and plant material that will have supported the aspirations of growers and manufacturers to invest in new manufacturing facilities and expand plantings of Douglas-fir, eucalypts, cypresses and indigenous species. This investment will reflect increased confidence in being able to secure the highest possible value for their products along the entire seed-to-market value chain.

Leading indicators of this are:

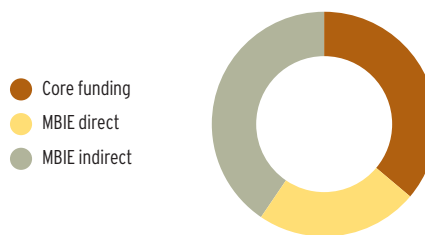
- By 2016 Scion and iwi and other partners will have identified the current and future economic opportunity for using some indigenous species, and have external investment supporting realisation of the commercial opportunity associated with those species. Particular focus will be given to support the economic and social development of Northland, East Coast/Hawkes Bay and central North Island.
- By 2017 Scion's technical outcomes will be used in the development of at least one market ready product from Douglas-fir or a eucalypt. This product will have international market potential.
- By 2017 Scion will have demonstrated to pre-commercial stage the potential to first, extract chemicals and second, formulate valuable compounds using a whole of tree approach for three species.
- By 2019 Scion will have provided tools, new plant material (e.g. germplasm) and competitive niche wood products that will increase the confidence of growers of Douglas-fir, eucalypts, cypresses, redwoods and indigenous species to increase plantings of these species by at least 5% over 2014 plantings.
- By 2019 solutions for novel pre drying/drying for three difficult-to-dry species have been identified then trialled

at full-dimension material scale to produce dry, check/collapse-free full-size timber. Processing costs have been estimated. The information is being used by a partner company to establish the commercial feasibility of this new approach to drying.

**Our key partners in delivery are:** the New Zealand Forest Owners Association, New Zealand Farm Forestry Association and Māori operating through their forestry and land holding entities, Tane's Tree Trust, the Northern Totara Working Group, local and regional authorities and their economic development agencies, Ministry for Primary Industries, Department of Conservation, Landcare Research, JNL, Southwood and the University of Canterbury.

**Technology transfer:** Scion will work in partnership with the key stakeholders including iwi, regional councils and forestry and wood manufacturing companies to build business cases and exemplars to assist all parties make research informed decisions as to how to best implement the findings from the programme within their businesses and operating context. Other key tools that will be used include Forest Investment Finder and tree growth calculators such as that for kauri.

### Investment



Core funding \$0.35, MBIE direct \$0.02, MBIE indirect \$0, Other government \$0, Commercial \$0.4. Total \$0.7 (millions)

## Impact KPI-5: Expand opportunities for wood products and building systems

By 2019 Scion will have supported wood processing and manufacturing companies by delivering new value enhancing tools and technologies that assist them to meet their growth targets and encourage increased investment in wood-based manufacturing and more productive timber-based construction techniques in New Zealand.

Leading indicators are:

- By 2015 Scion will have demonstrated the potential to maximise recoverable yield, minimise waste, and manage variability between and within radiata pine logs.
- By 2016 Scion will have demonstrated to a pre-commercial stage at least one new wood preservation/protection system that supports New Zealand wood products in the most environmentally discerning markets.
- By 2017 Scion will have demonstrated and secured external investment to enable at least one new modified wood product to compete in high margin market segments.
- By 2018 Scion will have produced thermally modified wood samples from at least three species, large enough for market place testing. Durability, stability and structural performance have been assessed and a commercial

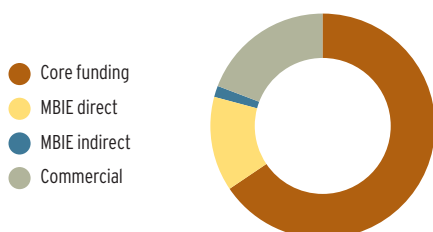
feasibility explored. The information is being used by an investor company to establish the commercial feasibility of the modified wood process.

- By 2019 Woodscape has been upgraded to reflect both new products and new knowledge developed for current technologies. Assessments have been made to the business case stage, and for the development of a new or substantially enhanced wood manufacturing operation.
- By 2019 Scion will have progressed a novel wood modification that incorporates some of the key attributes identified in the business cases to a pre-commercial stage.
- By 2019 Scion, with National Science Challenge 11 science and industry partners, will have developed a platform to provide better performing, higher amenity built environments in terms of affordability, performance and sustainability. This platform addresses the wider impacts of intensive living on the urban environment.

**Our key partners in delivery are:** The New Zealand Wood Processing and Manufacturing Association and their members and affiliated groups, Solid Wood Innovation, Standards New Zealand, Ministry for Primary Industries, Windsor Engineering Ltd, Abodo, FP Innovation, Furniture Association of New Zealand, Universities of Wurzburg, Hamburg and Gottingen and EU COST Actions. Callaghan Innovation, WEL Limited, Ministry of Business, Innovation and Employment (Building and Housing), Auckland University of Technology and NSC11 (Building better homes, towns and cities) partners.

**Technology transfer:** Scion will work in partnership with the key stakeholders in co-developing project plans and implementation strategies. In product development, Scion will develop exemplars including piloting of processes and products with industry partners.

### Investment



Core funding \$3.1, MBIE direct \$0.65, MBIE indirect \$0.07, Other government \$0, Commercial \$0.9. Total \$4.7 (millions)

**Alignment to National Science Challenges:** \$200,000 of Core funding aligned to Building Better Homes, Towns and Cities.

### IO3: Expand opportunities in the wood fibre, pulp, biopolymer, packaging and biochemical industries and from their biomass side streams

*By 2026 Scion has supported existing and new industries to establish new bio-based manufacturing capacity for export and domestic markets worth at least \$1 billion per annum more than 2011 values.*

We will support the New Zealand wood and biomass processing and manufacturing industries and those with aspirations to build new enterprises that:

- Enable the New Zealand packaging industry to continue to grow through providing world leading packaging systems in the face of increasing regulatory, performance and consumer pressures on both the packaging and the produce they contain. (This also supports the important food exporting industries in New Zealand.)
- Increase the value of co-products in wood, fibre and other biomass manufacturing operations (such as residues) to expand their product offerings, build new manufacturing enterprises and improve competitiveness of established industries.
- Give effect to the WPMA 2050 vision.
- Create new product options based on biomaterials to underpin the development of emerging or new materials-based manufacturing industries in New Zealand (New Zealand based biorefineries).
- Enable New Zealand to capture value from the emerging global market for biobased, renewable and high performance products by establishing global partnerships along new and existing value chains (bioeconomy).
- Work with government, industry and universities to develop a viable roadmap for a New Zealand biobased (and ultimately circular) economy.
- Support development of new manufacturing feedstocks, processes and products and implement their commercialisation in alignment with National Science Challenge Science for technological innovation.

### Alignment to the National Science Challenges:

- *Science for technological innovation* - design, materials and manufacturing theme: lignin, bioplastics and fibre products.

### Impact KPI-6: Develop new industrial bioproducts for existing and emerging manufacturing industries in New Zealand

*By 2019 new capital investment will be occurring in new and existing manufacturing industries in New Zealand as Scion's developments in new high-value and performance focused products derived from forest materials and biomass side streams are being adopted.*

Leading indicators are:

- By 2016 Scion will establish two lines of biotech trees in a field containment trial (from terpene-modified trees for biorefinery feedstocks and lignin-modified trees for pulp processibility).
- By 2016 Scion will have developed at least one new high-value product derived from forest or other biomass side streams (wood, fibre, pulp, biopolymer and chemical) to the prototype stage and this has been reviewed by a commercial partner for potential investment.
- By 2017 Scion will have aligned a cluster of organisations (including industry, government and research organisations) to pursue an integrated biorefinery concept (combining bioenergy and bioproducts) and together have developed a joint roadmap.
- By 2017 Scion will have identified two potential biochemical opportunities from hydrothermal liquefaction (HTL) processing of biomass.
- By 2018 at least six new polymeric material products with

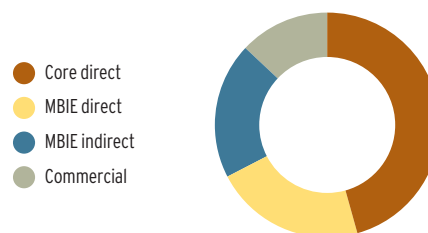
renewable content have been developed to prototype stage using existing (e.g. extrusion, injection moulding) and emerging technologies (e.g. 3D-printing or electrospray).

- By 2019 at least two of these polymeric material prototypes are incorporated in new product offerings by firms.
- By 2019 Scion will have assisted a commercial packaging company to develop boxes with improved performance in coolstores.
- By 2019 new high performance products (packaging, composites and new compounded materials containing biopolymers) developed by Scion in collaboration with commercial partners are supporting the development of new industries in New Zealand and providing direct revenue to New Zealand.
- By 2019 two lines of biotech trees will be harvested and processed to determine their viability as alternative biorefinery feedstock (production of high value chemicals and/or processability for fibre or bioenergy). The investment case will have been presented to potential commercialising parties (Note: This objective also contributes to Impact KPI 8 - bioenergy).
- By 2019 Scion will have developed processes to produce unique natural fibres that when used in Scion-developed packaging and wood composite applications show improved product performance over 2014 materials.
- By 2020 Scion and commercial partner(s) have developed a viable and New Zealand-specific biorefinery business case based on Scion-developed high value bioproducts and cost efficient technology platforms for commodity fibres and bioenergy.

**Our key partners in delivery are:** the Wood Processors and Manufacturers Association of New Zealand and their members and their affiliated groups, Biopolymer Network Ltd, Packaging Council of New Zealand, Alto, ExtrusionCo, Sonae Industria Ltd, Clariant New Zealand Ltd, ZESPRI Ltd, Altex, VITO, VTT, Fraunhofer, Momentive/Hexion, Lawter, PlasticsNZ, Lignotech, Oji, CHH Packaging, NZ Food Safety Centre, Innventia, Revolution Fibre Ltd, ArcActive, Fulton Hogan, Finewood, Lignotech, EU COST Actions, OpenBio, Callaghan Innovation, Plant and Food Research, AgResearch and the Universities of Waikato, AUT, Canterbury, Auckland, Victoria and Massey.

**Technology transfer:** Scion has established close collaboration with several companies working within the market to ensure market pull for all new products. This includes extensive international collaborations (both with industry and other research partners) to enable the global commercialisation of products and technologies developed. In product development, Scion will provide exemplars including piloting of processes and products in conjunction with industry.

## Investment



Core funding \$5.7, MBIE direct \$2.7, MBIE indirect \$2.4, Other government \$0, Commercial \$1.6. Total \$12.4 (millions)

**Alignment to National Science Challenges:** \$400,000 of Core funding aligned to Science for Technological Innovation.

## IO4: Increase New Zealand's energy security through the use of forest and waste biomass for bioenergy

*By 2026 bioenergy's contribution to New Zealand's primary energy supply has increased to 9% (an increase of 24PJ over 2010 values), including 350 million litres of liquid biofuels.*

In addition to the strategies described above, this outcome also aligns to the New Zealand Government Energy Strategy ([www.med.govt.nz/energy-strategy](http://www.med.govt.nz/energy-strategy)) and the Bioenergy Association of New Zealand aspiration to supply more than 25% of New Zealand's energy needs and 30% of the country's transport fuels from processing wood-crops and converting organic by-products to energy by 2040 ([www.banz.org.nz](http://www.banz.org.nz)).

We will support:

- New Zealand industry, in particular wood fibre manufacturing operations, as they seek to increase use of bioenergy to 30% by 2022 equating to 270MW of new thermal bioenergy and 30MW of new electricity.
- New Zealand wood processors to develop liquid biofuels to enhance their product offerings and increase the value extracted from processing residues.
- Forest and land owners to explore options for using forests as an energy product or co-product.
- Energy companies as they work to increase the renewable content of their energy products.
- The development of industries working in a symbiotic way to develop mixes of products (including energy) and optimise use of other energy resources (e.g. geothermal energy and waste (now commonly termed biomass side streams)) to create lowest embodied energy use per unit product and greatest individual and collective value. This will directly support regional growth.

## Impact KPI-7: Accelerate the use of bioenergy and liquid biofuels in New Zealand

By 2019 Scion will have identified the key barriers towards more widespread use of biomass for heat and the production of transport fuels and proposed solutions.

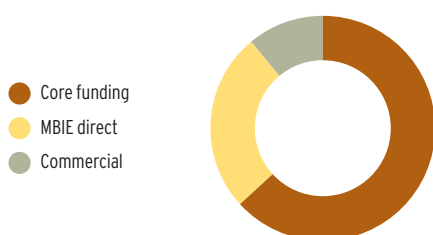
Leading indicators are:

- By 2016 Scion will have developed an interim biofuels roadmap for consultation and stakeholder engagement.
- By 2017 Scion will have assisted one company to re-evaluate its strategy towards bioenergy/biofuels implementation, and will have provided technical support towards the development of a commercial project.
- By 2017 Scion will have supported one biomass side stream-to-bioenergy commercial opportunity in New Zealand.
- By 2018 Scion will have supported a group of firms in one region to develop a value proposition, based on industrial symbiosis using wood energy, outlining the benefits/risks across economic, social and environmental criteria, enabling them to make an informed decision for action.
- By 2019 Scion will have identified, and reached national alignment, around the Implementation Roadmap for Biofuels in New Zealand. Technology barriers, acceleration options and policy interventions will be identified.
- By 2020 Scion and commercial partner(s) will have developed a viable and New Zealand specific biorefinery business case based on Scion's high value bioproducts and commodity (fibres and bioenergy) platforms

**Our key partners in delivery are:** the Wood Processors and Manufacturers Association of New Zealand, fuel distributors and their members and affiliated groups, including CHH (Oji) Pulp and Paper, Norske Skog, regional councils, Industrial Symbiosis Kawerau, Z Energy, NZ Refining, KiwiRail, Air NZ, Bay of Connections, Advanced Biofuels Research Network, GNS, National Renewable Energy Laboratory, KIER and the Universities of Waikato, Canterbury, Auckland, Otago and Massey.

**Technology transfer:** Scion will continue to work in formal partnerships (e.g. Industrial Symbiosis Kawerau, Bay of Connections Energy group, etc.) to ensure approaches and methodologies employed are aligned to the needs of firms and their regions, including iwi, and implementation is maximised.

### Investment



Core funding \$2.6, MBIE direct \$1.0, MBIE indirect \$0, Other government \$0, Commercial \$0.4. Total \$4 (millions)

## IO5: Protect and enhance market access and improve risk management in the forest industry including forest health and preparedness for biosecurity incursions, fire and climate change

By 2026 ensure forest growing and wood product companies can meet their export revenue targets and increase their forest value by minimising risks associated with pests (insects, pathogens, weeds) that are either established biosecurity incursions, or that present market access issues, and climatic factors such as fire and wind and the frequency of extreme events.

We will support the New Zealand forestry industry, Ministry for Primary Industries, Ministry for the Environment, Department of Conservation, land owners, rural authorities, regional councils, Māori, rural fire authorities and other key stakeholders to:

- Reduce the likelihood of new pest incursions and increase the effectiveness of pest eradication programmes.
- Reduce the impact of established pests, weeds and wildings, with a particular emphasis on foliage diseases.
- Reduce impacts of rural fire on forests, communities and infrastructure through risk reduction, readiness, response and recovery approaches.
- Improve resilience to climate change and extreme weather events including wind.
- Sustain nationally important technical capability in biosecurity and fire, and nationally significant collections relating to forest plants, insects and fungi.
- Reduce risk of trade restrictions to our forest produce markets due to biosecurity concerns.

### Alignment to the National Science Challenges:

- *New Zealand's biological heritage* - reducing the potential for pest incursion and increasing New Zealand's ability to respond to biosecurity issues.
- *Resilience to nature's challenges* - improving New Zealand's ability to reduce the impact of fire and of wind.

## Impact KPI-8: Ensure New Zealand forests are resilient to current and future natural threats

By 2019 new tools and technologies will have been developed to quantify and mitigate impacts from the increasing risk to New Zealand's forests from pests, fire and wind, and climate change, and will have been adopted by forest industries, land owners, and central and regional government.

Leading indicators are:

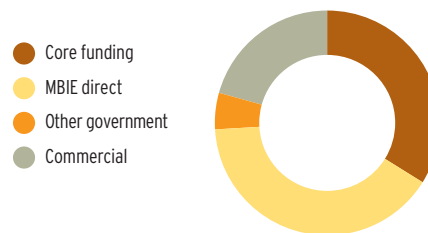
- By 2016 Ministry for Primary Industries or forest growers will have adopted a new tool or method developed by Scion and Scion's research partners to enable early detection and/or eradication, or improved control of a pest to New Zealand's forests.
- By 2016 Scion will have identified radiata pine germplasm with improved resistance to at least one foliar disease.

- By 2016 Scion, with its research and industry partners, will have defined a strategy to reduce the use of phytosanitary treatments, specifically methyl bromide, by at least 30%, and this will be presented to the Ministry for Primary Industries for evaluation and subsequent adoption by industry.
- By 2016 Scion will have (i) supported forest industries to maintain access to cost-effective herbicides and management options for the environmental certification of New Zealand forests, and (ii) agreed with stakeholders research priorities for reducing wilding conifer impacts.
- By 2016 rural fire stakeholders through the Rural Fire Research Advisory Committee will have adopted new fire behaviour models or adopted enhanced data collection systems that lead to both improved fire fighter safety and intelligence for making fire fighting decisions.
- By 2017 there will be examples for policy makers and forest growers using Scion's knowledge of climate change impacts and resultant implications that provide guidance in managing risk and adapting to impacts of climate change.
- By 2018 options to reduce the impact of *Phytophthora* on radiata pine, kauri and one horticultural species have been identified.
- Ongoing - the National Forest Herbarium and the Forest Health Collections and Databases remain viable and provide valuable information on the national forestry position for New Zealand.

**Our key partners in delivery are:** the forestry industry operating through the Forest Growers Levy Trust Board Inc., forestry companies, the New Zealand Forest Owners Association (FOA), New Zealand Farm Forestry Association, regional and local councils, Māori groups, land owners, Ministry for Primary Industries, Department of Conservation, Ministry for the Environment, Ministry of Foreign Affairs and Trade, Stakeholders in Methyl Bromide Reduction (STIMBR), port authorities, wood processors, New Zealand Fire Service Commission, New Zealand Defence Force, New Zealand Rural Fire Authorities, Rural Fire Research Advisory Committee (RFRAC), AgResearch, Landcare Research, Plant and Food Research, University of Canterbury and Lincoln Bioprotection Centre.

**Technology transfer** will be achieved through Scion's close working relationship with the above associations, government entities and industries. Scion will continue as part of the above teams (e.g. RFRAC, FOA) to jointly develop the annual work plans and ensure effective implementation.

## Investment



Core funding \$2.7, MBIE direct \$3.2, MBIE indirect \$0, Other government \$0.4, Commercial \$1.6. Total \$7.9 (millions)

**Alignment to National Science Challenges:** \$130,000 aligned to Resilience to Nature's Challenges and \$699,699 to New Zealand's Biological Heritage.

**Databases and Collections:** National Forest Herbarium and National Forest Health Collections and Database are supported to the value of \$835,000 of which \$335,000 is from Core funding.

**IO6: Ensure forest industry and bioeconomy businesses' licence to operate (and reputation) through workers' safety and capabilities, verifiable environmental performance, product traceability and modern standards; and by anticipating long-term change**

*Scion, through the provision of tools, technologies and regulatory compliance frameworks (such as standards and traceability) and the use of citizen science will support the New Zealand forest industry and firms in the bioeconomy sector in addressing freedom to operate issues (both social and technical) and thereby ensure access to domestic and international markets.*

**Impact KPI-9: Sustain New Zealand forest industry and bioproduct manufacturers' licence to operate**

This is an underpinning domain of science with broad impact across the forestry, forest products and industrial bioproducts sectors. Its purpose is to understand the factors influencing (and likely to influence) community and key stakeholders' perception and acceptance of technologies and practices in the sectors Scion works with. Current examples include genetic modification and new breeding technologies, drones, steepland harvesting and use of chemicals (e.g. herbicides for forest weed control, methyl bromide for log fumigation, CCA wood preservatives). This is supported by associated development of technology (such as for product traceability in supply chains) and up-to-date standards which incorporate new innovations (e.g. engineered wood products, bioadhesives, natural wood preservatives) and account for different market needs. To ensure that effective progress is made against this Intermediate Outcome, the following Impact KPI essentially summarises the activities that will be undertaken. Progress against these objectives will be reported as a narrative.

By 2019 Scion has supported the industry to enhance its social licence to operate.

Leading indicators are:

Human factors; health and safety and workforce development

- By 2016 Scion and the forestry industry will have identified how Scion can assist the industry in meeting its targets for improving worker safety.

Social acceptance of new technologies and industry practices

- By 2016 the benefits and risks of genetic modification research will have been quantified and presented to the forest industry, government and other key stakeholders for an informed decision on its future.

- By 2017 Scion and its research partners will have supported the implementation of the National Environmental Standard for plantation forestry.

Fit-for-purpose standards

- On-going - support wood products and bioproducts industries to grow and develop by addressing domestic standards that create artificial barriers to products accessing markets or applications.
- On-going - support the New Zealand export industry by developing new options for bioproducts such as packaging to enhance acceptance of New Zealand products in international markets.

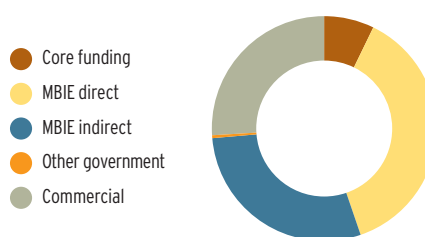
Product traceability and verification

- On-going - development of technologies and IT systems that allow wood, wood fibre and industrial bioproducts to be traced within the value chains they are transacted in and for their source to be verified.
- On-going - support industry to meet environmental compliance for regulators and customers.

**Our key partners in delivery are:** the forest industry operating through the Forest Growers Levy Trust Board Inc., the New Zealand Forest Owners Association (FOA), special stakeholder focus groups such as Stakeholders In Methyl Bromide Reduction (STIMBR), Ministry for Primary Industries, Ministry of Foreign Affairs and Trade, port authorities, Wood Processors and Manufacturers Association, ESR, Forest and Wood Products Australia, Plant and Food Research, NZ Centre for Food Safety, food manufacturers, industrial bioproducts manufacturers and Biopolymer Network Ltd.

**Technology transfer** will be achieved through the close working relationship that Scion has with the above associations, government entities and industries. Scion will continue as part of the above teams (e.g., STIMBR, FOA, WPMA, New Zealand Packaging Council) to jointly develop the annual work plans and ensure effective implementation.

### Investment



Core funding \$0.2, MBIE direct \$1.3, MBIE indirect \$1.0, Other government \$0.01, Commercial \$0.9. Total \$3.4 (millions)

In this section, other elements of Scion's strategy (Figure 3, page 18) are presented to support the achievement of SCI targets.

### Develop a customer-focussed and high-performance culture

Scion's "People, Performance and Culture (PPC) Plan 2011-16"<sup>51</sup> outlines the people and cultural requirements necessary for Scion to achieve its Statement of Core Purpose. Each year, objectives are set to achieve the following outcomes:

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

Over the SCI planning period Scion intends to:

1. Fully embed a health and safety culture and ensure Scion is at best practice with respect to health and safety.
2. Undertake more intensive workforce planning using tools adapted from the pan-CRI HR Managers' group to ensure Scion has the capabilities it requires for the future and that this takes into account capabilities held by other CRIs and coordinated through the National Science Challenges.
3. Build depth in leadership succession and organisational resilience, particularly at Level 4 (e.g., research leaders), by extending Scion's leadership development programme.
4. Increase the number of short-term visitors and sabbaticals to host international experts in fields of high importance to Scion's success; and grow the number of post-graduate students working on Scion initiated topics through its collaborations with New Zealand universities.

### Grow productivity through smart processes and systems

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

**Facilities:** A 10-year infrastructure development plan, comprehensively reviewed and updated in 2012, is designed to bring laboratory, office facilities and IT up to the standards required for a twenty-first century research organisation, addressing 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 laboratory, office facilities and infrastructure and development of containment facilities consistent with the Environmental Protection Authority specifications to support extension of biological material development and enhancement. Over the SCI planning period Scion plans to:

1. Undertake a major rebuild-refurbishment of its Timber Engineering Laboratory and associated pilot scale facilities (estimated CAPEX is \$8-10m).
2. Design and build an Innovation Centre Building (see page 21 and Figure 6).
3. Complete office refurbishments.
4. Ensure all facilities and laboratories continue to comply with health and safety 'best practice' requirements.

**Systems:** IT-based financial and human resource management systems, application of IT systems to improve data management and local, national and international collaboration are critical to Scion's future success. Scion works closely with other CRIs to adapt best ideas and ensure IT systems are 'fit for purpose', are affordable over the long-term, are secure and take account of the very rapid innovation occurring in this sector.

Over the SCI planning period Scion intends to:

1. Develop capabilities and infrastructure to enable exploitation of 'big data' and improve access and reuse of data held in national collections by Scion (L&G8).
2. Enhance technology and knowledge transfer through effective information management, web delivery technologies and science data management planning. This supports Scion's strategy to grow productivity through smart processes and systems (L&G2).
3. Provide collaboration tools (such as enhanced video conferencing and SharePoint) to enable Scion to foster national and international science collaborations.
4. Increase pan-sector or pan-CRI collaboration or shared services opportunities.
5. Upgrade cyber security and Scion's IT system's resilience.

<sup>51</sup> A new five-year People, Performance and Culture plan will be presented to Scion's Board for approval in August 2016. The Remuneration & Organisation Committee oversees the development and implementation of this plan.



## INFORMATION SYSTEMS PLAN ALIGNMENT

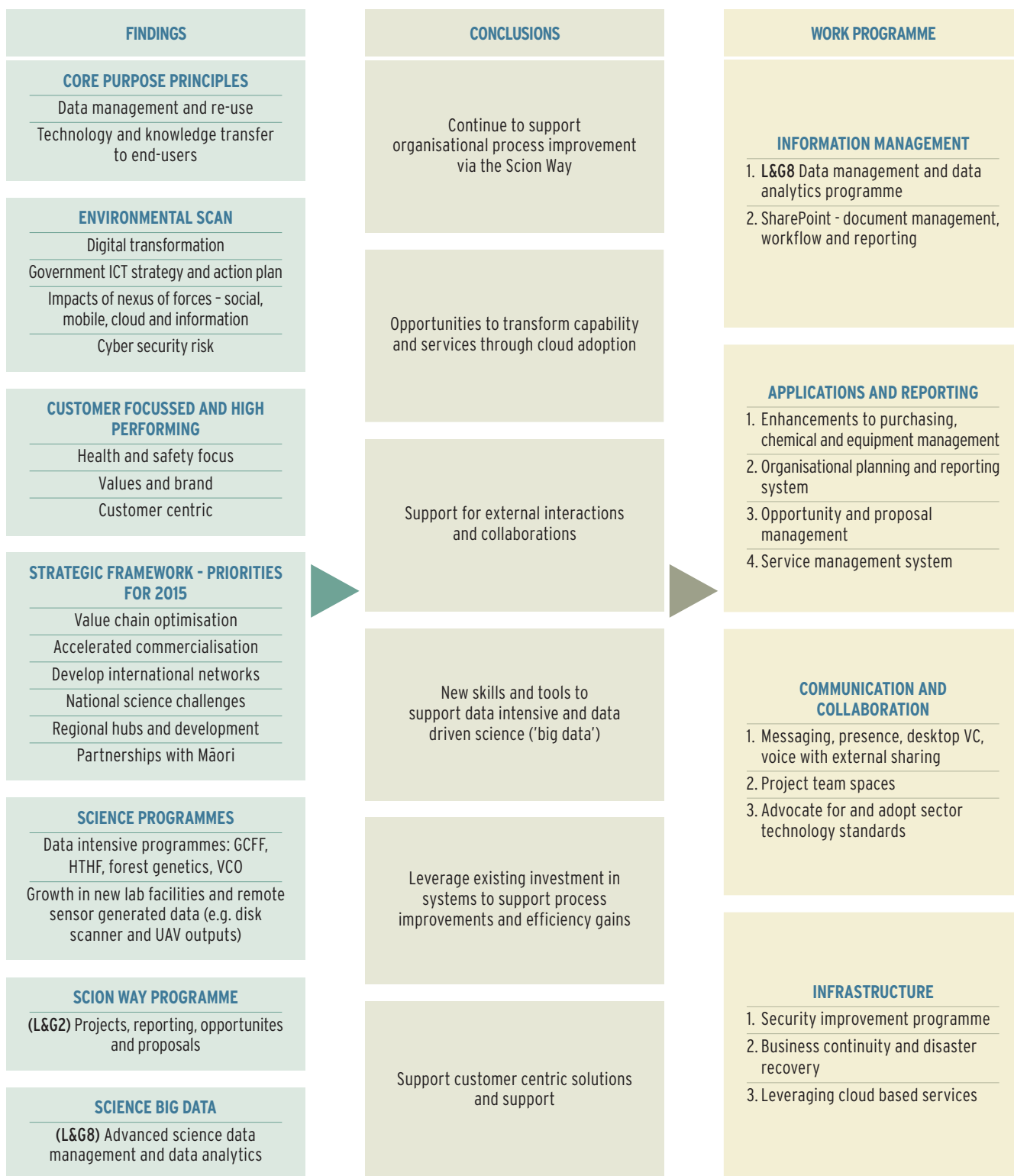


Figure 14: Scion's IT plan is aligned to achieve Core Purpose Outcomes and SCI targets.

**Science equipment:** Scion's plan is to purchase equipment that enables core science to be undertaken efficiently and to a high standard, and, in niche areas, to provide competitive advantage (e.g. testing equipment for industrial product development, remote sensing technology for

forest mensuration and surveillance). This is complemented by a plan to install pilot scale infrastructure to support market assessment and de-risk commercialisation of technologies arising from Scion's programmes. In particular, construction of bio-refinery pilot plant facilities to support

Intermediate Outcomes/Impacts 3 and 4 is of high importance over the planning period. 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.

Over the SCI planning period Scion plans to:

1. Continue its programme to develop pilot plant infrastructure to scale-up and de-risk the commercialisation of Scion (and partners') technologies. (Much of this work will be integrated with the refurbishment of the Timber Engineering Laboratory.)
2. Purchase equipment to support research into bio-oil production, disc scanning to understand the drivers of improved wood quality, remote sensing of forests and improved storage for science materials.

Final allocation of CAPEX and re-investment of surpluses

is subject to Board approval of the final business cases for each initiative.

### Improve knowledge and technology translation<sup>52</sup>

Technology translation at Scion occurs through a wide range of channels and mechanisms including secondments of staff into firms (and vice versa); workshops and development of training material; visitor programmes to Scion and companies; Scion's website; multi-media tools; media releases, trade articles, Scion's newsletter *Scion Connections* and software decision support tools.

To further improve technology translation, Scion plans to:

1. Work with sector 'change' champions and adapt 'best practice' from other industries, such as the dairy industry and international thought leaders such as VTT (L&G5).

#### EXAMPLES OF SCION PARTNERSHIPS DOMESTICALLY AND INTERNATIONALLY

RELATIONSHIP	PARTIES INVOLVED	FOCUS AREAS
Materials Accelerator	Universities of Auckland and Waikato, Callaghan Innovation, Scion, MBIE	New bio-based composite materials and products from this
Sustainable Land Use Alliance (SLUA)	AgResearch, Plant & Food Research (PFR), Landcare Research; Scion	Sustainable land-use and management
Better Border Biosecurity (B3)	AgResearch, PFR, Landcare Research; Scion, MBIE	Primary industry pre- and post-border biosecurity
Bioresource Processing Alliance (BPA)	AgResearch, Callaghan Innovation, PFR, Scion, universities, MBIE	Bioprocessing technology for new products, process efficiency gains, and waste re-use and reduction
Canterbury University	School of Forestry, other faculty	Forest biosecurity, silviculture, mechatronics
Waikato University	Bay of Plenty Tertiary partnership	Postgraduate programmes, executive education
Massey University	School of Design, College of Science	Industrial design and packaging technologies (including with new materials)
VTT (Finland)	VTT (Australia)	Forest industry and new bioeconomy science and technology solutions
Forest Product Innovation (Canada)	NZ Wood Council	Forest industry revitalisation, value chain synthesis and new technologies
Korean Institute for Bioenergy Research (KIER)	NZTE	Thermochemical technologies for wood-to-biofuels

Table 4: Examples of Scion partnerships domestically and internationally.

<sup>52</sup> The term 'technology translation' (rather than transfer) explicitly acknowledges the importance of user engagement in the process of introducing new knowledge, technologies and practices that enable change in individuals, communities or industries.

2. Apply techno-economic models to ensure all technologies optimally align with user needs and enable 'best packaging' of technology for end-users.
3. Upgrade Scion's website and Scion Connections newsletter; and, for iwi 'put more tangible products in their hands' and utilise established communication channels within Māoridom. This work will be informed by a comprehensive refresh of Scion's marketing and communication plans in 2015.
4. Use its 'big data' Learning and Growth (L&G) initiative (L&G8) to improve the sharing, analysis and interpretation of very large data sets.

## Collaborations to form best research teams

Scion collaborates extensively nationally and internationally to form the best possible teams to deliver its science and innovation outcomes. Scion has established a wide array of relationships and collaborations with universities, CRIs

and international research entities. Examples are shown in Table 4. Of particular significance over the planning period will be the formation of a host of new relationships through the National Science Challenges.

Scion plans to:

1. Work closely with the teams in the National Science Challenges and ensure these function efficiently, are well-supported by project management tools and reporting systems (i.e. the Scion Way) and challenge milestones are met on schedule.
2. Continue to nurture the alliances and relationships shown in Table 4, while seeking ways to improve their operational efficiency.
3. Support the growth of the entities in which it is a shareholder such as Biopolymer Network Ltd<sup>53</sup> (Scion owns a third), which has an exciting pipeline of technologies coming through to market realisation, including Zealafoam™ a light weight, compostable product for fresh food packaging.

### SCION'S 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 and 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	Over 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.

Table 5: Scion's databases and collections of national significance.

<sup>53</sup> See <http://www.biopolymernetwork.com/> for background about the company and its bio-based solutions.

4. Develop its international network (as described earlier) through the L&G5 reinvestment initiative. Agencies with world leading capability and technologies that are synergistic and complementary to Scion, such as VTT (Finland), VITO (Belgium), Fraunhofer (Germany), Forest Products Innovation (Canada) and Forest Wood Products (Australia) will be a priority in this endeavour.

## Improve accessibility to Scion's databases and collections

Scion has stewardship of the following resources of national significance:

These collections, databases and research assets will continue to be maintained to a high standard (as finances allow) enabling public access and re-use of the data. The annual cost of sustaining databases and collections is circa \$1.3 million per annum, with \$400,000 of this provided through core funding. In addition, a plan is being implemented with robust cyber security to improve public access to and reuse of forestry data generated and/or held by Scion.

## Pan-CRI shared services

Scion participates in several pan-CRI initiatives intended to improve effectiveness of delivery on our core purpose and greater efficiency with consequent cost savings. Joint action, as well as benchmarking and implementation of best practice across participants, are key elements.

The pan-CRI procurement forum currently delivers measurable savings of \$3 million annually across its seven members. This forum complements the all-of-government procurement reforms through which Scion is accessing IT, vehicle, energy and other savings. Scion also participates in the pan-CRI insurance collective.

Through the 'umbrella' coordination of Science NZ, all CRIs have now adopted the Saphire software system as their standard tool for recruitment. Other outcomes from the CRI human resources group include consistency in career progression opportunities, job band descriptors and capability planning tools. A new initiative in benchmarking and sharing best practice in health and safety was inaugurated in autumn 2015.

## 7

# FINANCIAL PERFORMANCE AND REINVESTMENT

**1. Financial projections and performance:** Scion's updated financial projections through to June 2020 are summarised in Table 6. Financial performance indicators are described in Table 7. Associated consolidated cash flow and balance sheet details are presented Tables 8 and 9.

Scion is forecasting to grow revenues by 3.4% to \$49.078 million and achieve an Operating Profit (EBIT) of \$2.302 million (Table 6). This represents a 7.3% return

on equity (RoE) before reinvestment. Reinvestment of \$1.033 million will generate a tailored RoE of 4.7% (Table 7). Future revenues are projected to increase at 3.0% to 3.1% annually. Risks to achieving these financial targets are the unknown scale of contribution of National Science Challenges, ability to grow licensing revenues and ongoing fiscal constraints on Crown and local government expenditure.

## PROJECTED STATEMENT OF FINANCIAL PERFORMANCE FOR THE FIVE YEARS ENDING 30 JUNE 2019

	30/06/2015 \$000	30/06/2016 \$000	30/06/2017 \$000	30/06/2018 \$000	30/06/2019 \$000	30/06/2020 \$000
<b>REVENUE</b>						
Core Funding	17,733	17,733	17,733	17,733	17,733	17,733
Other Crown Revenue	11,242	12,509	13,114	13,731	14,360	15,002
Commercial and Other	18,478	18,837	19,685	20,611	21,583	22,530
<b>Total Revenue</b>	<b>47,453</b>	<b>49,078</b>	<b>50,532</b>	<b>52,074</b>	<b>53,675</b>	<b>55,265</b>
<b>OPERATING EXPENDITURE</b>						
Personnel	24,223	26,053	26,808	27,505	28,248	28,982
Other Operating Costs	19,447	19,323	19,855	20,481	21,108	21,704
<b>Total Operating Expenditure</b>	<b>43,670</b>	<b>45,376</b>	<b>46,663</b>	<b>47,986</b>	<b>49,356</b>	<b>50,687</b>
<b>SCION MARGIN</b>	<b>3,783</b>	<b>3,702</b>	<b>3,869</b>	<b>4,088</b>	<b>4,319</b>	<b>4,578</b>
Loss on disposal of Fixed Assets	(14)	0	0	0	0	0
Restructuring Costs	(150)	(100)	(100)	(100)	(100)	(100)
<b>EBIT-R*</b>	<b>3,619</b>	<b>3,602</b>	<b>3,769</b>	<b>3,988</b>	<b>4,219</b>	<b>4,478</b>
Reinvestment	(1,034)	(1,300)	(1,400)	(1,500)	(1,600)	(1,700)
<b>EBIT</b>	<b>2,585</b>	<b>2,302</b>	<b>2,369</b>	<b>2,488</b>	<b>2,619</b>	<b>2,778</b>
Net Interest Income/(Expense)	275	250	49	40	42	33
<b>Profit before tax</b>	<b>2,860</b>	<b>2,552</b>	<b>2,418</b>	<b>2,528</b>	<b>2,661</b>	<b>2,811</b>
Tax	(835)	(727)	(701)	(733)	(772)	(815)
<b>Group Profit after Tax</b>	<b>2,025</b>	<b>1,826</b>	<b>1,717</b>	<b>1,795</b>	<b>1,890</b>	<b>1,996</b>
Share of after tax profit from Associated Companies	(162)	(200)	0	0	0	0
<b>Profit attributable to Shareholders</b>	<b>1,863</b>	<b>1,626</b>	<b>1,717</b>	<b>1,795</b>	<b>1,890</b>	<b>1,996</b>

\*EBIT-R is EBIT before reinvestment

Table 6: Projected Statement of Financial Performance for the five years ending 30 June 2020.

	Forecast 2015	Target 2016	Target 2017	Target 2018	Target 2019	Target 2020
<b>EFFICIENCY:</b>						
Operating margin	13.6%	13.0%	13.1%	13.5%	13.8%	14.1%
Operating margin per FTE	\$22,276	\$21,816	\$22,456	\$23,786	\$25,034	\$26,307
<b>RISK:</b>						
Quick ratio	1.63:1	1.24:1	1.10:1	1.02:1	0.98:1	0.98:1
Interest coverage	N/A	N/A	N/A	N/A	N/A	N/A
Operating margin volatility	18.7%	16.0%	15.1%	8.7%	5.9%	8.0%
Forecasting risk	0.8%	0.4%	0.1%	(0.1)%	(0.2)%	(0.2)%
<b>GROWTH/INVESTMENT:</b>						
Adjusted before reinvestment	8.0%	7.3%	7.4%	7.4%	7.5%	7.6%
Adjusted return on equity	5.6%	4.7%	4.7%	4.7%	4.7%	4.8%
Revenue growth	(1.2)%	3.4%	3.0%	3.1%	3.1%	3.0%
Capital renewal	1.3x	2.0x	1.6x	1.5x	1.5x	1.4x

Table 7: Projected Financial Performance Indicators for the five years ended 30 June 2020.

**2. Reinvestment of surpluses:** Scion's reinvestment portfolio underpins its strategy through Learning and Growth (L&G) initiatives (see Figure 3, page 18). Business investment cases for each L&G are reviewed by the Board as part of the annual refreshing of Scion's strategy and SCl, and preparation of the Annual Operating Plan.

Initially, these incorporated significant 'internal facing' investment to support leadership development and culture change, the design and adoption of systems and processes to improve organisational productivity (the Scion Way); catch-up on a backlog of building repairs and maintenance; and improving Scion's capability to engage effectively with Māori.

In 2015/16, with the exception of final year of smart systems and processes (L&G2), reinvestments are all external facing initiatives (see Table 8) that support Scion's strategy and forest industry stakeholders' goals:

1. Accelerate commercialisation (L&G4);
2. International S&T collaborations to speed-up innovation in the forest industry and by bioproducts manufacturing firms (L&G5);
3. Enhance technology translation through secondments and targeted training workshops, and via schools (L&G6);
4. Grow the Māori economy through improved communication and regional 'roadshows' to meet directly with iwi (L&G7); and
5. 'Big data' informatics capability (L&G8).

A brief rationale was provided earlier (page 38) for these strategic initiatives. Levels of investment in each L&G and the aggregate impact on RoE are shown in Table 8. Thus, Scion will continue to operate within the guidelines of the CRI Balance Sheet review and retain flexibility to reduce expenditure if revenue growth is less than planned.

	2016		2017		2018		2019		2020	
	EBIT	RoE	EBIT	RoE	EBIT	RoE	EBIT	RoE	EBIT	RoE
<b>REINVESTMENT PROJECT ('000)</b>										
L&G 1 - A customer focussed culture	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
L&G 2 - Productivity through smart systems	125	(0.3%)	100	(0.3%)	0	0.0%	0	0.0%	0	0.0%
L&G 3 - A safe modern workplace	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
L&G 4 - Accelerate commercialisation	550	(1.5%)	600	(1.6%)	750	(1.9%)	900	(2.2%)	1,150	(2.6%)
L&G 5 - International S&T collaborations	150	(0.4%)	150	(0.4%)	150	(0.4%)	150	(0.4%)	150	(0.3%)
L&G 6 - Enhance technology translation, secondments	80	(0.2%)	150	(0.4%)	150	(0.4%)	150	(0.4%)	150	(0.3%)
L&G 7 - Engage Māori, build Māori economy	75	(0.2%)	75	(0.2%)	100	0.2%	75	(0.2%)	75	(0.2%)
L&G 8 - Big data, industry informatics	320	(0.9%)	325	(0.9%)	350	(0.9%)	325	(0.8%)	175	(0.4%)
Future initiatives - Opex	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Sub-total	1,300	(3.6%)	1,400	(3.7%)	1,500	(3.8%)	1,600	(3.9%)	1,700	(3.9%)
Interest foregone		0.0%		0.0%		0.0%		0.0%		0.0%
<b>Total reinvestment</b>	<b>1,300</b>	<b>(3.6%)</b>	<b>1,400</b>	<b>(3.7%)</b>	<b>1,500</b>	<b>(3.8%)</b>	<b>1,600</b>	<b>(3.9%)</b>	<b>1,700</b>	<b>(3.9%)</b>
Tax	-364	1.0%	-392	1.0%	-420	1.0%	-448	1.1%	-476	1.1%
<b>Profit impact reinvestment</b>	<b>936</b>	<b>(2.6%)</b>	<b>1,008</b>	<b>(2.7%)</b>	<b>1,080</b>	<b>(2.7%)</b>	<b>1,152</b>	<b>(2.8%)</b>	<b>1,224</b>	<b>(2.8%)</b>
<b>Initial target RoE</b>		<b>7.3%</b>		<b>7.4%</b>		<b>7.4%</b>		<b>7.5%</b>		<b>7.6%</b>
<b>Revised RoE target after impact of reinvestment</b>		<b>4.7%</b>		<b>4.7%</b>		<b>4.7%</b>		<b>4.7%</b>		<b>4.8%</b>

Table 8: Summary of strategic learning and growth (L&G) initiatives 2014/15 to 2018/20, underlying (target) RoE and tailored rate of return. Allocations from 2016/17 are indicative.

### 3. Cash position, balance sheet structure and dividends:

Scion is forecasting end-of-year cash balances in the range of \$3.3 million (June 2016) to \$1.7 million (June 2019) over the five year planning period (Table 9). This is judged to be prudent given the ongoing revenue uncertainty with MBIE core and contestable funding (Scion has a \$20 million exposure in FY2016); the yet to be determined impact of National Science Challenges; and proposed modernisation of the aging (circa 1950s) wood engineering laboratories and test facilities (scheduled to commence in 2015/16 and estimated to cost \$8-10 million). The combination of

reinvestment of surpluses of \$1.3-1.7 million per annum and capital renewal (\$7.0-8.1 million pa) means Scion net assets are forecast to grow by \$9.0 million to \$43.004 million over the planning period (Table 10). Scion may recommence dividend payments when the current external operating environment stabilises; MBIE investment exposure for FY2016 reduces (post the 2015 core funding review); the large items in the 10-year campus renewal plan (initiated in 2011) are completed; and progress with commercialisation of Scion's technology pipeline is generating positive cash flows. This position will be reviewed annually.

#### SCION GROUP (NEW ZEALAND FOREST RESEARCH INSTITUTE LIMITED) PROJECTED STATEMENT OF CONSOLIDATED CASHFLOWS FOR THE FIVE YEARS ENDED 30 JUNE 2020

	30/06/2015 \$000	30/06/2016 \$000	30/06/2017 \$000	30/06/2018 \$000	30/06/2019 \$000	30/06/2020 \$000
<b>CASHFLOW FROM OPERATING ACTIVITIES</b>						
<b>Cash received from operations</b>						
Crown	28,566	30,092	30,847	31,464	32,093	32,735
Other Clients	20,135	18,459	19,560	20,483	21,452	22,397
Interest	264	252	49	40	42	33
<b>Total Cash received from operations</b>	<b>48,965</b>	<b>48,803</b>	<b>50,456</b>	<b>51,987</b>	<b>53,587</b>	<b>55,165</b>
<b>Cash disbursed on operations</b>						
Personnel	24,253	25,987	26,827	27,552	28,263	28,995
Suppliers	15,844	16,735	16,839	17,279	17,748	18,211
Interest on debt	1	0	0	0	0	0
Taxation	662	745	674	722	759	801
<b>Total Cash disbursed on operations</b>	<b>40,760</b>	<b>43,467</b>	<b>44,340</b>	<b>45,524</b>	<b>46,770</b>	<b>48,007</b>
<b>Projected Net Cashflows from Operations</b>	<b>8,205</b>	<b>5,336</b>	<b>6,116</b>	<b>6,463</b>	<b>6,817</b>	<b>7,157</b>
<b>CASHFLOW FROM INVESTMENT ACTIVITIES</b>						
Sale of fixed assets	0	0	0	0	0	0
Purchase of investments	(215)	(150)	0	0	0	0
Purchase of fixed assets	(5,080)	(8,162)	(7,000)	(7,000)	(7,000)	(7,000)
Purchase of intangibles	(120)	(120)	0	0	0	0
<b>Net Cash Received/(Disbursed) from Investing Activities</b>	<b>(5,415)</b>	<b>(8,432)</b>	<b>(7,000)</b>	<b>(7,000)</b>	<b>(7,000)</b>	<b>(7,000)</b>
<b>CASHFLOW FROM FINANCING ACTIVITIES</b>						
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
<b>Total Cash Disbursed on Financing Activities</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Net Increase (decrease) in cash</b>	<b>2,790</b>	<b>(3,096)</b>	<b>(884)</b>	<b>(537)</b>	<b>(183)</b>	<b>157</b>
Exchange rate effect	0	0	0	0	0	0
Opening cash balance	3,637	6,427	3,331	2,447	1,910	1,728
<b>Closing Cash Balance</b>	<b>6,427</b>	<b>3,331</b>	<b>2,447</b>	<b>1,910</b>	<b>1,728</b>	<b>1,885</b>

Table 9: Projected Statement of Consolidated Cashflows for the five years ended 30 June 2020.

**SCION GROUP (NEW ZEALAND FOREST RESEARCH INSTITUTE LIMITED) PROJECTED CONSOLIDATED BALANCE SHEET AS AT 30 JUNE 2015, 2016, 2017, 2018, 2019, 2020**

	30/06/2015 \$000	30/06/2016 \$000	30/06/2017 \$000	30/06/2018 \$000	30/06/2019 \$000	30/06/2020 \$000
<b>CURRENT ASSETS</b>						
Short term investments and cash	6,427	3,331	2,447	1,910	1,728	1,885
Debtors	5,918	6,258	6,384	6,511	6,641	6,774
Prepayments	794	817	817	817	817	817
Inventory	441	380	380	380	380	380
<b>Total Current Assets</b>	<b>13,580</b>	<b>10,786</b>	<b>10,028</b>	<b>9,618</b>	<b>9,566</b>	<b>9,856</b>
<b>LESS CURRENT LIABILITIES</b>						
Creditors	4,197	4,291	4,463	4,642	4,827	5,020
Personnel liabilities	3,130	3,236	3,317	3,400	3,485	3,572
Income in advance	1,438	1,208	1,208	1,208	1,208	1,208
Provision for tax	224	206	234	244	257	272
<b>Total Current Liabilities</b>	<b>8,989</b>	<b>8,942</b>	<b>9,222</b>	<b>9,494</b>	<b>9,778</b>	<b>10,072</b>
<b>Net Working Capital</b>	<b>4,591</b>	<b>1,844</b>	<b>806</b>	<b>124</b>	<b>(212)</b>	<b>(216)</b>
<b>INVESTMENTS</b>						
Investments in subsidiaries & associates/ Intangible Assets	337	287	287	287	287	287
Intangible Assets	446	330	330	330	330	330
<b>Total Investments</b>	<b>683</b>	<b>618</b>	<b>618</b>	<b>618</b>	<b>618</b>	<b>618</b>
<b>FIXED ASSETS</b>						
Fixed Assets	31,658	36,156	38,912	41,388	43,614	45,614
Biological Assets	504	504	504	504	504	504
<b>Total Fixed Assets</b>	<b>32,162</b>	<b>36,660</b>	<b>39,416</b>	<b>41,892</b>	<b>44,118</b>	<b>46,118</b>
<b>TERM LIABILITIES</b>						
Provision for Staff Liabilities	1,339	1,399	1,399	1,399	1,399	1,399
Deferred tax liability	2,116	2,116	2,116	2,116	2,116	2,116
Term Debt	0	0	0	0	0	0
<b>Total Term Liabilities</b>	<b>3,455</b>	<b>3,515</b>	<b>3,515</b>	<b>3,515</b>	<b>3,515</b>	<b>3,515</b>
<b>Projected Total Net Assets</b>	<b>33,981</b>	<b>35,607</b>	<b>37,323</b>	<b>39,118</b>	<b>41,008</b>	<b>43,004</b>
<b>Represented by</b>						
Share Capital	17,516	17,516	17,516	17,516	17,516	17,516
Retained earnings brought forward	14,541	16,404	18,030	19,746	21,541	23,431
Revaluation Reserve	61	61	61	61	61	61
Current profit (loss)	1,863	1,626	1,717	1,795	1,890	1,996
<b>Projected Closing Shareholders Funds</b>	<b>33,981</b>	<b>35,607</b>	<b>37,323</b>	<b>39,118</b>	<b>41,008</b>	<b>43,004</b>

 Table 10: *Projected Statement of Consolidated Balance Sheet for the five years ended 30 June 2020.*



## 8

# PERFORMANCE MONITORING AND REPORTING

Scion's strategic indicators, measures and targets are presented in Table 11 and 12, respectively. These comprise CRI generic and Scion specific indicators (Table 11) and progress in achieving the strategic priorities outlined in Section 3 (Table 12). Because some indicators constitute a 'bundle' of measures these will be traffic lighted (green, orange, red) and

supported by qualitative (and as appropriate quantitative) information in Scion's quarterly Shareholder reports; and public six monthly and annual reports. The latter will incorporate financial reports consistent with the accounting policies described in Appendix 4. Financial indicators reported quarterly are presented in Table 7 (Section 7).

	INDICATOR NAME	MEASURE	FREQUENCY	2015 FORECAST	2016 TARGET
CRI GENERIC INDICATORS	End user collaboration	Revenue per FTE (\$) from commercial sources	Quarterly	\$63,717	\$64,202
	Research collaboration	Number of peer reviewed publications with collaborators	Quarterly	≥80	≥80
	Technology and knowledge transfer	Commercial (commissioned) reports	Annually	>200	>200
	Science quality	Impact of scientific publications	Annually	H index 50 Citations 7	H index 60 Citations 7
	Financial indicator	Revenue per FTE (\$)	Quarterly	\$163,631	\$167,271
	Stakeholder engagement	Relevant funding partners and other end users (number and per cent) that have a high level of confidence that Scion sets research priorities relative to the forest industry and biomaterials sector	Biennial	MBIE survey n>30; >85%	MBIE survey n>30; >85%
	National and international research providers (%) who have a high level of confidence in Scion's ability to assemble the most appropriate research team	Biennial	>85%	>85%	
	Relevant end-users (%) who have adopted knowledge and/or technology from Scion	Biennial	>90%	>90%	
SCION STRATEGIC INDICATORS	Māori economic development	Partnerships (number and value) established with Māori entities to support economic development through the forest industry	Quarterly	n>5; >\$1.0m	n>5; >\$1.0m
	Accelerated commercialisation	Technologies in Scion's pipeline (number and co-investment (\$)); projects that progress to the business case stage (case studies)	Quarterly	25 & \$600k; Cases ≥4pa	25 & \$600k; Cases ≥4pa
	Internationalisation	Joint research and technology development programmes and staff exchanges with Scion's international strategic partner organisations	Six monthly	<5 1	<5 1
	People and culture	Staff recruitment and retention (quality and days to fill); leadership development (assessment); good employer (EEO rating); health and safety; and internal staff satisfaction survey (biennial)	Annual and Biennial	Qualitative <50 days EEO rating 0 Zero harm	Qualitative <50 days EEO rating 0 Zero harm
	Organisational productivity	Development and application of the Scion Way 'best practice' suite (internal evaluation; ratio overheads (O/Hs); total revenue (%))	Annual	O/Hs <20% 100%	O/Hs <20% 100%

Table 11: Scion's performance monitoring scorecard indicators and measures.

Scion's internal Annual Operating Plan includes additional science output, health and safety; and social responsibility measures. Most of these measures have been tracked over at least five years and therefore provide insights into trends of organisational operational effectiveness and efficiency.

Progress in achieving the strategic priorities will be commented on and 'traffic-lighted' in the scorecard similar to that shown in Table 12.

#### SCIONS' STRATEGIC INITIATIVES OUTCOMES SCORECARD

PRIORITY	OUTCOME	RATING (% ACHIEVED)
Value chain optimisation	Capability built in VCO and market analyses	90%
	Application of VCO tools improves Scion science and investment	25%
	Industry-policy steering group confirm priorities and associated project outputs enable productivity gains in forests, through logistics and via processing	20%
Accelerate commercialisation & technology uptake	Pipeline management of Scion products and services at best practice	60%
	"Game changing" technologies licensed-commercialised:	50%
	<ul style="list-style-type: none"> <li>• Woodforce (Wood plastic pellets)</li> <li>• TERAX™ (Biosolids processing)</li> <li>• UAV LiDAR (Remote sensing)</li> </ul>	30% 5%
International networks	Projects agreed with selected partners:	35%
	<ul style="list-style-type: none"> <li>• Europe (VTT, VITO, others)</li> <li>• North America (FPI (Canada))</li> <li>• Asia (FRRI (Japan), target companies)</li> <li>• Australia (FWPA, CSIRO, companies)</li> <li>• South America (Chile, Brazil)</li> </ul>	20% 10% 70% tbc
Regional hubs & development	Technologies adapted or co-invented for NZ industry through international network	10%
	The new "Innovation Centre" building at Scion's North Drive innovation park is fully tenanted and postgraduate students & joint projects increase through the Tertiary Sector Alliance	15%
	Scion's future footprint at the University of Canterbury is confirmed and new opportunities arise from this and the University's Innovation precinct and the Lincoln and other hubs	10%
Partnerships with Māori	Scion contributes to the delivery of Regional Growth Study Action Plan targets related to the forest industry, manufacturing of bioproducts, sustainable land-use and water quality	10%
	Partnerships with iwi (including with 'cooperating clusters') enable increased economic returns for Māori through the forest industry	25%
	Surveys of the effectiveness of communication and technology transfer to iwi confirm improvement and is supported by examples of technology adoption-better practice	30%

Table 12: Scions' strategic initiatives outcomes scorecard (ratings will be shown as estimated percentage completion of the actions described in Section 3).

The forest industry has a big role to play in growing New Zealand's exports, achieving improved national environmental outcomes and supporting the vibrancy of regions. Export earnings from forest and wood products have grown strongly in recent years, especially from China. The recovery in housing starts (domestically and internationally) and the continued expansion of emerging markets for renewable materials, 'green' chemicals and bioenergy products will boost earnings further and directly support the Government's Business Growth Agenda goal of lifting the ratio of exports to gross domestic product to 40% by 2025<sup>54</sup>. New Zealand's energy security and greenhouse gas emissions profile can both be improved through the increased use of forest biomass and waste streams.

With New Zealand's annual log harvest growing by about 10 million m<sup>3</sup> over the next decade to 33+ million m<sup>3</sup>, more attention must be paid to understanding and developing high margin export markets for products from radiata pine. The WoodScape study<sup>55</sup> confirmed the importance of increasing New Zealand wood processing competitiveness through product innovation (especially from mill residues), greater log conversion efficiency, market development and supply chain coordination. Development of wood processing in New Zealand would reduce forest growers' high exposure (circa 70% in 2013/14) to the Chinese log market and enhance economic opportunity in regions such as Northland<sup>56</sup>, the Bay of Plenty<sup>57</sup>, the East Coast and Otago-Southland.

Developing commercial scale and export returns from non-radiata forestry species is also important in meeting growing market demand for durable (non-treated) timber; realising the \$285 million potential revenues from New Zealand's privately owned indigenous forests<sup>58</sup>, and in mitigating the exposure of New Zealand plantation forests to biosecurity and climate change risk.

Improving the competitiveness of forestry as a land use in order to increase replanting and new planting rates to about 70,000 hectares of new forest per year is also important for the industry's long-term viability and the attraction of new investors in wood processing. The 2020+ outlook for a global shortfall in softwood log supply; the recovery of the carbon price post 2015; development of other markets for forest-based ecosystem services (such as biodiversity); and, the imperative to reduce nutrient pollution of waterways and estuaries are positive drivers for forestry as a land use. However, there are immediate opportunities for forest growing research to improve forestry returns through improved tree genetics and nutrition, matching genotypes to sites, and reducing impacts of foliar diseases. Through these means, volume growth of forests could be doubled over the next 20 years to 35 tonnes of biomass per hectare per year while concurrently improving wood uniformity and stiffness<sup>59</sup>.

Māori have an increasing role in all of these areas of forest industry development. Scion plans to continue to strengthen and establish further partnerships with Māori trusts and incorporations with significant forest assets and large areas of under-utilised land with good potential for forestry<sup>60</sup>.

Scion is well positioned with forest industry stakeholders and manufacturing firms in the steadily emerging non-forest sourced biomaterials sector to achieve gains in all of these areas. Its refreshed science plan and core funding portfolio are designed to exploit changes in the external operating environment and maximise opportunities for the forest industry and industrial bioproducts through the National Science Challenges, regional development initiatives, international collaboration, the 'smart integration' of existing technologies; and by working closely with Callaghan Innovation and government departments.

<sup>54</sup> See <http://www.mbie.govt.nz/what-we-do/business-growth-agenda/export-markets> for detailed information about the Government's business growth agenda. Retrieved 18 March 2014.

<sup>55</sup> WoodScape. (2013). *Summary Report: Overall outcomes, key messages and recommendations for next steps*. [http://www.woodco.org.nz/images/stories/pdfs/woodscape/woodscapecsummaryreportfinal\\_web.pdf](http://www.woodco.org.nz/images/stories/pdfs/woodscape/woodscapecsummaryreportfinal_web.pdf)

<sup>56</sup> Ministry of Business, Innovation & Employment. (2015). *Tai Tokerau Northland Regional Growth Study opportunities report*. <http://www.med.govt.nz/sectors-industries/regions-cities/research/regional-growth-studies/tai-tokerau-northland-regional-growth-study-opportunities-report>. Retrieved 20 March 2015.

<sup>57</sup> Ministry of Business, Innovation & Employment. (2015). *Toi Moana Bay of Plenty Regional Growth Study opportunities report*. <http://www.med.govt.nz/sectors-industries/regions-cities/research/regional-growth-studies/toi-moana-bay-of-plenty-regional-growth-study-opportunities-report>. Retrieved 12 May 2015.

<sup>58</sup> KPMG. (2013). *Indicative value analysis of New Zealand's privately owned indigenous forests*. Report to MPI (March 2013).

<sup>59</sup> Forest Owners Association. (2012). *New Zealand forestry science and innovation plan*. <http://www.forestvoice.org.nz/docs/foaforestgrowingstrategy240112v15.pdf>

<sup>60</sup> Ministry for Primary Industries. (2013). *Growing the productive base of Māori freehold land*. Wellington, New Zealand. Retrieved 18 March 2014 from <http://www.mpi.govt.nz/Default.aspx?TabId=126&id=1734>

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 any combination of fuels, power, heat, wood products/fibres and chemicals from biomass
Composites	Products produced through mixing different materials, e.g. medium density fibreboard
Hapū	Section of a large tribe; clan; secondary tribe
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.
Iwi	Tribe; nation; people
Manaakitanga	We uphold the mana of Scion and those we work with. We care for ourselves, each other and the environment and ensure we stay safe from harm
Mātauranga	Knowledge
Mean Annual Increment	The annual increase in tree volume per hectare per year
National Outcomes	The national impacts as stated in a CRI's Statement of Core Purpose
Ngahere	Forest
Phytosanitary	Relates to the health of plants usually in the context of demonstrating freedom from pests
PTA	<i>Phytophthora</i> taxon <i>Agathis</i>
REDD+	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
Solid wood	This includes timber and engineered wood products such as laminated timber, laminated veneers and finger-jointed wood (also called engineered wood products)
Rōpu	Society; group; company of people
Taonga	Property; treasure; artefact; relic; anything highly prized
Te reo	Voice; language
Tikanga	Customs and traditions

## NATIONAL EXOTIC FOREST ESTATE STATISTICS 2013

### AREA AND STANDING VOLUME STATISTICS

AS AT 1 APRIL 2013

#### FOREST AREA

Net stocked area (ha)	1,728,500
Harvested area awaiting replanting (ha)	51,869
Total forest area	1,780,369

#### GROWTH CHARACTERISTICS

Standing volume (000 m <sup>3</sup> )	512,137
Average standing volume (m/ha)	296
Area-weighted average age (years)	16.8

#### AREA BY SPECIES

Radiata pine (ha)	1,553,700
Douglas-fir (ha)	106,500
Cypress species (ha)	10,100
Other softwoods (ha)	23,600
Eucalyptus species (ha)	22,000
Other hardwoods (ha)	12,600

#### RADIATA PINE AREA BY TENDING REGIME

Pruned with production thinning (ha)	203,300
Pruned without production thinning (ha)	687,200
Unpruned with production thinning (ha)	40,800
Unpruned without production thinning (ha)	622,300

#### PLANTING STATISTICS

YEAR ENDED  
31 DECEMBER 2012

#### NEW PLANTING

Total estimated new planting (ha)	11,500
Restocking (ha)	45,154

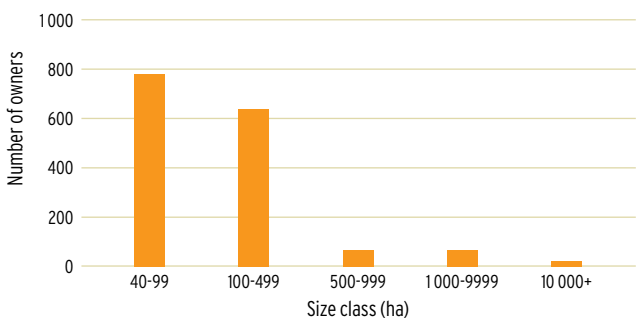
#### HARVESTING STATISTICS

YEAR ENDED  
31 DECEMBER 2012

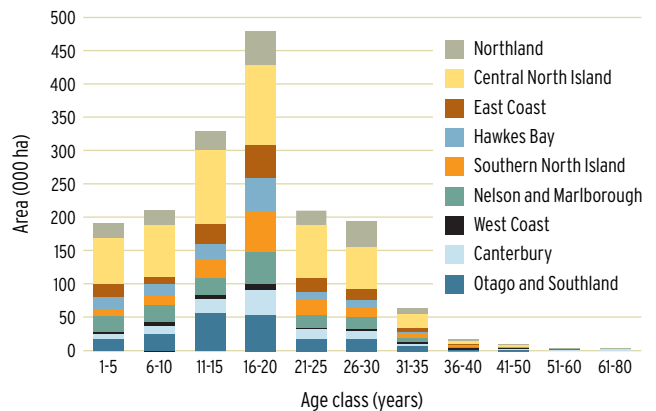
#### HARVESTING

Area clear felled - all species (ha)	50,342
Area clear felled - radiata pine (ha)	47,384
Volume clear felled - all species (000 m <sup>3</sup> )	26,296
Volume production thinned - all species (000 m <sup>3</sup> )	307
Total volume removed - all species (000 m <sup>3</sup> )	26,603
Average clear fell yield - all species (m <sup>3</sup> /ha)	522
Volume clear felled - radiata pine (m <sup>3</sup> /ha)	25,131
Average clear fell yield - radiata pine (m <sup>3</sup> /ha)	530
Area-weighted average clear fell age for radiata pine (years)	27.7

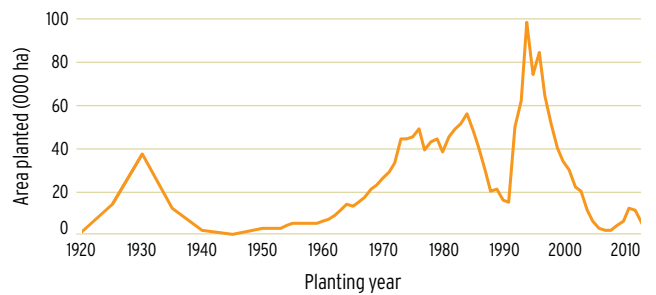
#### NUMBER OF FOREST OWNERS BY NATIONAL SIZE CLASS



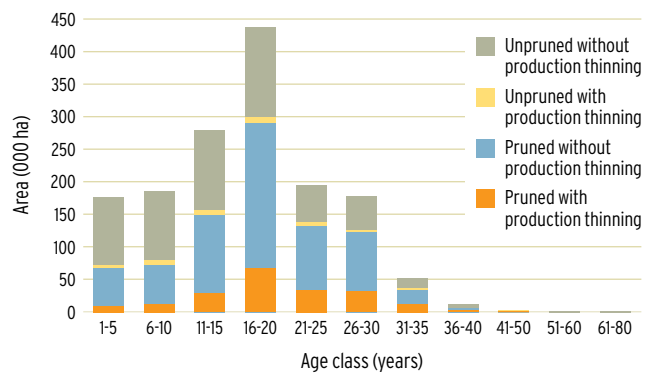
#### FOREST AREA BY AGE CLASS AND WOOD SUPPLY REGION



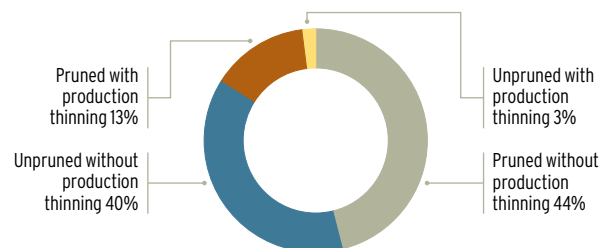
#### NEW FOREST PLANTING 1920 - 2013 (PROVISIONAL)



#### RADIATA PINE FOREST AREA BY AGE CLASS AND TENDING REGIME, AS AT 1 APRIL 2013



#### RADIATA PINE BY TENDING REGIME - 2013



These tables and figures are sourced from the Ministry for Primary Industries' report *National exotic forest description as at 1 April 2013*.

### FORESTRY PRODUCTION

VOLUME (TONNES unless otherwise stated)	JUNE YEAR		
	2012	2013	% CHANGE
Panel products (m <sup>3</sup> )	1,963,703	1,827,974	-6.0%
Export logs (m <sup>3</sup> )	12,966,198	14,956,246	15.3%
Pulp	1,540,884	1,477,766	-4.1%
Paper and paperboard	857,262	790,152	-7.8%
Sawn timber (m <sup>3</sup> )	3,885,650	3,991,238	2.7%
<b>Total roundwood removals (m<sup>3</sup>)</b>	<b>26,431,016</b>	<b>28,275,146</b>	<b>7.0%</b>

Source: MPI

### FORESTRY EXPORTS

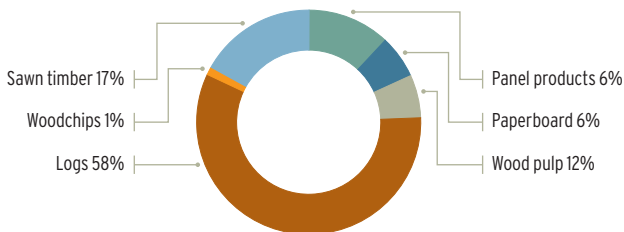
VALUE (SNZ MILLION FOB)	2012	2013	% CHANGE
Panel products	494	436	-11.7%
Logs, poles and wood chips	1,567	1,921	22.6%
Pulp	565	544	-3.7%
Paper and paperboard	376	337	-10.4%
Sawn timber and sleepers	763	794	4.1%
Other	507	447	-11.8%
<b>Total</b>	<b>4,272</b>	<b>4,479</b>	<b>4.8%</b>

VOLUME (TONNES unless otherwise stated)

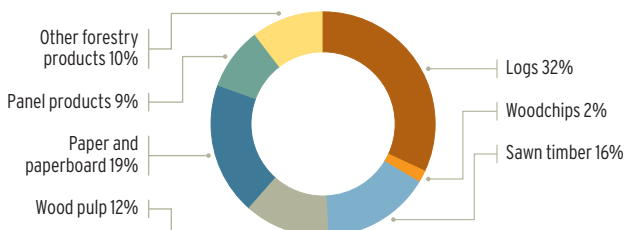
Panel products (m <sup>3</sup> )	954,612	870,160	-8.8%
Logs and poles (m <sup>3</sup> )	12,966,198	14,956,246	15.3%
Pulp	828,148	875,243	5.7%
Paper and paperboard	377,290	364,923	-3.3%
Sawn timber and sleepers (m <sup>3</sup> )	2,046,634	2,079,745	1.6%
Woodchips (BDU)	403,326	354,559	-12.1%

Sources: Statistics New Zealand and MPI  
Note: excludes newsprint exports

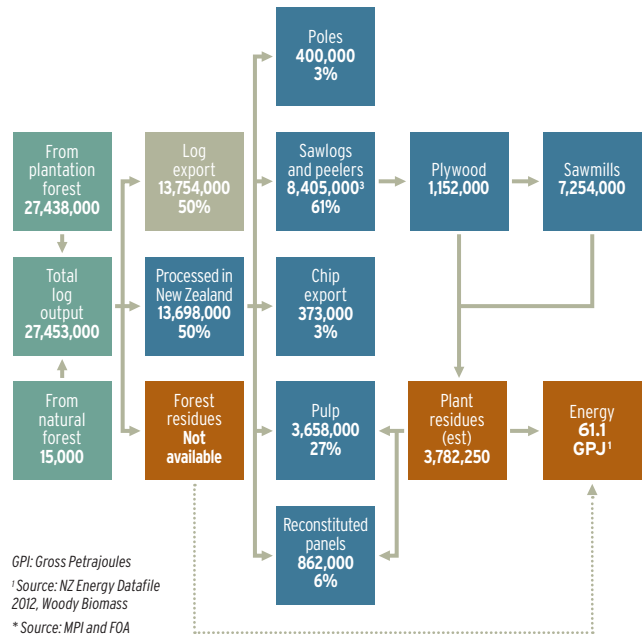
### NEW ZEALAND EXPORTS BY VOLUME (RWE)



### NEW ZEALAND EXPORTS BY VALUE



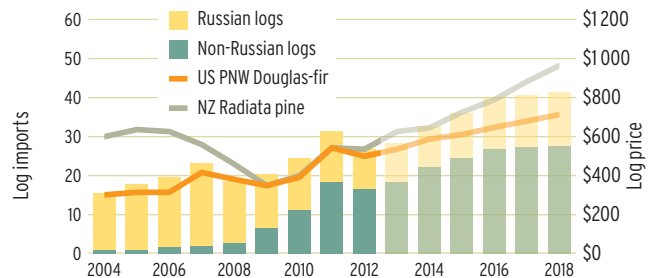
### LOG FLOW IN THE NEW ZEALAND FOREST INDUSTRY



GPI: Gross Petrajoules  
 1 Source: NZ Energy Datafile 2012, Woody Biomass  
 \* Source: MPI and FOA

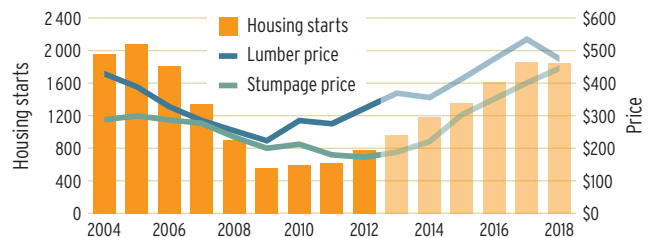
Volumes in (m<sup>3</sup>) roundwood equivalent. Year ended 31 December 2012.\*

### CHINESE LOG DEMAND WILL REMAIN ROBUST



Chinese softwood log imports (million m<sup>3</sup> per year) and softwood log prices (\$ per MBF, AMG or AWG)

### US HOUSING RECOVERY WILL BOOST LUMBER AND TIMBER PRICES



US Housing starts (1 000 units per year), softwood lumber price (\$ per BMF), and Southern Pine Stumpage price (\$ per BMF)

The data in these tables and figures are sourced from *Primary Industries production and trade June quarter 2013*, Ministry for Primary Industries; *New Zealand plantation forest industry facts and figures 2012/2013*, Forest Owners Association; ANZ; Statistics NZ and a New Zealand forest management company.

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](http://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 and provide a zero harm, safe workplace. 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 all 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 six-monthly 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 4.)

### 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:

- Ngāti Whakaue - covering the total site.
- Ngāti Wahiao - covering the southern end of the site.

## 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.

## 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, derivatives, carbon credits 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 Financial 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 comprise the financial statements of the Group and its subsidiaries as at 30 June. Control is achieved when the Group is exposed, or has rights, to variable returns from its involvement with the investee and has the ability to affect those returns through its power over the investee. Specifically, the Group controls an investee if and only if the Group has:

- Power over the investee (i.e. existing rights that give it the current ability to direct the relevant activities of the investee)
- Exposure, or rights, to variable returns from its involvement with the investee, and
- The ability to use its power over the investee to affect its returns

When the Group has less than a majority of the voting or similar rights of an investee, the Group considers all relevant facts and circumstances in assessing whether it has power over an investee, including:

- The contractual arrangement with the other vote holders of the investee
- Rights arising from other contractual arrangements
- The Group's voting rights and potential voting rights

The Group re-assesses whether or not it controls an investee if facts and circumstances indicate that there are changes to one or more of the three elements of control. Consolidation of a subsidiary begins when the Group obtains control over the subsidiary and ceases when the Group loses control of the subsidiary. Assets, liabilities, income and expenses of a subsidiary acquired or disposed of during the year are included in the statement of comprehensive income from the date the Group gains control until the date the Group ceases to control the subsidiary.

All intra-group assets and liabilities, equity, income, expenses and cash flows relating to transactions between members of the Group are eliminated in full on consolidation.

A change in the ownership interest of a subsidiary, without a loss of control, is accounted for as an equity transaction. If the Group loses control over a subsidiary, it:

- Derecognises the assets (including goodwill) and liabilities of the subsidiary
- Derecognises the carrying amount of any non-controlling interests
- Derecognises the cumulative translation differences recorded in equity
- Recognises the fair value of the consideration received
- Recognises the fair value of any investment retained
- Recognises any surplus or deficit in profit or loss
- Reclassifies the parent's share of components previously recognised in OCI to profit or loss or retained earnings, as appropriate, as would be required if the Group had directly disposed of the related assets or liabilities.

### 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 Consolidated Statement of Financial Position. In the parent company financial statements, investments in associate companies are stated at cost less any impairment charges.

**e) Intangible assets**

Intangible assets acquired separately are capitalised at cost and those acquired 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:

<b>Software</b>	
Useful lives	Finite
Method used	4 years - Straight line
Type	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.

**Carbon credits.** New Zealand emission reduction units (NZU's) are recognised when the Group controls the units, provided that it is probable that economic benefits will flow to the Group and the fair value of the units can be measured reliably. Control of the NZU's arises when the Group is entitled to claim the NZU's from the government.

NZU's are initially measured at fair value on entitlement as an intangible asset unless the Board have determined they are held for sale, in which case they would be recorded at fair value as inventory.

Following initial recognition, the intangible asset is measured at fair value when the Board of Directors

consider there is an active market for the sale of NZU's. NZU's determined as held for sale at recognition and recorded as inventory, are subsequently measured at the lower of cost and net realisable value.

The liability arising from the deforestation of eligible land is measured using the market value approach. A liability exists and is recognised on pre-1990 forests if the land use changes from forestry.

**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 and Periodicals	20 years

**h) Recoverable amount of non-current assets**

At each reporting date, the group assesses whether there is any indication 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 defined benefit plan provisions are based on an actuarial valuation.

**m) Leases**

*Group as a Lessee.* The determination of whether an arrangement is or contains a lease is based on the substance of that arrangement at inception date. 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 three 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 Ministry of Business, Innovation and Employment in the form of Core Funding, 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.

**v) Derivative financial instruments and hedging**

The Group uses derivative financial instruments such as forward currency contracts to mitigate its risks associated with foreign currency fluctuations. These derivative financial instruments are initially recognised at fair value on the date on which a derivative contract is entered into and are subsequently remeasured to fair value.

Derivatives are carried as assets when their fair value is positive and as liabilities when their fair value is negative.

Derivative assets and liabilities held for the purpose of trading are classified as current in the statement of financial position. Derivative assets and liabilities are classed as non-current when the remaining maturity is more than 12 months, or current when the remaining maturity is less than 12 months.

The fair values of forward currency contracts are calculated by reference to current forward exchange rates for contracts with similar maturity profiles.

Any gains and losses arising from changes in the fair value of derivatives are taken directly to profit or loss for the year.

## 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, costs to complete 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 and disclosed. Details of heritage assets can be found in note 10 and 21.

### 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.





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