

# Scion connections

Issue Six | December 2012

## Scaling up advanced manufacturing



**A \$5.5 million laboratory upgrade at Scion houses new equipment that could help to blaze new trails for wood processors and manufacturers in New Zealand. The latest investment adds to a comprehensive range of scientific equipment and services for supporting industrial research using renewable resources.**

Manufacturers of advanced materials and products need expert help to achieve innovation while reducing risk. Scion's unique combination of equipment and capability means that manufacturers can get all the R&D support they need on one site.

Scion's role in this sector is nothing new. Starting back in the 1980s with an industrial-scale mechanical pulping plant, Scion helped manufacturers of pulp and paper get ahead. This unique facility is now used to develop biorefinery technologies for producing biofuels and chemical co-products.

General Manager for Manufacturing and Bioproducts Dr Elspeth MacRae says Scion has invested heavily in growing this capability to a new level.

"We have just installed a fermentation laboratory that enables us to scale-up our industrial biotechnology capability. This facility will be used to research biological processes using micro-organisms," she explains.

Combined with the mechanical pulping plant, the fermentation laboratory (pictured at left) enables scientists to emulate key aspects of processing lignocellulosic material in biorefineries (see more on page 5). The ability to conduct large-scale experiments is crucial to demonstrating the commercial potential of new technologies.

"It is often difficult for investors to see the potential in ideas that remain in a laboratory. Our aim is to introduce the scale needed to evaluate product options and demonstrate viable opportunities to industry," Elspeth says.

Scion demonstrated the value of the scaled approach with TERAX™, a waste management technology co-developed with the Rotorua District Council (RDC). A pilot plant was constructed at Rotorua's wastewater treatment plant in 2011 to test a process that was developed in a lab. The success of this scaled-up experiment has given RDC the confidence to scale it up even further. The Council has approved the design, and construction of a full-sized demonstration plant for the TERAX™ process will begin in 2013.

"We hope that by demonstrating biorefinery technologies at pilot scale, we can provide investors with similar confidence," Elspeth says. "New Zealand needs to take bold steps in developing new ways of creating sustainable products from renewable resources. Our purpose is to support manufacturers in taking these steps."

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# > Plenty of reason for optimism

## **Improvement in the United States housing starts and New Zealand building consents over recent months is welcome news for our wood processors. Also, despite exchange rate pressures, log exports are holding up well this year.**

A continued “bumpy” recovery in the near term is anticipated, with the US fiscal cliff and European problems still to be resolved. However, the relentless growth in global demand for housing, materials, clothing and energy, underpins our optimism in the future of New Zealand’s forest industry and its capacity to achieve a \$12 billion export target by 2022.

While we have many pressures on land and water, even in lowly populated New Zealand, other countries have enormous and growing challenges with food (and thus water) and energy security. One of the many strengths of forestry is that increased plantings bring environmental benefits - stored carbon, greater biodiversity, better water quality and land stability.

Clearfell harvesting of stands temporarily disrupts some of these benefits and increases the risk of weather storm hazards. We are, therefore, working closely with forest growers, through a Future Forest Research (FFR) led Primary Growth Partnership (PGP) with Nelson-based Trinder Engineering, to improve harvesting equipment and techniques for steep land.

We highlighted the strategic significance of this harvesting research and value of strong, interactive linkages with firms at our Annual General Meeting attended by Minister Joyce. The meeting provided the opportunity to distil our achievements over the past 12 months - you can read more about these in our 2012 Annual Report at [scionresearch.com/general/publications/annual-reports](http://scionresearch.com/general/publications/annual-reports) - and also our future directions.

The latter includes the opportunity for Scion and the forest industry to contribute ideas on the big science questions or National Science Challenges confronting New Zealand. In my comments above I have alluded to a couple of possible examples - “intensification of land-use within environmental limits” and “resilience to hazards”.

You can read more about the National Science Challenges and contribute your ideas at [thegreatnzscienceproject.co.nz](http://thegreatnzscienceproject.co.nz)



We are also looking forward to the complementary and added benefits arising from the newly named Callaghan Innovation for high-value wood and fibre manufacturing. This includes our well-regarded research on wood composites, bioplastics, bioadhesives, and renewable chemicals.

The preliminary details for Callaghan Innovation indicate it will assist us in at least three key areas:

- extend our extensive network of contacts with firms involved in wood and fibre manufacture;
- provide a broader scope of technology foresight;
- develop solutions to improve manufacturing competitiveness in the forest industry.

At the same time we will be working hard to keep our science and technology internationally competitive. Our Strategic Science and User Advisory Panels assist us with this task. They convened for the second time in November and specifically looked at our programmes in forest growing research. Panel members can be found at [scionresearch.com/general/about-us/our-people](http://scionresearch.com/general/about-us/our-people)

I hope you enjoy this edition of Connections and would welcome any suggestions or comments you might have.

**Warren Parker**  
Chief Executive

## ➤ Fighting rural fires with smartphones



**Whenever a fire breaks out, people reach for their phones. Thanks to a smartphone app developed by Scion's rural fire research team, phones can be used for more than just ringing 111. Fire managers can use their phone to help fight the fire.**

Rural fire researchers at Scion have produced an Android-based smartphone app that helps fire managers to predict fire behaviour.

This app allows fire managers to input wind speed, relative humidity, slope, and other factors into their phone. The software then calculates how hot and how fast a fire is likely to spread in different vegetation types.

Senior fire researcher, Grant Pearce says that firefighters love this idea, because it reduces the amount of gear they need to carry around in an emergency.

"They've got all the information they need in their pocket at all times," he says.

This app is based on 20 years of research into how fire is likely to behave in New Zealand conditions. Data collected from experimental burns and wildfires were used to develop tools that help fire managers to make decisions about how best to tackle any given fire.

"These tools started out as paper-based lookup tables and field manuals. Over time, we evolved these into software applications, which are now used widely by fire managers," Grant explains.

Fire managers can use the software to calculate a fire's rate of spread, its intensity, flame length and a whole lot of other useful measures for fire fighting purposes. This information is calculated using inputs such as wind speed, relative humidity and slope.

Kevin Marsh of City Forests in Dunedin used the fire behaviour software during forest fires at Mount Allan in Otago. He says the fire behaviour software was invaluable in helping the incident management team to predict fire movement and evacuate people from dangerous areas.

"Now this software is available for smartphones, we can potentially have access to it at all times," he says.

Training sessions for the app have been provided to rural firefighters in the Greater Wellington region and Manawatu, with more sessions in the pipeline as other regions get connected.

The development of an Apple-based app is now under way, following completion of the android version.

Development of this smart phone app was funded by the Forest and Rural Fire Association of New Zealand (FRFANZ), with production of the underlying fire behaviour models funded by the Ministry of Business, Innovation and Employment (MBIE) and rural fire end-user organisations.

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*"The fire behaviour software was invaluable in helping the incident management team to predict fire movement and evacuate people from dangerous areas."*

*Kevin Marsh - City Forests.*

# ➤ Investment in the future

**Scion is working to demonstrate biorefinery processes and products at pilot-scale using unique-in-New Zealand analytical capability. Following is a sample of the wide-ranging equipment and skills we use to support manufacturing research and development.**

## **Pretreatment**

Scion's fibre processing plant is an industrial-style research facility that has underpinned development of New Zealand's pulp and paper industry.

The plant (pictured below) allows process engineers to investigate alternative wood resources, new process configurations and new products which cannot be examined practically in a production environment or laboratory.

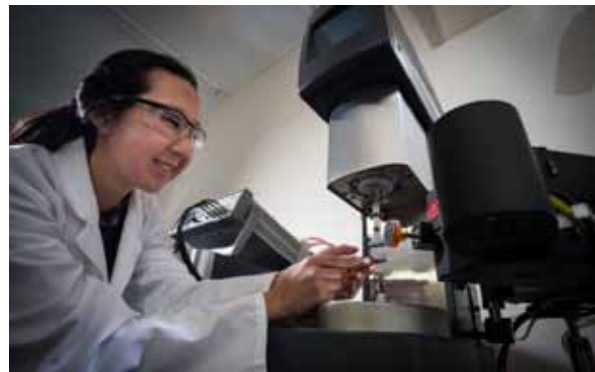
Offering mechanical pulp refining, fibre segregation and an MDF blowline, this capability provides a foundation for research into new biorefinery processing.



## **Creating new materials and products**

In everyday use, materials encounter mechanical challenges such as stresses and strains, as well as exposure to a range of temperatures, humidity and liquids. Precise measurements of material properties allow manufacturers to test newly developed materials of all kinds (including biomaterials) and to comply with industry standards for material performance.

Scion's new Dynamic Mechanical Thermal Analysis (DMTA) instrument (pictured below) is the most advanced platform available in New Zealand for mechanical analysis of solid materials. It is capable of performing measurements on a wide range of movements and stresses. Scion also has a Rheometer that can perform the same kinds of analysis on fluids.



## *Advanced manufacturing and technology*

*Scion offers a comprehensive suite of equipment and specialised skills aimed at manufacturing products from biorefineries.*

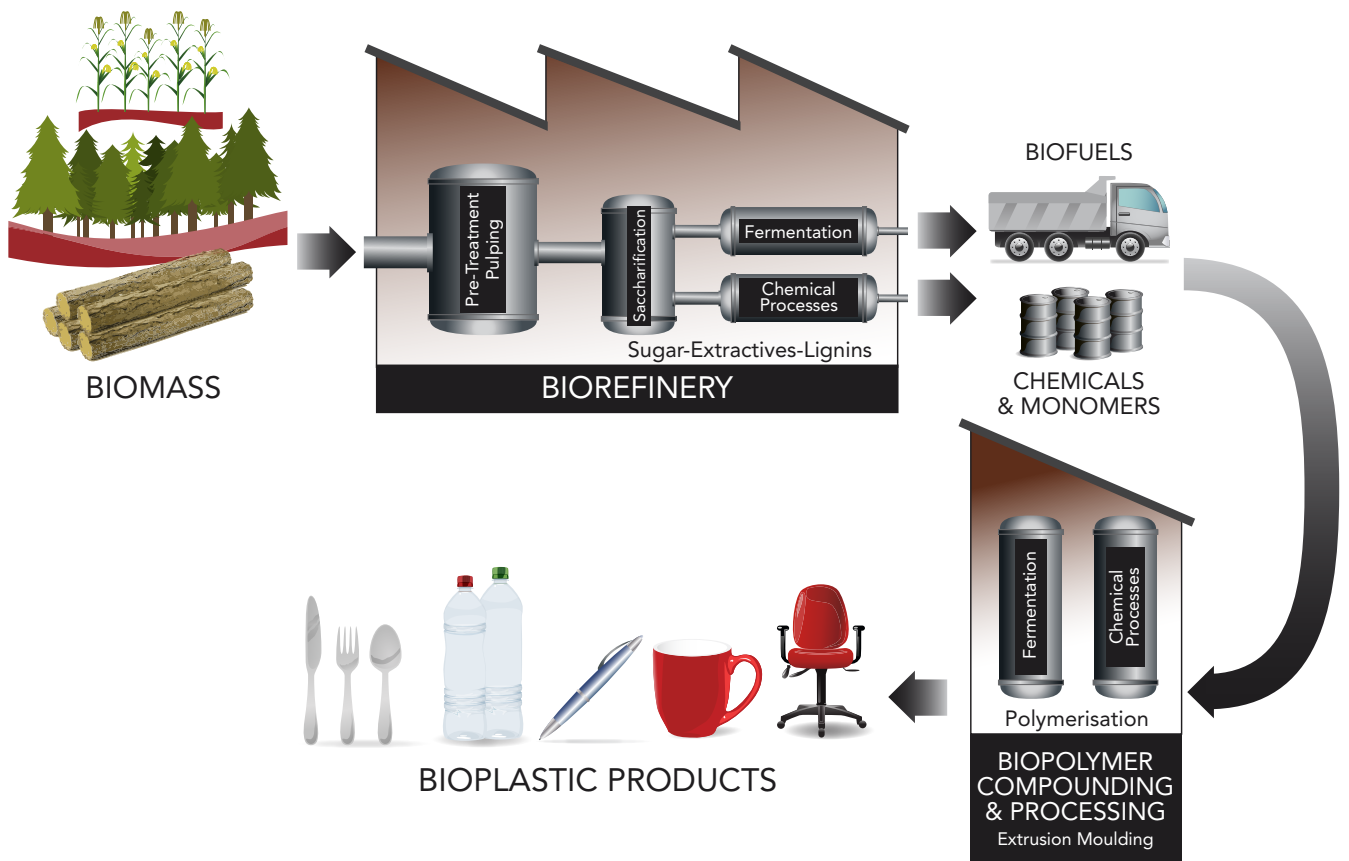
### *Our capabilities include:*

- Advanced materials: development, characterisation and testing*
- Product development, testing and performance*
- Wood modification and advanced processing*
- Industrial biotechnology*
- Plastics and bioplastics*

*For more information on our full range of services see [www.scionresearch.com](http://www.scionresearch.com)*

Scan this code with your smartphone to view our full range of advanced manufacturing services.





## ➤ Biorefinery technology

**Scion has the expertise to support growing global interest in biorefinery processing, based on a long history of research and development for the pulp and paper industry.**

A biorefinery is an industrial facility that converts biomass into fuels, power, and value-added chemicals. The biorefinery concept is comparable to today's petroleum refineries, which produce multiple fuels and products from petroleum.

Scion's focus is on developing biorefinery processes to create new products from renewable lignocellulosic (woody) materials. Co-products available from the pulping process include extractives, lignin and hemicelluloses. Fibre processing specialists are also contributing to important new developments in biofuel research, producing ethanol from lignocellulosic material.

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### Exploring biological processes

*Biological processes provide the key to efficient biofineries, offering huge advances in industrial processing and energy efficiency.*

*Scion's new **fermentation plant** enables scale-up of industrial biotechnology capability to generate products from microbes. These microbial outputs include enzymes, biopolymers (bioplastics), biofuels and biochemicals.*

*Scan this code for more information about the fermentation plant.*



## > Shedding light on spiral grain



### **An accidental breakthrough with a piece of wood and a flatbed scanner could lead to huge savings for the timber industry.**

Warped timber adds costs to the wood-processing industry and can undermine the reputation of timber as a reliable building product. Spiral grain is the biggest culprit behind this problem.

A spiral grain wraps around a log like the stripes on a barber pole rather than being aligned perfectly up and down. During drying, spiral grain leads to shrinkage and warping of timber, a major issue for many softwood species, including radiata pine.

Dr Keith Mackie, from industry-led Solid Wood Innovation, says segregation of potentially inferior material as early as possible in the processing sequence would save drying costs on inferior timber. It would deliver a more consistent quality timber product to the building and construction industry.

Measuring spiral grain has proven to be both tricky and expensive. An “accidental breakthrough” by Scion scientist Mark Riddell may soon change that.

Just before heading home one evening, Mark decided to scan a dry disc of wood on a flatbed scanner, hoping to generate a decent image of split lines. The 20mm (about thumb width) thick piece was labelled on the top-side with a thick marker pen. Surprisingly,

the scan detected the label on the top side of the disk. After checking the disk was label side up and not label side down, Mark grabbed a fresh disc and drew a straight line across the top face and scanned it. The line appeared in the scanned image, but an S-shaped kinking was apparent.

Mark believed that the kinks were due to light being deflected through the wood along the path of the grain, and if a spiral grain exists, this path will be at an angle rather than vertical.

Following further research, Mark and his colleagues have developed a reliable method for producing 2D maps of spiral grain in discs of wood up to 35mm in thickness. They published their findings in the *International Association of Wood Anatomists Journal*. The approach was also presented at a recent conference in Portugal, where it sparked considerable interest and also won Mark the Future Forests Research Award for Science of International Quality 2012.

This technology may become the gold standard for assessing spiral grain with work progressing towards larger scale automated grain assessment. The data produced by this method will ultimately be used to reduce issues associated with timber warping.

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## > Rail trail a winner in timber design awards

An historic railway route was given new life thanks to radiata pine, and was named the Sustainability Award winner at the NZ Wood Resene Timber Design Awards in October.

The Hauraki Rail Trail, part of Nga Haerenga, The New Zealand Cycle Trail, was recognised ahead of three other finalists in the sustainability category, sponsored by Scion. The category called for entries that showed a commitment to sustainability where there is a focus on timber, the carbon footprint, location of supply and/or energy efficiency.

Auckland-based Frame Group was behind the Hauraki Rail Trail and said radiata pine appealed because of the benefits over steel or concrete options, and the fit with ecological and economic objectives of Nga Haerenga. Traditional bridge styling with modern connection detailing and prefabrication methods produced 25 attractive bridges ranging in length from four to 75 metres.



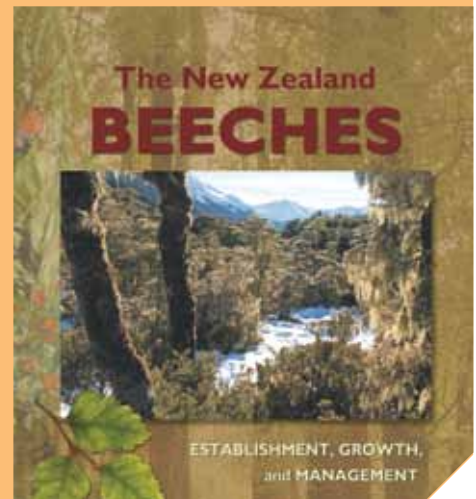
## > Managing beeches for timber

Anyone interested in growing New Zealand beech (*Nothofagus*) may value a new book produced by Scion and Tane's Tree Trust. This is the sixth publication in Scion's popular series on New Zealand's indigenous trees, providing guidelines for managing native species to meet multiple objectives, including timber production. (See [www.scionresearch.com](http://www.scionresearch.com) for details on the full series.)

Beeches are among the best known and most important native tree species in New Zealand. Although most remaining beech forests are located within the conservation estate, substantial areas of manageable beech forest remain in freehold and Maori tenure. The book provides up-to-date information on the ecology, establishment and sustainable management of beeches.

Written by Mark Smale (Landcare Research) and Scion scientists, David Bergin and Greg Steward, the publication was funded by the Sustainable Farming Fund and Future Forests Research.

For a copy of the book contact: [publications@scionresearch.com](mailto:publications@scionresearch.com)



## > Striking the boron balance

Boron is vital to tree growth, but the quantity of boron is equally important. Too little will cause deformities in conifers, and too much of it can be toxic.

Recent studies by Scion indicate that Douglas-fir may be particularly sensitive to boron toxicity. An optimum range of 4-8 kg per hectare of boron produced the greatest plant growth rate for radiata pine seedlings in a greenhouse study where climatic conditions were controlled. In contrast, an application rate of 4 kg per hectare was found to reduce growth of young Douglas-fir at a high country site, indicating a lower rate of 1-2 kg per hectare is more appropriate for this species.

These results demonstrate that the range between boron deficiency and toxicity in two important commercial tree species is narrow and species-specific - important information for tree growers.

Results have been published in the *New Zealand Journal of Forestry Science* (D-fir) and *Communications in Soil Science and Plant Analysis* (radiata pine).

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## > New senior appointment

Steve Sopora has been appointed as Scion's new General Manager, Business Development and Commercialisation.

Recruited from Canada, Steve previously worked as the Manager of Business Development for Methanex Corporation, the world's largest methanol producer.

During his time with Methanex, Steve was involved in establishing new methanol plants in Egypt and the United States.

Steve's interest in technology development evolved from a background in chemical and process engineering. He combines technical experience with the strong business and leadership skills required to drive innovation through to market.



## > Upcoming conferences

### **Southern Connection Congress**

21 - 25 January 2013

University of Otago, Dunedin, New Zealand

The Southern Connection Congress will focus on the rapid changes occurring in many ecosystems. Scion is sponsoring this international event due to our interests in environmental sciences and climate change.

Scion is participating in a number of conferences over the next three months. For details please visit [scionresearch.com/events](http://scionresearch.com/events)

## > Changes to the *New Zealand Journal of Forestry Science*

Scion is pleased to announce that from 2013 the *New Zealand Journal of Forestry Science* will be published by the global scientific publisher Springer Science+Business Media. It will form part of the SpringerOpen portfolio of over 100 peer-reviewed fully open-access journals. Scion will retain editorial management of the long running journal, having published it for over 40 years.

The *New Zealand Journal of Forestry Science* plays an important role in capturing knowledge about planted forests. Journal editor Dr Ruth Falshaw says this tradition will be enhanced through the support of an international publisher.

"Scion and Springer share the same vision about open-access scientific publication. The *Journal* will remain freely available on-line with no author charges and many other benefits," she explains.

The benefits include: on-line submission; an html, xml and pdf version of each paper on-line; digital object identifiers; links to references embedded in the text of each paper; access to anti-plagiarism software; global promotion through Springer's on-line platforms SpringerOpen and SpringerLink; and an international standard code of ethics.

For more information, or to make submissions, contact [nzjfs@scionresearch.com](mailto:nzjfs@scionresearch.com)

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