March 2007 | **Issue 3**

SCION

NEWSLETTER

Biomaterial Futures

Industrial biotechnology

MANUFACTURING FOR THE FUTURE

Modern industrial practices rely heavily on the use of fossil fuels, man-made chemicals and non renewable materials. The pollution, waste and supply issues associated with these practices are forcing major changes in manufacturing.

This trend has seen the rise of industrial biotechnology, which enables manufacturing using biological processes and renewable raw materials.

Biological processes use enzymes, bacteria, and other naturally occurring micro-organisms to break down substances and/or synthesise new ones. Scion's Group Manager for Biomaterial Research, Dr Elspeth MacRae, explains this concept by comparing it to a digestive system.

"Just as the enzymes inside the stomach of a termite convert wood pulp into sugars – so industrial biotechnology uses similar principles on a much larger scale," she says.

"Industrial biotechnology involves the use of large bioreactors to transform materials into the building blocks of new products. By basing these processes on biological systems, it is possible to reduce the harmful waste products often produced from synthetic substances."

Towards this goal Scion and its fellow Crown Research Institute, AgResearch, have formed a research programme with US-based Diversa Corporation to develop improved methods of fermentation for producing bioethanol from trees (see page 3). Scion has also entered a significant partnership with Arborgen, a leading researcher of plant biotechnology in the US to identify genes that can influence the characteristics and productivity of forest plantations (see page 2).

"Technology of this kind is being explored in a wide range of industrial applications and points the way towards sustainable manufacturing using renewable plant-based resources. Advanced economies in the future will see economies based on carbohydrates, rather than the hydrocarbons that currently drive the world."

Dr MacRae says New Zealand is well-placed to capitalise on this trend, given our expertise in primary production, and the rate at which we can grow plants. Plantation forestry is a renewable source not only of wood and fibre, but also of plant cell walls (lignocellulosics) which will provide new biomaterial building blocks for the future. Scion views the utilisation of these feedstocks as a means of getting the most out of renewable plant resources.

"Scion is helping to lead the movement towards a bio-based economy because we have expertise in applications of industrial biotechnology relating to plant fibres, cellulose, bioplastics and enzymatic transformation. This capability is built on 60 years of history in plantation forest research," she explains.

"Our partnerships with international researchers such as Diversa and ArborGen will help us to accelerate New Zealand's progress towards the vision of sustainability based on our ample carbohydrate resources. The potential benefits to New Zealand from the research are numerous, both economically and environmentally."

Inside this issue

A partnership between Scion and US-based ArbonGen LLC will lead to new discoveries.

Find out about it on Page 2.

COMBINING EXPERTISE TO TAILOR TREES

Selective breeding techniques have been integral to the development of agriculture for thousands of years.

The same techniques have been applied more slowly in forestry, but the time has come to make significant advances through modern biotechnology. Advances in the discovery and commercialisation of new bio-based products will broaden applications for one of the world's most versatile renewable resources – wood.

Scion and US-based ArborGen LLC have signed a multi-million dollar research and development agreement to focus on the areas of gene discovery and molecular breeding for forest trees. The research will help improve tree growth and quality for both commercial forestry and biomaterials applications through faster identification of genes that will be of high value to increasing the productivity of forest plantations.

ArborGen Chief Executive, Dr Barbara Wells, says the partnership with Scion brings together two leaders in forestry biotechnology, creating exciting synergies for breakthrough discoveries and product development.

"There continues to be intense and growing global demand for wood products, in addition to renewable energy sources such as biofuels.

"ArborGen is a recognised leader in the development of new technologies and commercial products that will improve the sustainability and productivity of plantation forests, giving us the tools with which to meet that demand while, at the same time, reducing pressure on native forests."

Dr Wells notes that identifying, developing and applying preferred traits such as improved growth and superior wood quality are key objectives of ArborGen's partnership with Scion.

Scion's Chief Executive, Dr Tom Richardson, says the ArborGen partnership will ultimately lead to new discoveries.

"This will not only make our forestry industry more efficient and cost-effective, but will also enable New Zealand to build a stronger bio-based economy."

Dr Richardson predicts future plantation forests will be different to what they are now, with trees grown for a wider range of purposes such as to make ethanol or other biofuels, or grown with specific characteristics for manufacturing bio-based products.

Partnering for progress

The word "Scion" refers to a cutting or shoot taken off an established plant in order to graft it to another rootstock. This is an appropriate descriptor of what Scion seeks to achieve – grafting our core capabilities onto new partnerships so fresh opportunities in bio-based products and sustainable manufacturing can flourish.

Scion's recent partnerships agreed with ArborGen, and then Diversa and AgResearch, are two examples which promise new bursts of growth in areas that have applications in industrial biotechnology.

PARTNERSHIP PUSH TO DEVELOP BIOFUELS INDUSTRY

As the world looks to alternatives for fossil fuels, Scion has entered a partnership which could ultimately see New Zealand's vehicle fleet running on homegrown biofuels.

Scion and AgResearch have formed a research programme with Diversa Corporation (Nasdaq: DVSA) to explore the feasibility of a transportation biofuel industry in New Zealand that uses bio-based feedstocks such as trees and grasses.

The New Zealand Government has formulated strategies to respond to climate change, decrease carbon emissions, and to develop and produce secure, clean energy at affordable prices. The research partners believe New Zealand's forestry industry has the potential to meet these goals, by providing renewable and sustainable energy alternatives from an environmentally beneficial resource.

This partnership combines the broad range of skills required to develop a "second generation" biofuel industry to replace current biofuel production methods. Scion is focused on applying its knowledge of plantation forestry, wood and fibre to the development of new biomaterials from renewable plant resources. AgResearch has expertise in biological science, and plays a key role in boosting the productivity of New Zealand's bio-dependent economy. Diversa is a leader in the development of high-performance specialty enzymes.

Diversa's Chief Executive, Edward Shonsey, says resources such as New Zealand forests could be used to make ethanol and replace a significant proportion of imported petrol.

"This is one of the most exciting and profound projects I have ever been involved in and we are looking forward to successfully developing new cocktails of enzymes to convert wood to ethanol," he says.

"This represents an opportunity to have a positive impact on the future of New Zealand and other countries with abundant cellulosic biomass such as wood. Successfully developing new ways to produce ethanol from wood could really change the paradigm of energy thought and policy. We are combining our enzyme technologies with the research capability and expertise at Scion and AgResearch to determine whether a biofuel industry would work in New Zealand," Mr Shonsey explains.

The three organisations have completed a study, undertaken at Scion in Rotorua and Diversa in San Diego, to investigate the potential for applying Diversa's enzymes to convert New Zealand-grown wood into sugars. This process would enable forests to be used as a sustainable source of sugars that can then be fermented and refined into ethanol and other products. Scion Chief Executive, Dr Tom Richardson, says the results from the initial study are extremely positive, which has prompted the three organisations to agree to move forward into a bigger research programme.

"This particular project will look at how we might use some of this renewable resource to replace petrol in cars. New Zealand has seven per cent of its land mass in plantation forests. This project provides a great example of how we can derive new products and environmental benefits from these forest resources. Our country is in a unique position to investigate the real possiblity of transforming from a petrochemical-based to a carbohydrate-based economy," he says.

OPENING THE BIOENERGY GATEWAY

The forest industry offers a viable alternative to fossil fuels through the use of wood residues. The opportunity to use this waste more effectively has been identified by both the forest industry and the government.

The Forest Industry Development Agenda (FIDA) Bioenergy Programme is funding a new initiative that will help develop the maket for wood residues in New Zealand. Wider use of bioenergy would enable forest growers to potentially cash in on large quantities of woody material left in the forest after harvesting.

The Bioenergy Knowledge Centre has been launched to provide tools and information to those who want to use wood as a renewable energy source. Scion is managing the Bioenergy Knowledge Centre in conjunction with SYSDOC Limited and EECA, who administers the FIDA Bioenergy project.

The "Bioenergy Gateway" is a new website (www.bioenergy-gateway.org.nz) that supplies useful information to anyone with the need to generate heat for industrial, commercial or residential purposes. Such end-users may include wood processors, dairy processors, homeowners or schools. The website also provides information to forest growers, sawmillers and other potential suppliers of wood residues.

The Bioenergy Knowledge Centre also offers a "call centre" which gives access to a pool of experts who can assist in evaluation and analysis of bioenergy opportunities for New Zealand-related projects (0800 BIOENERGY).

"When forests are harvested as much as 20 per cent of wood residue can be left behind to rot or is discarded as waste. There is huge potential for this waste to be used for energy production." – Jeanette Fitzsimons

The forestry sector is already a major user of wood waste for the generation of process heat in the wood processing industry. This is mainly used for wood drying kilns. Large processing sites can also produce electricity from burning wood waste through a process known as co-generation.

Government Spokesperson on Energy and Conservation, Jeanette Fitzsimons, says much more wood waste could be used for energy production in forestry and other sectors if a better infrastructure were in place for the buying and selling of forestry residues on harvesting sites.

"When forests are harvested as much as 20 per cent of wood residue can be left behind to rot or is discarded as waste. There is huge potential for this waste to be used for energy production," says Ms Fitzsimons.

EECA and Scion envisage that the Bioenergy Knowledge Centre will help raise awareness of these opportunities, provide vital information and create a market for the industry. The overall objective of the Bioenergy Knowledge Centre is to reduce risks (technical, financial and operational) and create opportunities related to bioenergy projects.

Contact: Per.Neilsen@scionresearch.com

SCIENCE IN THE PARK
DISCOVERING SCION

Come along to Scion's open day on Saturday March 24, 10am – 4pm, 2007 in Rotorua.

Experience first hand how science and technology is shaping the future through Scion's interactive showcase of activities, displays and seminars.

For more information visit www.scionresearch.com or call 0800 4 Scion.

March 2007 | Issue 3

CONTACT SCION

Phone: +64 7 343 5899 • Email: enquiries@scionresearch.com • Web: www.scionresearch.com