ScionConnections

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Science in the bathroom

There are 2.5 billion people worldwide[1] living without adequate access to safe and affordable sanitation. In total, it is almost the combined population of the world's two most populated countries, China and India. The implications for human and environmental health are enormous, but the toilet as we know it is not an option for many of the regions that need sanitation most. They need a new solution to treat human waste, and the Bill & Melinda Gates Foundation is working with scientists from Scion, and all over the world, to make it happen.

The challenge to reinvent the toilet was started by the foundation in 2011. Their aim is to remove the barriers to safe sanitation by funding scientists to create a toilet that is safe for humans and the environment, is sustainable, cheap to use (less than US$0.05 per user per day) and works 'off the grid'.

[1] See http://www.gatesfoundation.org/What-We-Do/Global-Development/Reinvent-the-Toilet-Challenge

Solving a very specific problem

Scion came to the project in 2015, when the Gates Foundation awarded our research team a grant to create a proof of concept – showing that our wet oxidation could be an effective way to treat human waste. A supplemental project was also awarded to look at how Scion's extrusion expertise could be applied in other aspects of the project. A year later, the initial results prompted the foundation to award our team a further grant to create a full-scale working prototype in the next two years.

The method that Scion staff are using in our toilet model grew from expertise established in treating waste water from the pulp and paper industry. While the initial proof of concept demonstrated the potential of our wet oxidation process, the treated human waste still had high nutrient concentrations which made it unsuitable to be directly discharged.

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New Chief Executive Julian Elder joins Scion

Dr Julian Elder.

Dr Julian Elder commenced as Scion's Chief Executive on 7 March, succeeding Dr Warren Parker upon his retirement from the role in early 2017.

Julian is a deeply experienced chief executive, having had leadership roles for large-scale civil infrastructure projects in waste treatment, renewables, telecommunications, energy and water. He has a successful track record leading multi-stakeholder complex ventures, delivering sustained profitable growth to utility, contracting and professional services businesses across Asia Pacific.

He brings extensive commercial experience in business development, performance and risk management, most recently having led WEL Networks Limited from 2007 to 2014 and the associated Waikato Networks Limited from 2011 to 2014, doubling the size of the combined business during his tenure. Prior to that role he was Chief Engineer at Watercare Services from 2005 to 2007.

Julian is passionate about health and safety, commercial excellence and customer service. He is recognised for innovation and thought leadership and has significant experience in commercialising technology and raising investment to support this.

Graduating from the University of Auckland with a PhD in Electrical Engineering in 1984, Julian is a Chartered Member of the New Zealand Institute of Directors and a Chartered Professional Engineer. He is currently Chair of the Waikato Regional Theatre Governance Panel and a director of Flick Electric Company, and until recently a director of Soda Inc., Enterprise Angels, New Zealand Wind Farms, a trustee of the Waikato Animal Welfare Foundation and a member of the University of Waikato Honours Committee.

Scion Connections interviewed Dr Elder early in his new role

Q. ***What excites you most about Scion?***

The signifiance and importance of Scion's work for New Zealand and for the world. Scion is stepping up its focus on commercialising the technology it develops and has embarked on major initiatives to establish a world-leading Innovation Hub on its Rotorua campus for the forest industry, advanced manufacturing of wood and biomaterials, and commercialisation of related technology.

Q. ***How do you think our research and technology can make a big impact and where is our greatest potential for growth?***

The unique position that Scion has is that it sees right across the value chain. I believe we have an opportunity and a role to shape New Zealand's future – a sustainable renewable future driven by forestry and wood products.

Q. ***What are you looking forward to working on?***

Working with our staff to help make the New Zealand forestry sector bigger and better. Forest science through to new products excites me, and I look forward to breaking down some of the hurdles faced today and making sure that Scion is seen as a thought leader around future business models and new innovations.

Q. ***This year we're celebrating Scion's 70th anniversary - what vision do you have for the next 70 years?***

It's too early to have a concrete vision, but I think forestry has the opportunity to be a signicant part of a renewable and sustainable world. I envisage a stronger and vibrant Scion that is a destination for industry, public and scientists because of the science and commercialisation we are doing and delivering from protection through tailored trees and forests, engineered timber, bioproducts, bioenergy, sustainable land use and new business models.

Q. ***What do you think the biggest challenges will be?***

Getting and building a consensus across key stakeholders, getting the right regulatory environment to allow us to tailor-make trees and then obtaining the revenue to build strong and deep capability.

Q. ***What brought you to Scion?***

The opportunity to make a fundamental difference to New Zealand's future.

Q. ***What are some key projects you've worked on?***

The Mangere Wastewater Treatment Plant, which included New Zealand's largest environmental restoration project; Newater in Singapore, which reclaimed ultra pure water from wastewater and included the largest epidemiological study into the effects of this water. Bidding for, winning and then being recognised as the best builder and operator in the country for 12.5% of the government's national Ultrafast Fibre Initiative.

FOR FURTHER INFORMATION
contact Dr Julian Elder at julian.elder@scionresearch.com

Grant Pearce pointing out the aftermath of the Port Hills Fire to representatives from the US Forest Service Missoula Fire Sciences Lab, San Jose State University and the University of New South Wales.

Science supports rural wildfire response

The recent Port Hills fire is one example of the enormous risk that rural wildfire can pose to homes, farms, forests and infrastructure. The response to the fire was supported by robust science from our rural fire research team.

The team used estimated fire spread times and the associated fire intensity and flame length to assist the incident management team to develop the fire attack strategies, determine resource needs and ensure fire-fighter and public safety. The Prometheus fire growth simulation model was also used to predict fire behaviour and evaluate different fire breakout scenarios.

Scion fire scientist Grant Pearce observed the fire personally. "It certainly met the definition of an extreme fire. It escalated suddenly, spread rapidly and with high intensity, changed directions abruptly, fire whirls and a fire tornado was reported; but above all, it was unpredictable."

Extreme fire risk is increasing

More extreme fires are expected with climate change projected to bring increased temperatures, decreased rainfall in some areas and stronger, more frequent westerly winds. The blurring of urban boundaries, with people increasingly moving into rural areas, is also likely to increase both the risk of fire and the potential impacts. This season's fires in the Coromandel, Hawke's Bay and Christchurch resulted in the greatest house loss in 100 years.

The Scion rural fire research group began a five-year project to understand and address the threat of extreme fire in late 2016. The work is supported by the Ministry of Business, Innovation and Employment's Endeavour Fund, a number of local and international stakeholders and Scion's core funding.

The goals of the programme include understanding the atmospheric conditions that can cause a fire to become extreme. They will look at the role of heat transfer mechanisms in different fuel types to improve the existing fire behaviour prediction tools, how extreme fires could be prevented, and real-time monitoring of fire outbreaks and fire growth.

25 years of rural fire research

February 2017 marked 25 years of rural fire research in New Zealand. Grant Pearce has been on the scene since it began. "Our research has focussed on reducing fire risk, being ready to fight it, responding to fire and recovering from it," says Grant. "Now we are preparing for a future with more extreme fires. We can't stop nature, but we can take precautions and be prepared based on the best science possible."

Grant's outstanding service to rural fire research was recognised at the 5th New Zealand Rural Fire Research Workshop held in Christchurch on 7-8 March.

"As an individual scientist, Grant has a tremendous science impact on the New Zealand and international wildland (rural) fire community. He operates at all levels of the fire sector providing advice and expertise to fire managers up through to principal rural fire officers, senior government staff and Ministers" said Kevin O'Connor, from the National Rural Fire Authority, during presentation of an award to Grant.

FOR FURTHER INFORMATION on Scion's rural fire research, contact Grant Pearce at grant.pearce@scionresearch.com

Waging a war against erosion

Erosion of our East Coast North Island hill country has been a problem since deforestation began in the 19th century. As each year passes, more and more soil is lost to the sea, and the scenario is likely to get worse as climate change brings more frequent intense storms, increasing soil loss. Erosion flow-on effects continue to slowly degrade land productivity, reduce quality of life for rural communities and increase sediment loadings to rivers.

The Whangaparaoa 2L Trust are kaitiaki of Mataroa Station, nearly 2,500 ha of steep, erosion-prone land on the East Coast. Their ability to continue farming the station, and to bring their vision of environmental sustainability and community resilience to life, is dependent on stabilising some of their more vulnerable land.

Keeping the soil on the whenua

To combat the severe gully erosion that has become a serious problem on the trust's land, they began looking for ways to manage and stabilise it, securing its resilience for generations to come. The trust together with Scion secured funding from MPI's Sustainable Farming Fund (SFF) and Erosion Control Funding Programmes (ECFP) to research the survival and benefits of different plant species for erosion management, and to reforest 64 ha around the trial area.

Planting vegetation is a recognised method for stabilising eroding land. Plants reinforce the soil through networks of roots, and slow run off by collecting and holding rainwater. They also have other benefits including carbon sequestration, timber production and habitat creation for native species conservation. Planting mānuka can also offer the opportunity for honey production. Equipped with knowledge of the trees' survival rate, and their associated cost and benefits, will allow the trust to make informed decisions about their land.

The process

The project team worked with trustees to understand what they wanted planted on their land. Lead scientist Loretta Garrett says, "Sharing knowledge and the opportunity to work collaboratively with Scion was very important for the Whangaparaoa 2L owners. We surveyed the trust to find out which species they'd like to see planted on the land and matched this up with science to find the best options to trial".

Securing the environmental resilience of the land is a key priority for the trust as well as balancing the economic, social and cultural values that underpin their livelihood.

The trial tested the survival of a range of different species planted on the trust's land in September 2015. Species planted included mānuka, a mix of tōtara and willow poles, coast redwoods, and eucalypts. The addition of willow poles to tōtara accelerated the root spread in the early years while the tōtara were establishing, to be removed at a later time. Vetiver grass, which has a deep rooting system, was also trialled in some of the very severely eroded areas within the gully scar. All plantings were compared to radiata pine as a benchmark. The costs and benefits of each species were valued over a 120-year timescale.

At the end of the journey

The project team completed their final monitoring visit in November 2016, tallying up which species had survived. The final report will be presented to the trust and people interested in the work at a hui in autumn, 2017. The results will also be published as a brochure so other communities around the East Coast can benefit from the findings.

FOR FURTHER INFORMATION on the Waikura Valley erosion control project, contact Loretta Garrett at loretta.garrett@scionresearch.com

SCION™ FORESTS ■ PRODUCTS ■ INNOVATION | 70 years of science

Marking 70 years

This month marks Scion's 70th anniversary. In April 1947 the then State Forest Service established a Forest Experiment Station on the Scion campus to centralise forestry research. Our roots run deeper however, and Scion's development has paralleled the evolution of commercial plantation forestry and its associated industries over the past century.

Scion, and its predecessors from the 1920s, developed the genetics of trees whose progeny now populate over 90 per cent of New Zealand commercial forests. In 1947, the forest health group was formed and the control measures they developed for dothistroma needle blight and sirex wood wasp still apply today. In the late 1950s, research into wood manufacturing and wood products commenced and resulted in technologies such as drying, preservation and fibre production now widely used by New Zealand's wood processors.

In 2000, Scion extended its focus to developing renewable chemicals, materials and energy from forest resources and, later, into ecosystem services to further extend the revenue streams available from forests. These changes reflected increasing international interest in petrochemical substitutes and New Zealand's need to enhance environmental performance and energy security. More recently the focus on using land within tighter environmental limits, realising value from forest ecosystem services and benefiting from the digitisation of services and manufacturing has stepped up.

Such achievements built Scion's reputation as a world-leader in forest industry research and technology development. Now we have 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.

Scion envisages a future where forestry as a renewable resource will be pivotal to New Zealand's economic, environmental and social wellbeing. We will gain a respected position of thought leadership opening up pathways for existing forests and processors and for new forests and processors. As partners with industry organisations and iwi we will grow and transform the forest industry to expand and enrich regions across New Zealand and enrich and expand sectors such as building and construction, biomaterials and advanced manufacturing. And, in this future low-carbon bioeconomy we have helped develop, trees will also be part of the landscape as major contributors to addressing climate change and achieving sustainable land use.

On behalf of the Board, I take this opportunity to honour our past and its people and welcome the next 70 years of Scion innovation in driving "Prosperity from trees".

Tony Nowell CNZM, Scion Chair

VITO's Sofie de Regel and Scion Sustainable Architect Andrea Stocchero.

Scion and VITO explore our built environment

Scion's partnership with Belgian-based research and development organisation VITO has grown from strength to strength since our initial partnering in 2015. Brought together by complementary expertise and a shared desire to commercialise more biobased materials, the Scion and VITO partnership has expanded into New Zealand's built environment.

Scion Science Leader Doug Gaunt says, "Our projects with VITO have been very successful and that prompted us to thinking about what we could do next. We've chosen to focus on the sustainability of New Zealand's built environment. It's a growing trend internationally, and VITO has a lot of experience in this area".

This led to a collaboration between VITO's Sofie de Regel (Sustainable Built Environment Researcher) and Sustainable Architect at Scion, Andrea Stocchero. The programme saw Andrea visit VITO at the EnergyVille center in Belgium and, in return, Sofie came to New Zealand for a scientific secondment at Scion.

The project outline

The purpose of Sofie's secondment was to gauge the awareness and existing capabilities for environmental assessments of building and biobased materials in New Zealand.

Sofie and Andrea spent four weeks meeting with New Zealand building industry associations, research institutions, product manufacturers and building supply companies to gather insights straight from key stakeholders. Now they are collaborating to summarise New Zealand's best practice, barriers and gaps to define how Scion and VITO can best support a wider sustainability uptake within the built environment.

Assessing environmental performance

The primary tool that researchers use to assess environmental impact is a life cycle assessment (LCA). LCAs are recognised by industry and regulators worldwide as a reliable and comparable method to assess the environmental performance of products, processes or services. For the built environment, that includes building materials, building elements and buildings as a whole.

An LCA assesses (potential) environmental impacts and benefits of the subject, throughout its life cycle in a holistic and detailed way with defined boundaries. In forestry and wood product terms, that includes the process from raw material acquisition in the forest through to production, use, end-of-life treatment, recycling and final disposal of wood.

LCAs are used hand-in-hand with Environmental Product Declarations (EPD). Each EPD is based on an LCA and is a standardised and third party verified means of communicating the environmental performance of a product.

Together, LCAs and EPDs support the supply and demand for sustainable materials and products. They are widely used internationally. Sofie says, "Governmental regulations in this field are becoming more and more common in Europe. If a manufacturer wants to make an environmental claim about his product, in some European countries it is mandatory to support the claim with an EPD".

"The international context is relevant to New Zealand," says Andrea. "Some New Zealand companies who export goods to Europe and America have already been asked about EPDs for their products. While that only affects a small proportion of the New Zealand export market, it demonstrates how New Zealand exporters can be affected by international policy."

The next steps

Scion and VITO want to support the construction of more sustainable buildings in New Zealand, and the supply of more sustainable building products.

"New Zealand is in a unique position, our country has the potential to become a world leader in environmental sustainability. To be a good kaitiaki (guardian), we need to fully embrace sustainability holistically and across sectors.

"Interest in this field is growing and we're eager to support it. We're at a crucial point in New Zealand, reliability of information and consistency of methods is of critical importance to achieve sustainable outcomes. VITO has a lot of expertise in this area and having them on board is very valuable to us," says Andrea.

FOR FURTHER INFORMATION on the project please contact Andrea Stocchero at andrea.stocchero@scionresearch.com or Sofie De Regel at sofie.deregel@vito.be

VTT's Anne-Christine Ritschkoff speaks to Scion staff.

Finnish research leaders touch down in Rotorua

As part of our ongoing partnership with the VTT Technical Research Centre of Finland, Scion hosted executive vice president Anne-Christine Ritschkoff and vice president Tiina Nakari-Setälä at our Rotorua campus on 28 February.

It marked the first meeting of Scion and VTT executive leaders since we signed a collaboration agreement in 2016. Anne-Christine and Tiina's visit is part of a regular schedule of meetings to strengthen cooperation and promote our common vision for the bioeconomy and circular economy.

Dr Elspeth MacRae, Scion's General Manager Manufacturing and Bioproducts, says, "There's so much potential for our work with VTT to grow. By showcasing some of our current work, we find more common interests and spark new opportunities for collaboration".

Anne-Christine and Tiina were shown examples of a wide range of our work from drones (UAVs), big data, to using biopolymers in packaging and much inbetween. To round out the day, a discussion was held on the first joint VTT/Scion project, adapting VTT's hemicellulose technology - which is used to make new packaging products - to use different polymers from radiata pine grown in New Zealand. Other potential research areas may include bark biorefinery, mobile modular manufacturing and processing, and joint bidding for global entities.

FOR FURTHER INFORMATION
on our partnership with VTT contact Dr Elspeth MacRae at elspeth.macrae@scionresearch.com

Science in the bathroom

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Phase two of the project will include a second process to solve those issues. Current options for the second stage include using bacteria that grow in the presence of infra-red light, and a collaboration with Swansea based firm, SPECIFIC, who use titanium dioxide and other treatments to degrade waste.

The team has a busy two years ahead with some significant challenges to overcome. Project Leader Dr John Andrews says, "We're creating a small reactor to sit in people's homes, and we need to make sure it's 100 per cent safe and still able to cope with the volume of waste a home full of people can generate".

To power the reactor, the team is working on options for a power source. They may use mains electricity, solar power or something else entirely. "We're also collaborating with a company called Urine-tricity from Bristol to create a microbial fuel cell, to act like a battery," says John.

Eventually the prototype will be fitted with a toilet bowl and seat of sorts, and when the working prototype is ready the team plan to have some lucky colleagues test it out.

The winners

"The real winners of this challenge will be the 2.5 billion people who'll benefit from the technology," says Research Leader Dr Daniel Gapes. "That number keeps us motivated, it's been key to our success. We're just one of many teams around the world working on a solution to this problem, but we're all sharing information and working together."

Scion has a lot of experience in waste treatment, with over a decade developing TERAX® technology and from research for the pulp and paper industry. Daniel says, "This research came from forestry, but the things we learn from this project could be applicable across a variety of fields. We're just excited to be part of project that's tackling big problems with bold solutions".

FOR FURTHER INFORMATION
on our 'Reinvent the Toilet' project, please contact Dr Daniel Gapes at daniel.gapes@scionresearch.com

Fascination of Plants Day

Plant science organisations all over the world will be celebrating the international Fascination of Plants Day on 18 May. This biennial event is set aside to recognise the value of plant science for producing food and non-food items like paper, timber, chemicals, energy and pharmaceuticals.

Dr Elspeth MacRae, General Manager Manufacturing and Bioproducts, is New Zealand's representative on the European Plant Science Organisation, which co-ordinates the celebrations. "Plants are the basis of New Zealand's world-leading food and beverage industry and it is plant raw material that underpins our up and coming biomaterials and bioproduct industries," she says.

Scion will be celebrating Fascination of Plants Day by planting two tree species with unique stories of their own, the Wollemi pine and Gallipoli pine.

There are fossil records of the Wollemia genus that have been dated to 200 million years ago. But the first living specimens were not discovered until 1994, when a chance find by an abseiler led to the discovery of what is now known as the Wollemi pine. The species was named after the Wollemi National Park, north-west of Sydney where it was found.

In the years following the discovery, Scion propagated new seedlings through tissue culture, helping to secure the future of the Wollemi pine.

The Gallipoli pine to be planted is a descendant of the Gallipoli Peninsula's Lone Pine. It is one of 50 trees grown by Scion from seeds that were collected in 2012 from the Turkish red pine (*Pinus brutia*) growing at Paeroa Golf Course (New Zealand). This tree is an authenticated New Zealand descendant of the original Lone Pine and traces back to a pine cone brought home by Australian soldier Sergeant Keith McDowell after World War 1. The remaining seedlings were gifted to RSAs nationwide in 2015.

Fascination of Plants Day is great opportunity to celebrate the unique history of these two species, and their long term survival thanks, in part, to the science Scion provided. The planting will be in conjunction with our 70th anniversary events.

FOR FURTHER INFORMATION on Fascination of Plants Day, visit www.plantday.org

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49 Sala Street,
Private Bag 3020, Rotorua 3046,
New Zealand
Telephone: +64 7 343 5899
Facsimile: +64 7 348 0952
www.scionresearch.com