

## SLMACC PROJECT 406896

MARLBOROUGH FUTURE IS DURABLE:

# Opportunities for a durable hardwood industry in Marlborough

Marlborough Research Centre, Blenheim

Friday 16<sup>th</sup> February 2024

**Clemens Altaner**

# Opportunities for NZDFI species

- Naturally ground-durable → Outdoor solid wood (e.g. posts, decking, wharf-timber...)
- Stiff and strong → Structural engineered wood products (e.g. LVL)
- Colour → Appearance (e.g. flooring)
- Dense → Bioenergy, carbon

# Durable eucalypts R&D

Research de-risked durable eucalypt investment

- Growing trees
- Utilising trees

→ Plausible business case

Ongoing process

*Analogy:*

- *Pinus radiata* is a well-established industry
- Received funding for decades
- Continuing investment into improvements

→ Clear research & development plan

# Posts

- *E. bosistoana* and *E. globoidea* performed well after 10 years in service
- Consumer survey revealed product satisfaction



## Naturally durable timber posts performing well

Paul Millen, Clemens Altaner and Harriet Palmer

*Since 2003, Marlborough-based Vineyard Timbers Ltd has been working to develop an industry based on home grown, naturally durable timber posts for use in vineyards. Between 2006 and 2009, around 1,400 posts were supplied to six vineyard owners in Marlborough's lower Wairau Valley to see how the posts were performing in service. The vineyard owners were keen to trial an alternative to the radiata pine posts treated with copper-chrome-arsenic and which are commonly used in New Zealand's vineyards.*



# Posts

- *E. bosistoana* and *E. globoidea* performed well after 10 years in service
- Consumer survey revealed product satisfaction
- Post peelers successfully tested
- Market and production survey



Promoting the wise use of trees for profit, amenity, sustainability and the environment

supported by  
**forestgrowers**  
commodity levy



## Producing posts and veneer from durable eucalypt timber

Clemens Altaner and Harriet Palmer

Producing a naturally durable timber alternative to treated radiata pine, and a high-stiffness component for engineered wood products, have been driving forces behind the New Zealand Dryland Forests Initiative. Wood quality research has also been an important part of this programme from day one. Growers need to be confident that the durable eucalypts they plant will grow fast and straight, and will also produce large, consistent volumes of durable, stiff and strong timber.



# Sawn timber

- *E. globoidea* machinability comparable or better than *P. radiata*



WOOD MATERIAL SCIENCE & ENGINEERING  
<https://doi.org/10.1080/17480272.2023.2222700>



RESEARCH ARTICLE



## Machinability of plantation-grown *Eucalyptus globoidea* timber

Hamish Scown, Hyungsuk Lim  and Clemens Altaner 

School of Forestry, University of Canterbury, Christchurch, New Zealand

### ABSTRACT

*Eucalyptus globoidea* is an emerging plantation species. Its naturally durable heartwood has the potential to be used for solid wood outdoor products. Good machinability of a timber is essential for solid wood processing but was unknown for *E. globoidea*.

The ASTM D1666 standard was used to assess the machinability of *E. globoidea* and compared to that of *Pinus radiata*, the dominating resource for the local wood processing industry and well-known for its good machinability. This study showed that *E. globoidea* machined equally well or better than *P. radiata* in planing, boring, mortising, grooving, edging, and turning. Sanding *E. globoidea* ( $723 \text{ kg/m}^3$ ) was not possible at the prescribed settings, whereas a smooth finish was obtained for the lower density *P. radiata* ( $461 \text{ kg/m}^3$ ). Reducing the sanding depth resulted in a satisfactory sanding finish. Defects that determined the machine scores were identified. When boring, mortising and grooving *E. globoidea* timber, most defects were chipping caused by the tool exiting the piece. When edging, most care needs to be taken at the corner.

The comparable machinability of *E. globoidea* and *P. radiata* according to ASTM D1666 indicated that the well-established *P. radiata* wood processing industry should be able to process *E. globoidea*.

### ARTICLE HISTORY

Received 31 January 2023  
Revised 3 May 2023  
Accepted 5 June 2023

### KEYWORDS

ASTM D1666; *Pinus radiata*;  
white stringybark; wood  
processing



# Sawn timber

- *E. globoidea* machinability comparable or better than *P. radiata*
- Demonstration products available





# LVL

- Good quality veneers peeled with production lathe



**NPI Ltd**



# LVL

- Good quality veneers peeled with production lathe
- Strong glue-lines can be obtained with optimised resin systems

Guo and Altaner *New Zealand Journal of Forestry Science* (2018) 48:3  
DOI: 10.1186/s40490-018-0109-7

New Zealand Journal of  
Forestry Science

## RESEARCH ARTICLE

Open Access



### Properties of rotary peeled veneer and laminated veneer lumber (LVL) from New Zealand grown *Eucalyptus globoides*

Fei Guo and Clemens Michael Altaner\*

#### Abstract

**Background:** *Eucalyptus* species can be alternative plantation species to *Pinus radiata* D.Don (radiata pine) for New Zealand. One promising high value use for eucalypts is laminated veneer lumber (LVL) due to their fast growth and high stiffness. This study investigated the suitability of *Eucalyptus globoides* Blakely for veneer and LVL production.

**Methods:** Twenty-six logs were recovered from nine 30-year-old *E. globoides* trees. Growth-strain was measured using the CIRAD method for each log before they were peeled into veneers. Veneer recovery, veneer splitting and wood properties were evaluated and correlated with growth-strain. Laminated veneer lumber (LVL) panels were made from eucalypt veneers only or mixed with radiata pine veneers to investigate the bonding performance of *E. globoides*.

**Results:** Veneers with no, or limited, defects can be obtained from *E. globoides*. Veneer recovery (54.5%) correlated



### Untersuchung von Einflussfaktoren auf die Verklebung von *Eucalyptus globoides*

Masterarbeit

Zur Erlangung des akademischen Grades

Master of Science Holzwirtschaft

Fakultät für Mathematik, Informatik und Naturwissenschaften

Fachbereich Biologie

Universität Hamburg

Vorgelegt am 05.12.2018

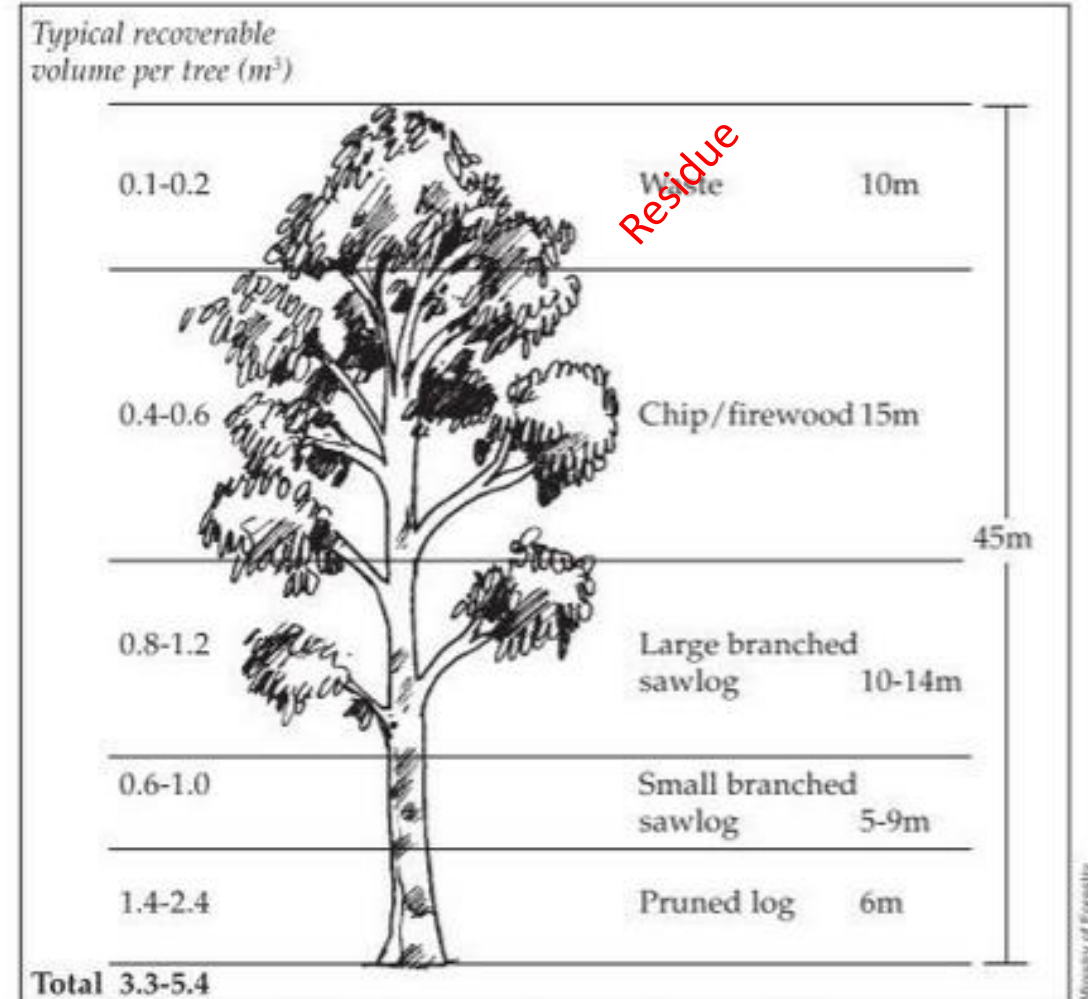
von

Marcel Kropat

# By-products NZDFI species

## Utilisation of whole tree

- Chip/Firewood
- Honey
- Foliage



Anonymous. 1995. Special Purpose Timber Species. New Zealand Ministry of Forestry.





# Wood quality

## Durability

- Affordable NDT method developed and verified against decay measurements
- Breeding populations screened

## Collapse

- Affordable NDT method developed
- *E. globoidea* screened
- Potential technical processing solution and silviculture intervention

## Growth stress

- Breeding populations screened
- Proof of concept NDT

# Durability

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Holzforschung 2019; aop

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 213 (2019) 111–117

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https://doi.org  
Received July  
published online

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Yanjie Li <sup>a, C</sup>

**Abstract:** Pl  
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<sup>a</sup> Research Institute of  
<sup>b</sup> School of Forestry, U

ARTICLE

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Yanjie Li, C

School of Forestry,

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Available online 1



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<sup>a</sup> Research Institute of Su  
<sup>b</sup> School of Forestry, Uni  
<sup>c</sup> LJ Cookson Consulting,

ARTICLE INFO

Keywords:  
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Decay resistance

Contents lists available at ScienceDirect

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European Journal of Forest Research (2018) 137:565–572

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ORIGINAL PAPER

Iyiola et al. *New Zealand Journal of Forestry Science* (2022) 52:13  
<https://doi.org/10.33494/nzjfs.52.1.13>  
E-ISSN: 1179-5395  
published on-line: 27/04/2022

Genetic  
of Eucal

Yanjie Li <sup>1,2,4</sup>

Received: 15 M  
© Springer-Ver

**Abstract**

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RESEARCH ARTICLE

Genetic vari



Contents lists available at ScienceDirect

Industrial Crops & Products

journal homepage: [www.elsevier.com/locate/indcrop](http://www.elsevier.com/locate/indcrop)

Genetic variation in drying collapse and heartwood properties at mid-rotation age of *Eucalyptus globoidea*

Vikash Ghildiyal <sup>1</sup>, Ebenezer Iyiola <sup>2</sup>, Monika Sharma <sup>3</sup>, Luis A. Apiolaza <sup>4</sup>, Clemens Altaner <sup>\*,5</sup>

School of Forestry, University of Canterbury, Private Bag 4800, Christchurch, New Zealand

ARTICLE INFO

ABSTRACT



Industrial Crops & Products 201 (2023) 116891



# Collaps

Industrial Crops & Products 201 (2023) 116891



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Industrial Crops & Products

journal homepage: [www.elsevier.com/locate/indcrop](https://www.elsevier.com/locate/indcrop)



Genetic variation in drying collapse  
mid-rotation age of *Eucalyptus globosa*

Vikash Ghildiyal<sup>1</sup>, Ebenezer Iyiola<sup>2</sup>, Monika :

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Wood Material Science & Engineering

ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/swoo20>

## ARTICLE INFO

### Keywords:

Breeding values  
Drying collapse  
Extractives  
Natural durability  
Tree breeding  
White Stringybark

## ABSTRACT

Main causes of d  
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*E. globosa* tree  
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## The effect of Joule heating on collapse and w absorption of wood

Vikash Ghildiyal, Ryan van Herel, Bill Heffernan & Clemens Altaner

To cite this article: Vikash Ghildiyal, Ryan van Herel, Bill Heffernan & Clemens Altane  
The effect of Joule heating on collapse and water absorption of wood, Wood Material S  
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To link to this article: <https://doi.org/10.1080/17480272.2022.2121660>

## Understanding and reducing drying collapse in difficult-to-dry plantation-grown eucalypt timber

A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in Forestry

By

Vikash Ghildiyal

School of Forestry, University of Canterbury



Senior supervisor:

Dr Clemens Altaner

School of Forestry, University of Canterbury

Associate Supervisor:

Dr Bill Heffernan

Electric Power Engineering Centre (EPEC), University of Canterbury

September 2023



# Growth-stress

## High throughput breeding for wood quality improvement

Nicholas T. Davies  
University of Canterbury  
New Zealand School of Forestry  
Department of Engineering  
University of Canterbury



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sp

Fei Guo, Clemens M. Altaner  
New Zealand School of Forestry, University of Canterbury

### ARTICLE INFO

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New Zealand School of Forestry, University of Canterbury

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## Wood Quality of Durable Eucalypts

A thesis  
submitted in partial fulfilment of  
the requirements for the degree of  
Doctor of Philosophy  
in Forestry  
by

**Ebenezer Adeyemi Iyiola**

School of Forestry,  
University of Canterbury



2021



Measuring Moisture Modulus with Raman Spectroscopy  
Fei Guo<sup>†</sup> and Clemens M. Altaner  
School of Material Engineering  
New Zealand School of Forestry

**ABSTRACT:** To measure moisture modulus with Raman spectroscopy, we investigated the Raman spectra of rewetted (water-saturated) *Eucalyptus regnans* and *Eucalyptus quadrangulata* wood during tensile tests. We used least squares models to predict the tensile strain we measured from the Raman spectra. The best model could predict tensile strain with a root mean square error of 427.5  $\mu\text{m}$  from the widely reported band shift at 1095  $\text{cm}^{-1}$ . Other Raman bands, mechanical strain, spectral changes at 1420, 1120, 845 and 456  $\text{cm}^{-1}$  were identified. The assignments of these bands were discussed in relation to the molecular deformation of the wood.

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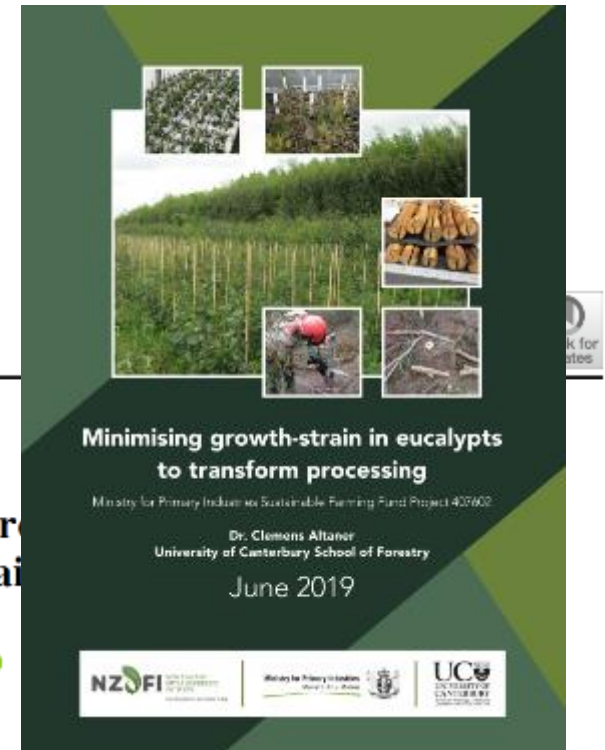
near infrared spectroscopy  
to measure growth strain

Altaner · Clemens M. Altaner

Received: 23 January 2019 / Accepted: 11 July 2019 / Published online: 25 July 2019  
© Springer Nature B.V. 2019

### Abstract

In order to quickly predict growth strain in eucalypts, we investigated the use of near infrared spectroscopy (NIRS) to measure growth strain in eucalypts. We used least squares models to predict the tensile strain we measured from the Raman spectra. The best model could predict tensile strain with a root mean square error of 427.5  $\mu\text{m}$  from the widely reported band shift at 1095  $\text{cm}^{-1}$ . Other Raman bands, mechanical strain, spectral changes at 1420, 1120, 845 and 456  $\text{cm}^{-1}$  were identified. The assignments of these bands were discussed in relation to the molecular deformation of the wood. In order to quickly predict growth strain in eucalypts, we investigated the use of near infrared spectroscopy (NIRS) to measure growth strain in eucalypts. We used least squares models to predict the tensile strain we measured from the Raman spectra. The best model could predict tensile strain with a root mean square error of 427.5  $\mu\text{m}$  from the widely reported band shift at 1095  $\text{cm}^{-1}$ . Other Raman bands, mechanical strain, spectral changes at 1420, 1120, 845 and 456  $\text{cm}^{-1}$  were identified. The assignments of these bands were discussed in relation to the molecular deformation of the wood. In order to quickly predict growth strain in eucalypts, we investigated the use of near infrared spectroscopy (NIRS) to measure growth strain in eucalypts. We used least squares models to predict the tensile strain we measured from the Raman spectra. The best model could predict tensile strain with a root mean square error of 427.5  $\mu\text{m}$  from the widely reported band shift at 1095  $\text{cm}^{-1}$ . Other Raman bands, mechanical strain, spectral changes at 1420, 1120, 845 and 456  $\text{cm}^{-1}$  were identified. The assignments of these bands were discussed in relation to the molecular deformation of the wood.



# Potential markets for naturally durable hardwood

Product	Market opportunity	Current market value
<b>Hardwood imports</b>	Substitution of high value timber imports MPI 2017: <ul style="list-style-type: none"><li>• 29,000 m<sup>3</sup> lumber</li><li>• 3,000 m<sup>3</sup> sleepers</li><li>• 5,000 m<sup>3</sup> posts/poles</li></ul>	<b>\$53.3 million per annum (\$1,400 per m<sup>3</sup>)</b>

# Establishing a durable eucalypt industry

NZ has existing wood processing industries and markets

- Post
- LVL
- Sawmilling / solid wood processing

NZDFI eucalypts can be processed with existing equipment



# Establishing a durable eucalypt industry

NZ has existing wood processing industries and markets

- Post
- LVL
- Sawmilling / solid wood processing

NZDFI eucalypts can be processed with existing equipment

Opportunity to **phase in** durable eucalypts once they become available

- **No need for large capital** investment into wood processing
- Enhance **diversification** and viability of existing wood processors

# Collateral benefits – environment

NZ: heavy metal contamination of land, water and air from CCA

THE CONVERSATION

Academic rigour, journalistic flair

CELLULOSE CHEMISTRY AND TECHNOLOGY

## PRESERVATIVE TREATED TIMBER PRODUCTS IN NEW ZEALAND

CLEMENS ALTANER

*School of Forestry, University of Canterbury, Christchurch, New Zealand*  
✉ Corresponding author: [clemens.altaner@canterbury.ac.nz](mailto:clemens.altaner@canterbury.ac.nz)

Received June 8, 2022

Copper Chrome Arsenic (CCA) is a potent wood preservative. It is currently the dominant wood preservative used in Aotearoa (New Zealand). Internationally, CCA has been phased out in many jurisdictions over the last decades due to health and environmental concerns. This review summarises the current knowledge about the health and environmental risks of CCA treated timber, revisits the risk assessment of New Zealand authorities of CCA treated timber and discusses the challenges New Zealand is facing from the continued use of this product. Overall, the attitude towards CCA treated timber is changing, with local government bodies and agricultural industries facing increasing challenges around the disposal of CCA treated timber and site remediation from CCA leaching.

**Keywords:** Copper Chrome Arsenic (CCA), disposal, end-of-life, environmental risks, recycling

### WOOD PRESERVATIVES

Wood is a natural and biodegradable material. The speed of biodegradation depends on environmental conditions and the nature of the wood. Premature biodegradation, *i.e.* rot of timber when in use, is a problem and detailed instructions for remediation of dry-rot infested buildings were already described in the Bible (Leviticus 14:33-57). However, some timbers can withstand conditions favourable for biodegradation

allowing to produce a highly durable and consistently performing building material from plentifully available non-durable timber species. In a New Zealand context, radiata pine (*Pinus radiata*) timber, which is non-durable and will decay within 5 years in ground contact,<sup>10</sup> can be efficiently converted into a highly-durable building material, due to radiata pine's excellent treatability, *i.e.* it is very permeable, making it



Shutterstock/speedshutter Photography

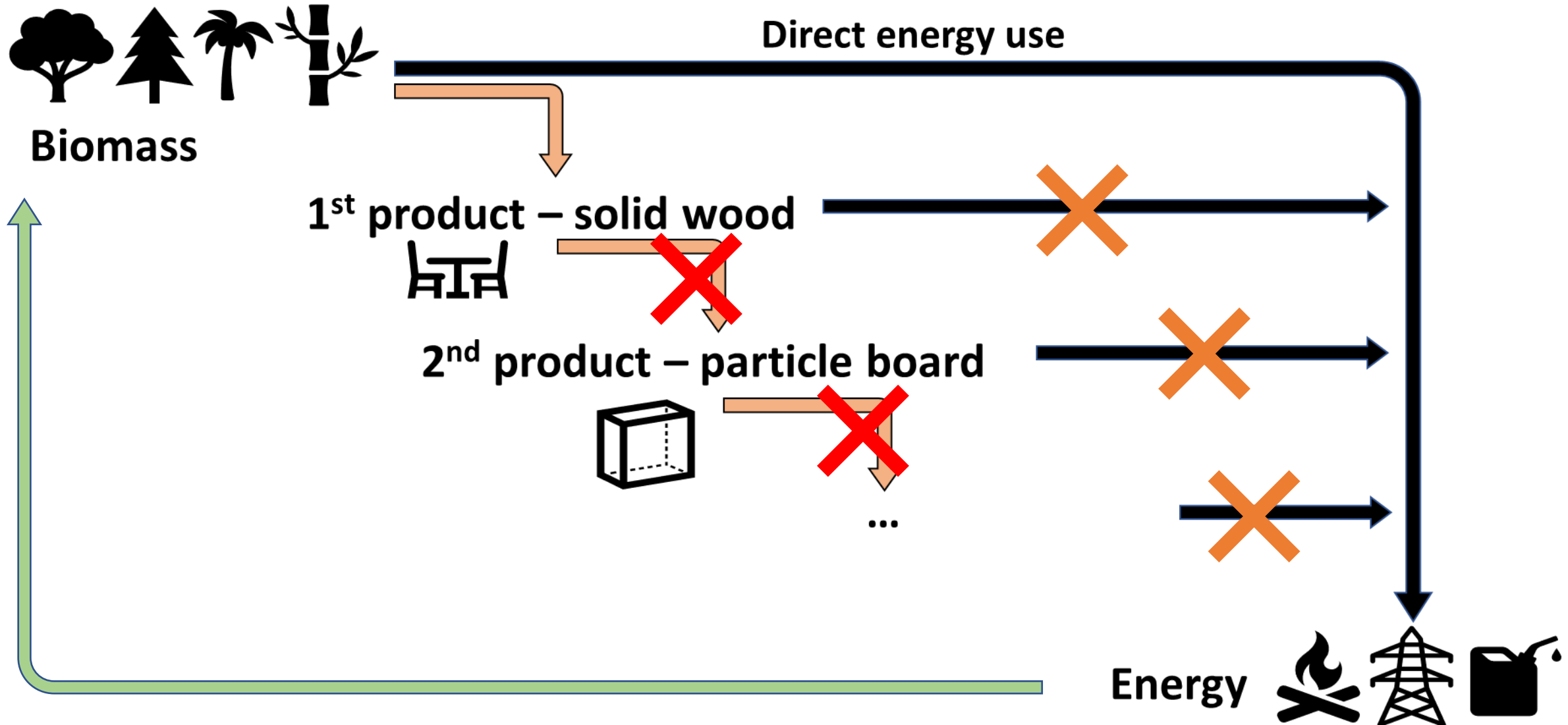
## Despite restrictions elsewhere, NZ still uses a wood preservative linked to arsenic pollution

Published: March 1, 2023 2:57pm NZDT

Clemens Altaner

Associate Professor in Wood Science, University of Canterbury

# Collateral benefits – circular bioeconomy



# Collateral benefits – circular bioeconomy

C.31



*“ The specific issue of waste timber’s frequent contamination with the heavy metal preservative copper-chrome-arsenic (CCA) was identified [...] “*

**2023 Advice**  
on the direction of policy  
for the Government’s second  
**emissions reduction plan**







# Marlborough's Rapaura sawmill sawing vineyard posts from *E. globoidea*

- Traditional small mill processing 80 year old *E. globoidea* sourced from Marlborough farm woodlot





# Research and education at the UC's NZ School of Forestry

**13 PhD research projects** along with several Masters projects and numerous undergraduate projects focused on:

- Wood quality, processing, products and markets
- Genetics and tree breeding
- Site species matching and modelling heartwood production
- Eucalypt health and protection







# Wood quality

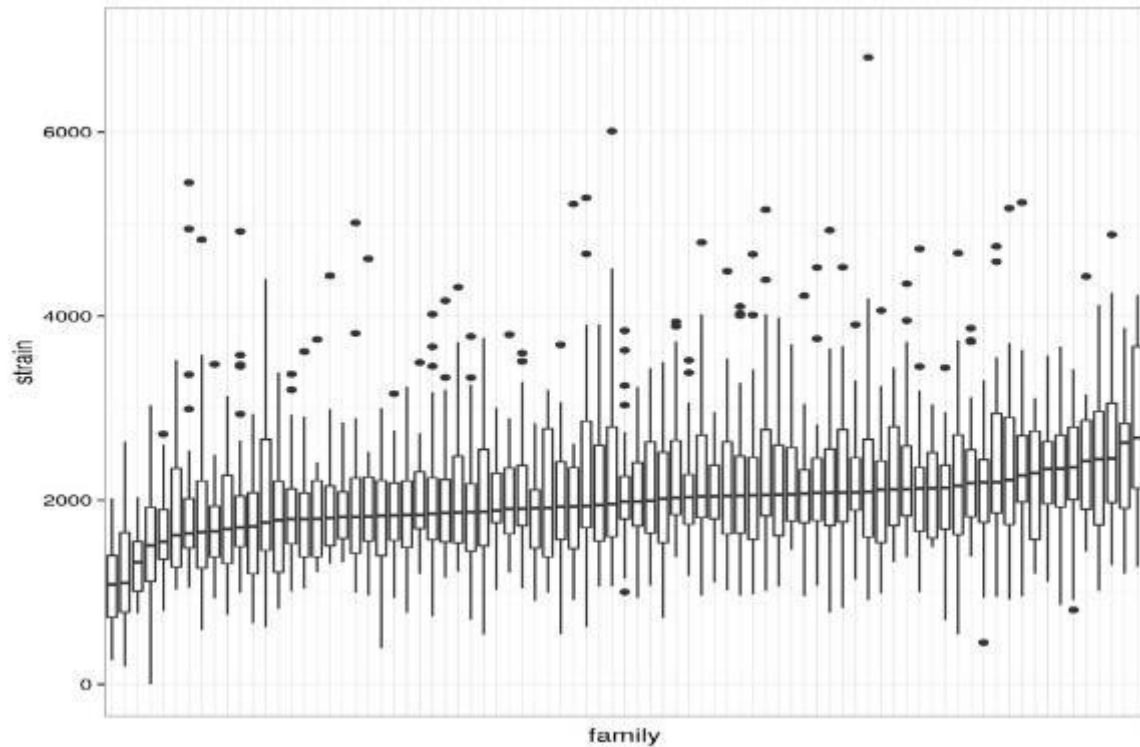
Address variation in wood properties through genetics

# Heartwood quality



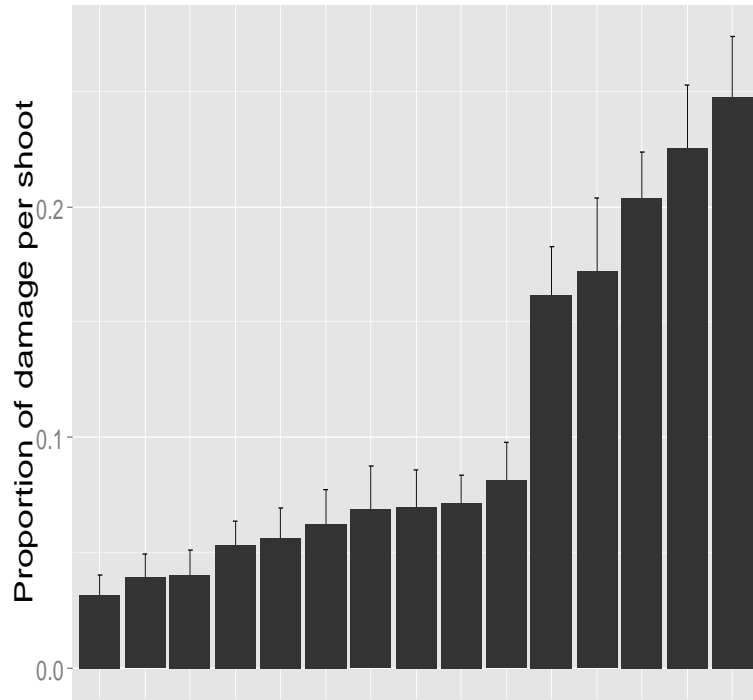
Variation in 4-yr *E. bosistoana*:

# Growth stress





# Pest resistance



- Genetic susceptibility to 4 pest species
  - 200 *E. bosistoana*, 15 families
  - 2 assessment methods compared over 18 months
- Some families are showing more/less tolerance
  - Particularly to leaf beetles
  - Link to provenance?

# Wood quality

## Durability

- Affordable NDT method developed and verified against decay measurements
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# Wood quality

## Durability

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- Potential technical processing solution and silviculture intervention