

What is the potential value of bio-products from forests in New Zealand?

October 2023



Chairman's Foreword

To place this foreword in context, I have only recently been introduced to the concept that “a tree is more than wood”. Wood is just one product from this amazing miracle of nature - a complex and intricate biochemical ecosystem within itself.

As we move to a world where fuels, chemicals plastics, garments, and even drugs that are currently derived from petrochemicals are replaced with new alternatives derived from renewable organics, our trees, our forests, represent a key strategic resource. New Zealand is increasingly being recognised as one of the technology thought leaders, not only in forest science, but also in the development of new, unique, bio-materials

This report sets out, at a very macro level, to assess what the commercial opportunity could represent. Its finding is that the total commercial opportunity for New Zealand is likely to be in the range of \$18 to \$25 billion. This represents a completely new industry segment that has the potential to be larger than those of most of the Country's primary product categories if not greater than all of them combined!

The potential positive impact for New Zealand is significant but must sit alongside the important primary sectors that have been the backbone of our economy for decades. This is not an either or. We need to work together to ensure that the best use is made of our land. Our hope is that this report will be the catalyst for a nationwide discussion around land use which we conduct in the spirit of Talanoa - “to talk and listen with respect.”

That korero has already begun with existing organisations working in the forestry bio-materials space, under the stewardship of the NZ Product Accelerator. A group that is already convinced of the exciting potential that awaits us if we move fast enough and in a nationally coordinated way.



Sir Ian Taylor KNZM
Co-Chair NZ Product Accelerator
www.nzproductaccelerator.co.nz

Contents

Executive summary	4
Purpose of this report	6
Approach to creating this report	7
A tree is more than wood	9
Global bio-products industry	10
New Zealand's forestry sector	11
Potential value and scale from a bio-products from forests industry	13
Further value of bio-products from forests	14
A chance to rethink the current industry	16
A need for alignment within the existing forestry sector	17
New Zealand's current policy and investment ecosystems	18
Key enablers	19
What happens next?	23
References	24
Appendix	25
Acknowledgements	26

Executive Summary

New Zealand has the potential to develop a profitable, sustainable bio-products industry from forests. Such an opportunity would require investment, changes to government policy and a rethink of the current forestry sector structure, but has the potential to lift forestry sector exports by \$12 - \$19 billion.

Objective

Forestry is a significant part of the New Zealand economy, yet our production forests are under-utilised, and the sector could be extracting more value than it currently does. This report seeks to highlight the potential value of a bio-products from forests industry to New Zealand. In this report, potential value excludes specific financial analysis, modelling and detailed forecasting. It considered indicative areas of economic value, and includes social and environmental value. The approach included a review of existing research, data and reports provided by the Bio-Forests Products Working Group and a series of semi-structured interviews with subject matter experts to validate findings.

Definition of bio-products from forests

Bio-products from forests refers to the products produced from woody biomass, including sawn timber. Secondary processing of this biomass can produce high value bio-products and sustainable alternatives to fossil fuels.

Existing forestry sector

The forestry and wood processing industry currently contributes \$6.7 billion in exports to the New Zealand economy, and is the fourth largest export industry¹.

In the last decade, the number of logs harvested in New Zealand has doubled, however domestic capacity for processing wood has remained unchanged since 2000. This has led to significant growth in the number of raw logs exported, making up 60% of export value. Value-add wood products, the other 40% of value, are only 15% of the total volumes exported¹.

Potential value

Globally there is a significant bio-product economy with a market cap of around \$105 billion², and is anticipated to grow over the next 20 years to more than \$500 billion³. This future market could be as high as trillions when we consider that in principle as much as 60% of all physical inputs to the global economy could be produced from a biological base⁴.

New Zealand could capture significant value from the creation of a bio-products from forests sector. The immediate value opportunity could see bio-products increase export value for the sector by an estimated \$12 - \$19 billion through shifting current raw log exports to higher value bio-products.

In addition, further value could come from the substitution of petroleum-based products currently imported into New Zealand, as well as economic value achieved through the bio-product industry's contribution to the decarbonisation of our economy, potentially avoiding the need for offshore mitigation activities and costs⁵. While the Emissions Trading Scheme is referred to as a supporting policy, this report does not consider carbon credits when describing the potential value.

The social and environmental impacts of bio-products add additional contributions to the New Zealand economy. These include:

- Increased and diversified employment opportunities
- Increased community prosperity to regional communities
- Presenting further opportunities for Māori businesses as key stakeholders within the forestry sector
- Recovery and utilisation of forestry slash to increase economic returns and to reduce the potential of damage from debris flows following severe storm events
- Reducing the use of fossil fuel in the production of other materials

Considerations and key enablers

To establish a bio-products from forests industry within the existing forestry sector there are several considerations within the supply and value chain that would need to be addressed.

The current industry has both opportunities and barriers that could support or hinder a future industry's establishment. Existing stakeholders can support the emerging sector, but there are also future stakeholders who will be needed that don't yet exist. These include slash collection services, anchor firms (larger, better managed and financed firms with links to international markets that act as 'anchors' for the rest of the bio-product value chain to support early establishment), and pilot plants to bridge the gap between concept and commercialisation.

New Zealand's policy and investment ecosystem has an opportunity to encourage investment and incentivise a market for bio-products. However, at present, New Zealand is not as attractive for investment as other countries. Although there are a number of existing policies that support the principles behind establishing a bio-products industry, current market signals indicate these policies lack the strength to incentivise industry establishment⁶.

Overall three key enablers, critical to support a bio-products industry in New Zealand have been identified. They are:

1. Government's role – both through policy and partnerships for co-investment and to facilitate investment relationships
2. Creating an investible industry - through improving the attractiveness of New Zealand investment environment
3. Designing a complete industry to be cohesive and competitive

Footnote

All figures within this report are in NZD unless otherwise specified

1. Ministry of Primary Industries. (2022)

2. Spekrijse et al. (2021)

3. Chui et al. (2020)

4. Brennan et al. (2021)

5. New Zealand Treasury. (2023)

6. Bio Pacific Partners. (2019)

Background



Purpose of this report

Understanding the significant opportunity that exists for a bio-products from the forestry sector in New Zealand.

The power of a tree

Forestry is an important industry for New Zealand, contributing significantly to the economy with approximately 1.6% of New Zealand's GDP. In 2021, the forestry sector's export earnings were \$6.7 billion with an estimated 35 - 40,000 people employed across the sector.

While forestry is a significant part of the New Zealand economy; it is recognised that the vast resource of over 1.74 million hectares of productive forests are being under-utilised, and as a sector we could be extracting significantly more value than we do at present.

In November 2022, the Forestry and Wood Processing Industry Transformation Plan (ITP) was released. The ITP recognises the need for transformation in processing capability and capacity to increase the return from wood products throughout the value chain, with bio-products from forests having a significant role in this transformation.

A bio-products from forests industry has the potential to be a significant value stream for the forestry sector, allowing the sector to realise significantly more value per tonne and per hectare of land used than traditional forestry exports. Bio-products from forests could provide the opportunity to reduce New Zealand's carbon footprint, not only in bio-fuel production, but also through production of substitutes for fossil fuel derived products such as plastics and bitumen.

Challenges to unlocking this potential

Whilst the ITP recognises the potential opportunity and role a bio-products from forests industry has to contribute to the transformation of the forestry sector, higher value bio-forest products are not included in the ITP's potential bio-products from forests economy, and opportunities may be missed if bio-products in a wider context are not included.

The issue is further complicated in that bio-products have many sub-industries with multiple product streams, which multiply out into thousands of potential value chain opportunities. With the limited resource and capability available to New Zealand, the question forms as to where should the limited resource and capability be directed to realise the immediate rates of return.

While individual companies involved in the Bio-Forests Products Working Group led by the NZ Product Accelerator have conducted their own individual economic evaluations, there is no consolidated comprehensive view of what the potential value of a new bio-products from forests industry could be. Further analysis is needed to understand and quantify the opportunity that exists to New Zealand.

This report is designed to consolidate the current research on bio-products from forests (from selected references provided by the Bio-Forests Products Working Group) and provide a high level view of the potential value of a new bio-products from forests sector for New Zealand.

Key question answered by this report

What is the potential value of bio-products from forests in New Zealand?

Footnote

All figures from Ministry of Primary Industries. (2022)

Approach to creating this report

A literature review and interviews with subject matter experts were utilised to provide a view of the potential value of bio-products from forests in New Zealand.

1

Analysis of existing literature

A review of resources, reports and supporting documents were collated by the Bio-Forests Products Working Group. The literature was read and summarised to identify the potential opportunities and considerations for a future industry producing bio-products from forests in New Zealand.

2

Expert validation

Semi-structured interviews were conducted with subject matter experts to test the assumptions and conclusions reached from the literature. These observations and insights were overlaid with other credible data and literature sources and international examples to provide greater context.

3

Report

This report was produced, as a consolidated view, to outline the potential value of bio-products from forests in New Zealand.



Defining potential value

This report is designed to provide a high level view of the potential value of a bio-products from forest industry.

'Potential value' excludes specific financial analysis, economic modelling or detailed forecasting. Potential value is defined as being broader than just economic value, and both social and environmental value are considered.

This report does not seek to calculate a 'total value', rather it explores possible opportunities for increased value, which would need further investigation and a detailed economic analysis. As the report does not include specific financial analysis, any costs associated with opportunities are also not quantified. This cost-benefit analysis would be required in future studies.

The potential value should be considered as an indicative guide to the types of opportunities bio-products from forests could achieve.

Potential for a bio-products from forests industry



A tree is more than wood

Bio-products from forests refers to the products produced from woody biomass. Secondary processing of this biomass can produce high value bio-products and sustainable alternatives to fossil fuels.

Bio-products from forests can be broken down into the following broad categories covering hundreds of possible products that can be produced from forests.

1

Bio-chemicals

These are the chemical building blocks of the tree which are extracted and produced in the bio-processing of the woody biomass.

Examples include:

- Lignin
- Tannins
- Cellulose based bio-chemicals

2

Bio-materials

The materials that can be produced from the application of bio-chemicals.

Examples include:

- Plastics
- Paints
- Resins
- Pharmaceuticals
- Cosmetics
- Composite products (e.g. wood-composite concretes)

3

Bio-energy

The energy sources that can be produced from woody biomass.

Examples include:

- Biocrude
- Liquid bio-fuels
- Solid bio-fuels (e.g. pellets)

Example: Port Blakely Essential Oils

Port Blakely are a US based forest products company that have just finished commissioning a world scale Essential Oils plant in Otago, New Zealand. Their essential oils plant will distil Douglas-fir foliage using a steam condensation method. In 2023, the plant will produce approximately 6-7 mt of essential oils to sell into the international market, this is expected to double to around 15 tonnes per annum over time¹⁵.

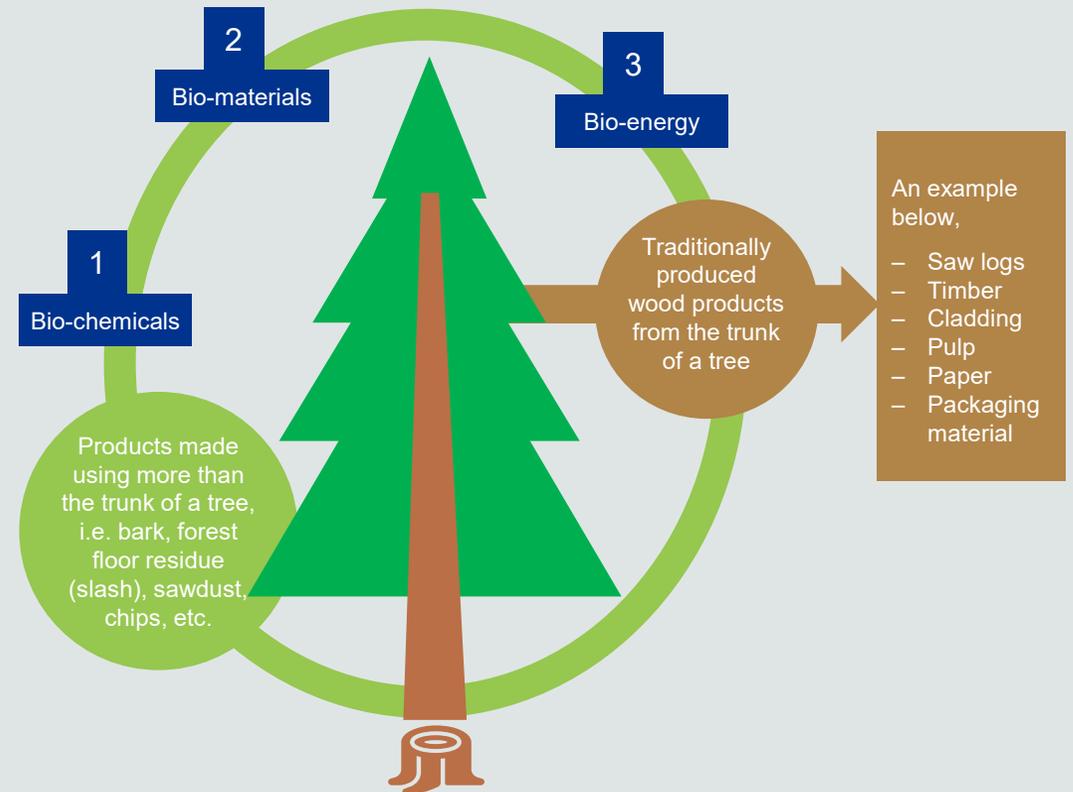
Douglas-fir essential oil is used in the fine fragrance and aroma therapy markets globally. Natural sustainably produced essential oils are increasingly replacing fragrances derived from hydrocarbons. The essential oils plant is part of Port Blakely's strategy to diversify into the bio-circular economy.

Example: NZ Bio Forestry

Founded by New Zealand Māori, Singaporean and Taiwanese partners, NZ Bio Forestry have built a business model to optimise the key resources of each economy.

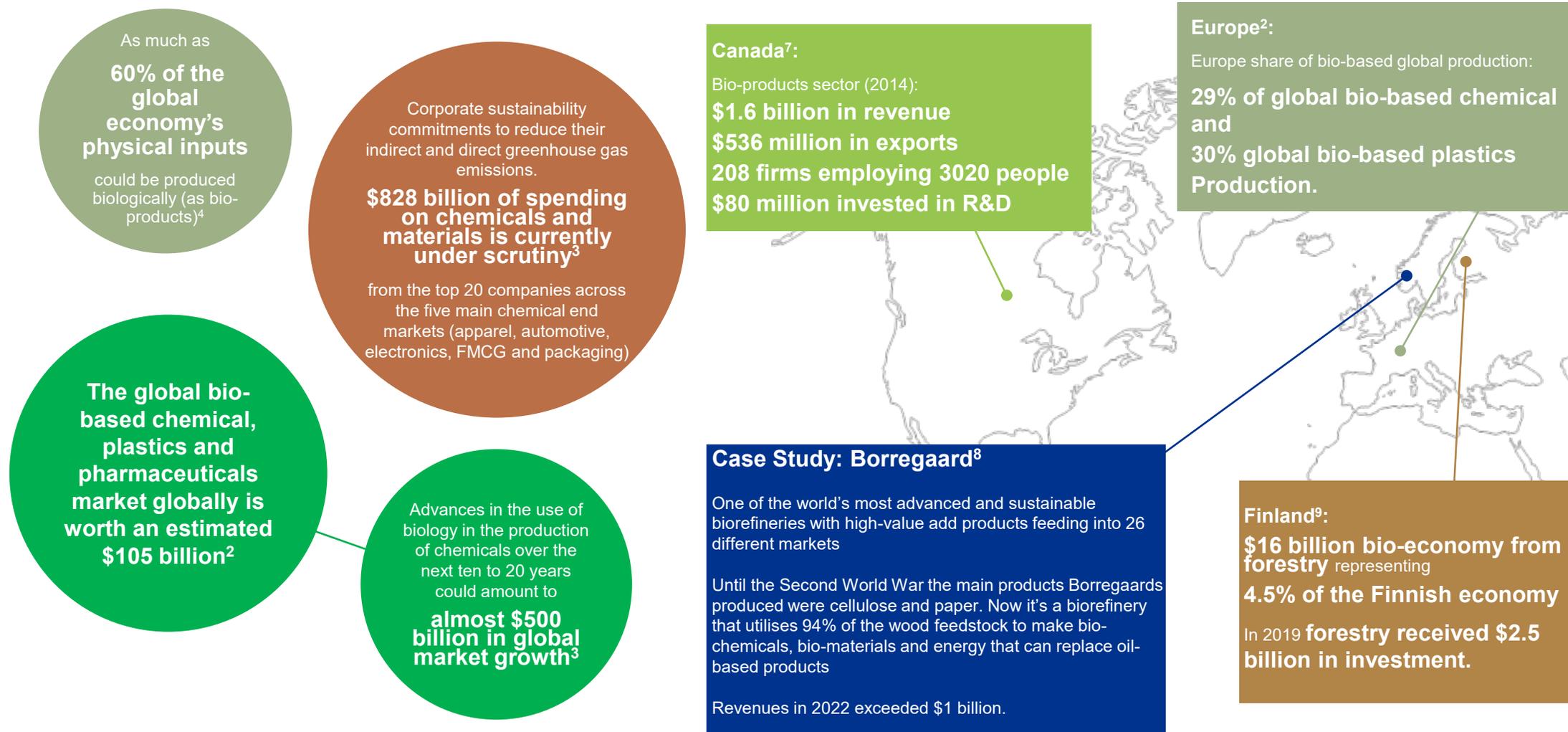
They use proven IP to convert plantation forestry biomass into bio-fuels, bio-chemicals and innovative materials. Their first modularised plant will be built in Asia this year.

Bio-products can increase the existing value of New Zealand's forestry assets. We have the potential to create value from wood that historically would be exported.



Global bio-products industry

Globally there is a significant bio-product market opportunity for New Zealand forestry.



Footnote
All values are in NZD | 1EUR:1.76NZD | 1NOK:0.15NZD | 1USD:1.66NZD
4. Brennan et al. (2021)
2. Spekrijse et al.(2021)
3. Chui et al. (2020)
7. Bioindustrial Innovation Canada. (2019)
8. The Borregaard Group. (2022)
9. Finland Promotional Board. (2022)

New Zealand's forestry sector

The current forestry sector is crucial to New Zealand's economy but there is more unrealised latent value to be captured.

New Zealand's production forests are abundant and versatile.

Forestry and wood processing exports contribute \$6.7 billion to the New Zealand economy, and forestry is the fourth largest export industry. An estimated 35 - 40,000 people are employed in the sector.

New Zealand has 1.74 million hectares of planted production forest, of which 70% is in the North Island. The Central North Island region has the highest concentration of production forestry, at 32% of national plantation forest stock.

In the last decade, the number of logs harvested in New Zealand has doubled to 36 million m³ however the domestic capacity for processing wood has remained unchanged since 2000. This has led to significant growth in the number of raw logs exported, with little growth in the export of value-add wood products. In 2021, New Zealand exported 22 million m³ of unprocessed logs, worth \$3.9 billion. Export logs represented 60% of the total sector export value in 2021, with the remaining 40% of value derived from other value-add wood products. These value-add exports were only 15% of the total volume exported.

\$6.7 billion

Export revenue in 2021

22 million m³

Logs exported in 2021

1.6%

Contribution to New Zealand's GDP

\$3.9 billion

Export value of raw logs in 2022

4th

Largest export earner

60%

Of total forestry export revenue from logs in 2021

40% of export value

came from just

15% of volume exported

Footnote
m³=metric tonne
All figures from Ministry of Primary Industries. (2022)

Potential value from bio-products from forests in New Zealand



Potential value and scale from a bio-products from forests industry

There is an immediate opportunity to increase the economic value of the forestry sector exports by an estimated \$12 - \$19 billion^A from a bio-products from forests industry.

Bio-products are a key component to increasing export value, reduce reliance on imported petroleum-based materials, and support New Zealand achieving our climate commitments. While it is not expected that all of the described value will be realised in combination, this gives an indication of the types of potential value a bio-products from forests industry could bring. Described value within this report does not include any 'multiplier effects' such as the additional direct and indirect value, deeper analysis is required to quantify this value.

\$12 billion - \$19 billion uplift in export value^A

There are multiple possibilities of value-add bio-products from forests that can be produced from woody biomass. At present, 60% of our export value (\$3.9 billion¹) is from log exports. There is significant opportunity to grow the export value of the sector through more on-shore processing into higher value bio-products. If only current log exports are considered, the potential uplift in export value could be as much as six times current value.

The average raw log value in 2021 achieved approximately \$370/dmt¹. This is significantly lower than the potential values of \$1550 - \$2140/mt for bio-chemicals and biomaterials⁸. If the same volume of exports were in these higher value bio-chemical and bio-materials rather than logs, the potential increase in export value could be between four and six times the current value (\$16.4 - \$22.6 billion^A). When current log export value is subtracted, the uplift is between \$12 - \$19 billion. Utilising wasted in-forest residue products could increase this even further.

Not all log export volume would be converted to the equivalent bio-product export volume, this calculation only demonstrates an upper value for that the potential increase in export value from bio-products from forests which is estimated to be somewhere between our current \$6.7 billion forestry industry and \$22.6 billion.

Offshore CO₂e mitigation costs

Establishing a bio-products from forests industry would also be a key component to support a zero carbon economy for New Zealand, with bio-products from the forest sector able to play an important role in decarbonising our economy. Scaling production of low-emissions, high-value wood products and fuels will enable other industries to decarbonise - wood pellets for example have the potential to reduce emissions by 93% compared to coal if used as a direct replacement.

New Zealand has made international commitments, however, we will not be able to meet our nationally determined contribution (NDC) to reduce our emissions under our current trajectory of 99Mt CO₂e shortfall⁵. In order to meet these targets New Zealand may need to use offshore mitigation. Currently, Treasury has budgeted that it will cost New Zealand somewhere between \$3.3 and \$23.7 billion in offshore mitigation by 2030 to achieve the NDC and meet international commitments⁵. These values are based on low and high scenario prices for international units and the size of the cost depends on whether New Zealand under, exactly, or over-achieves its domestic emissions budgets; and more importantly what price New Zealand pays for these international reductions⁵.

It is not be expected that bio-products from forests would fully decarbonise New Zealand but has an important contribution to make emission reductions, and thus lower future offshore mitigation costs.

Substitution value of imported petroleum-based materials

If a bio-products industry is established and New Zealand develops the capability and capacity to manufacture bio-chemicals and bio-materials from those chemicals, there is further potential value through substitution. These products could replace petroleum-based alternatives which New Zealand currently imports.

For example, instead of importing fuels, adhesives, paint and plastics, these products could be produced domestically from forests. In 2022, New Zealand imported a total of \$14.4 billion of these products¹⁰ that could be partially substituted with domestically produced bio-products. If current unutilised woody residues were collected and converted into bio-products replacing these imports, the substitution value estimated could be \$2.5 billion^A; if current log export volumes were also converted to replace these imports, the substitution value could be up to \$6.2 billion^A.

To fully quantify the additional economic value of potential substitution value, further analysis is required to determine which products could realistically be substituted through New Zealand's supply of woody biomass. It is also worth noting that export of these products rather than domestic consumption, could realise greater export value with higher margins in international markets than realises their substitution value in New Zealand.

Footnote

mt=metric tonne

A. Refer to Appendix for a detailed breakdown of calculations and assumptions.

1. Ministry of Primary Industries. (2022)

8. The Borregaard Group. (2022) | *Average prices/mt for their bio-polymer and bio-material products, 1NOK:0.15NZD.*

5. New Zealand Treasury. (2023)

10. United Nations. (2022) | *1USD:1.66NZD*

Further value of bio-products from forests

Social and environmental impacts and benefits of bio-products from forests can bring additional value to New Zealand beyond the economic impact.

Social value

Increased and different employment opportunities

- “If you export a log, you export a job” – by not adding value to logs before export, an opportunity is missed. A bio-products industry would increase jobs in the regions. These jobs would be highly skilled and higher paying jobs compared to traditional sector roles¹.
 - For example, scientists, robotics experts, data analysts and IT specialists.

Increased community prosperity

- A bio-products from forests industry would bring value to regional economies through its impacts¹:
 - directly (through economic activity generated by a facility)
 - indirectly (through associated industries downstream and upstream e.g. transport haulage, construction)
 - induced (economic activity in industries not associated with the industry but still affected by additional economic activity e.g. cafés seeing increased customers due to additional workers in town)
- To demonstrate, currently the pulp, paper and wood manufacturing sectors in New Zealand provide a multiplier effect of 3 to 1 in broader economic impact⁶.
- It would also mean increased modernisation of infrastructure in New Zealand.

Opportunities for Māori businesses

- Māori own 30% of forestry land in New Zealand and make up 22% of the total sectors workforce. Overall, Māori businesses own \$4.3 billion in forestry assets, however a challenge exists in that while Māori hold significant land ownership, they do not own the forests¹ meaning less liquidity and control over their whenua and less profit share.
 - Establishing a new industry in partnership with Māori could mean new business models that will bring significant economic, social, cultural, spiritual benefits for Māori

Environmental value

Support decarbonisation of NZ's economy

- A bio-product industry could reduce New Zealand's carbon emissions by approximately 6.9 million mt by 2030, with further reductions of 54 million mt by 2050¹.
- Bio-fuel production from slash specifically could significantly contribute to decarbonising the wider New Zealand economy.
 - Estimates suggest harvesting just 1.6 million mt of slash would produce 11 million GJ per year which would be enough to decarbonise the entire dairy sector¹.

Reduction in fossil fuel use in the production of materials

- Until the 1940s, all plastics were produced from organic sources (e.g. casein). The use of bio-chemicals from forest biomass can provide alternatives to the petroleum-based materials we use today¹.
- Naturally biodegradable microplastic residues from these materials will be friendlier on the environment than petroleum-based ones.

Recovery of forestry contaminants (slash)

- Approximately 3.5 million mt of forestry residues (slash) are left in forests.

Bio-product production will make collecting these forest residues attractive and economic¹. Less slash will mean less future infrastructure damage from slash during extreme weather events as experienced during cyclones Hale and Gabrielle.

Example: Futurity Bio-Ventures

Founded in 2019, Futurity is a renewable chemical and material production company working to commercialise their technology into a bio-refinery facility in New Zealand.

Futurity have modelled that successful delivery of their deployment plan for a planned co-located facility at Oji Fibre Solutions pulp mill will bring potential employment of 60 FTE and impact approximately 600 jobs within the Central North Island region, through an investment of \$80 million.

Footnote

GJ = gigajoule

1. Ministry of Primary Industries. (2022)

6. Bio Pacific Partners. (2019)

Considerations to producing bio-products from forests in New Zealand



A chance to rethink the current industry

Expert elicitation has highlighted the following observations and considerations about our current forestry sector.

Forest management practices

Because trees are currently grown for structural timber the forestry sector is 90% Radiata pine, grown for 28 years before harvest. In the future, the primary purpose for timber may shift to biomass production, so aspects of forest management may change⁶:

- variety
- biomass/ha
- growing cycles
- stem density

Ultimately it could mean greater and earlier returns for forest owners. The industry has invested many years of research into growing for current purpose, so now requires R&D for new optimal forest management practices.

Forest ownership and securing supply

Smaller forest owners (less than 1000ha) supplied 40% of the harvest in 2018-19¹. As forestry is not their primary source of income they are more opportunistic with when they sell.

This may present a challenge in securing long-term supply however it may be overcome by higher returns for their woody biomass in the long term.

Too many parties in the profit share?

New Zealand's forestry sector structure means the market is priced to its maximum to generate enough profit for all parties: Someone owns the land, someone else owns the tree, and someone else harvests the tree. All this is before it even makes it through the steps in the processing chain¹.

This may create a challenge for a future industry to get all stakeholders on board, however it may be overcome if higher value can be realised.

It also brings into question how Māori will benefit from a future industry.

In forest residue currently costly to recover

Forest terrain is often rugged and remote, increasing recovery and transport costs of slash. This increases the cost of production for manufacturers processing residue biomass.

In-forest residues may also require cleaning prior to processing.

- For example, slash washed away through extreme weather carries salt, soil and water contaminants making it unusable with our existing technology.

Future utilisation of slash into valuable bio-products will help overcome this, making its recovery more economic.

Domestic processing market is saturated

Current processing infrastructure is not suitable for bio-product production. Sector processing capacity has also remained the same since 2000¹.

Any bio-refinery will need to work with existing or new forestry processing and manufacturing facilities – essentially as a hub where multiple revenue streams are realized from the same woody biomass.

Investment in bio-product facilities cannot occur without an increase or modernisation of existing forestry processing capability.

Possible cluster locations

The Central North Island is likely the best location for the first bio-product cluster location.

- Highest concentration of New Zealand's forest stock (32%)¹
- This region has existing processing infrastructure, and road and rail connections
- Flat terrain means less costly recovery costs

However, when wider social and environmental factors are considered, other regions may benefit more from a bio-product cluster.

Highly competitive landscape

Where bio-products replace existing petroleum-based alternatives these are markets with established industries and may need support to compete (e.g. market incentives, tax incentives).

In particular, bio-fuels would enter a thin margin commodity market competing with petroleum fuels, so strong policy to incentivise decarbonisation would likely be required.

Competition with exports of logs

Any future bio-products industry would compete with the existing market structure. As one interviewee said – “there's no risk to putting a log on a boat”. This may present a barrier for investment into the establishment of an industry, which would need to be addressed.

Finding the “sweet spot”

There are hundreds of potential bio-products from forests to consider. There will need to be a balance between 'high-volume, low value', and 'low-volume, high value'.

Carbon pricing

Carbon pricing could potentially influence a redirection in the forestry sector's operations.

The current carbon sequestration benefits associated with biochemicals are not as widely recognised as those from traditional uses of wood, particularly in long life applications such as building materials.

As carbon prices escalate, the forestry industry's economic fabric could undergo transformation, highlighting the carbon sequestration potential not just from wood, but also from all durable products derived from it. This shift aligns with New Zealand's growing recognition of the circular bioeconomy approach.

Footnote

6. Bio Pacific Partners. (2019)

1. Ministry of Primary Industries. (2022)

A need for alignment within the existing forestry sector

There are both opportunities and barriers in our existing sector that could support or hinder a future industry's establishment.

1. Existing Stakeholders

There are many in the existing forestry sector who are working together to establish a bio-products from forests industry:

- Forest owners
- Research providers
- Supporting agencies
- Wood processors
- Industry leaders

2. Fibre Availability

New Zealand is sitting on the largest plantation of Radiata pine in the southern hemisphere, a sustainable **non-food** biomass source. This is an opportunity because much of the global bio-product industry is using biomass from food sources, calling their sustainability into question.

Despite future forecasts of wood harvest decline, there is sufficient forest biomass available to support a future industry. Particularly given a bio-product industry can extract value from all parts of the tree including 'waste' residues.

3. Future stakeholders needed

The following are stakeholders who will be needed, but do not yet exist in the sector:

- Slash collection and pre-processing
- Test bed / pilot plant facilities
- 'Anchor firm' for a bio-based cluster
 - Anchor firms are an integral part of value chains; they are larger, better managed and better financed with links to international markets. They act as an 'anchor' for the rest of the bio-product value chain, and are needed to establish market pull for early technologies.

Case Study: Oji Fibre Solutions

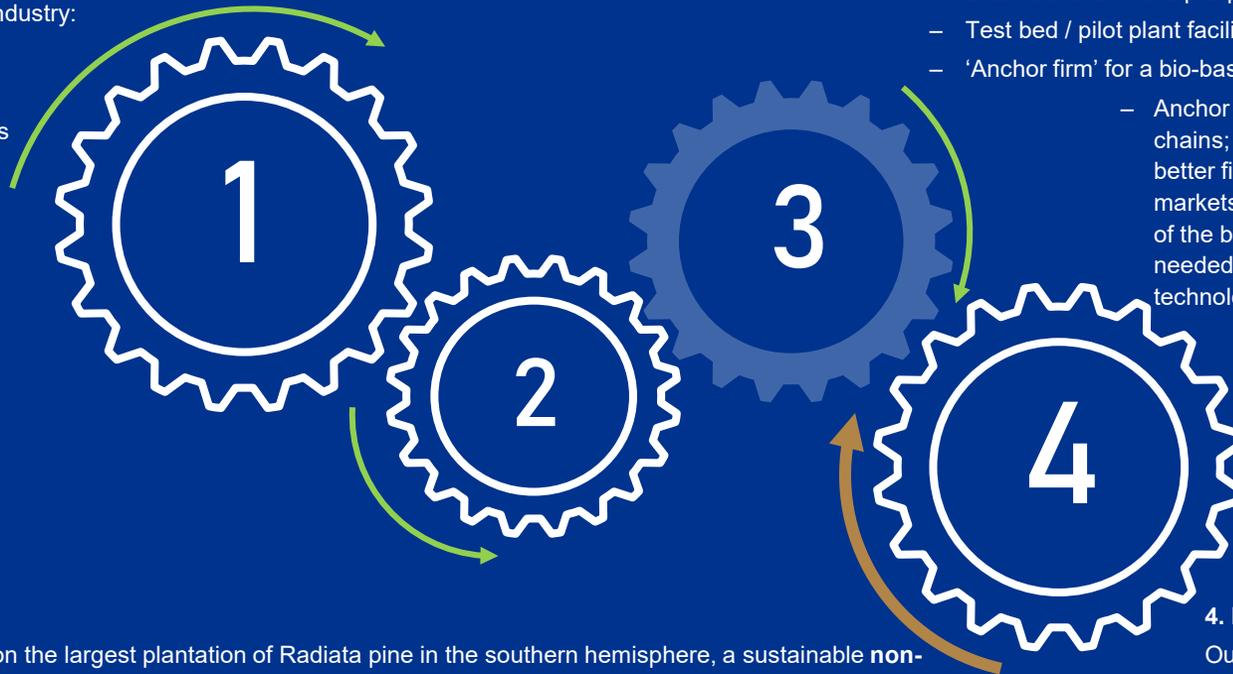
Oji Fibre Solutions are a pulp, paper and wood-fibre based packaging manufacturer, and are an active stakeholder in New Zealand's forestry sector. They are members of the global Oji group, a paper, pulp and forestry enterprise with operations across five continents.

In 2022, they produced over 1 million mt of pulp, paper and manufactured packaging goods into over 30 international markets.

Due to their existing infrastructure, expertise and international ownership, Oji Fibre Solutions have both the ability to innovate and the scale to act as an anchor firm within the existing value chain.

4. Existing operators who may see bio-products as a threat

Our interviews with subject matter experts suggested there may be resistance to a bio-products from forests industry from some who may perceive it as a threat. Brand new manufacturing facilities would add to the current domestic capability, but could be seen as a threat by existing processors. to the new product types. Roading and freight companies could also see bio-products as a potential threat as they are making significant profits from transporting logs unless they adapt to new product types.



New Zealand's current policy and investment ecosystems

In order to establish an industry making bio-products from forests, New Zealand needs an environment that encourages investment and incentivises the development of a market. These observations on the current state of policy and investment are also explored in greater detail as key enablers.

Investment

New Zealand is not currently an attractive environment for investment.

While we have plenty of sustainably grown woody biomass, global competition for investment in these industries is high and there are a number of factors inhibiting New Zealand, which would need to be taken into consideration when weighing up opportunities.

1 New Zealand is more expensive than competitors

The cost to establish and run a bio-refinery in New Zealand is higher than other countries⁶. Interviewees shared the following examples of added cost:

- High cost of labour
- High exchange rate
- New Zealand's physical distance from major markets creates logistics costs
- Earthquake prone, meaning higher building standards required
- Legal costs and processes to gain consent
- Interviewees discussed losing investors due to legal battles (over 3 years) over consents for facilities. Their estimates for construction of a new bio-pellet facility included 10-15% of cost for RMA and legal fees.

2 Less incentives in comparison to other global competitors

Other countries are better at attracting foreign investors through policies such as tax incentives, talent development and strong R&D programmes¹.

- For example, in Ireland, it is estimated that 20% of all private sector employment is directly or indirectly attributable to foreign direct investment (FDI). While this may be an extreme global example due to the attractive business environment (lower corporate tax rates) created by their FDI policy, Ireland are also very focused in their FDI initiatives on developing and nurturing talent, and heavily invest into their national R&D innovation system¹¹.

Policy

New Zealand does not have a bioeconomy strategy, however a number of existing policies support the principles behind establishing a bio-products from forests industry.

1 Existing New Zealand government policy which supports a forest bio-product strategy includes:

1. The Emissions Reduction Plan
2. Forestry and Wood Processing Industry Transformation Plan
3. New Zealand Emissions Trading Scheme

If these policies were strengthened they could incentivise establishment of a bio-products from forests industry.

2 Although these existing policies support the principles behind establishing a bio-products industry, the policies lack the strength to incentivise industry establishment

The lack of a national bio-economy strategy, or strong market signalling (e.g. New Zealand's carbon price relative to other nations, and the recent government reversal on biofuel mandate) doesn't give confidence to investors that New Zealand is committed to having a bio-economy¹.

Policy support would be particularly important in the initial period of industry establishment to encourage market demand and willingness-to-pay, as well as facilitating fibre security and availability through policies around harvesting requirements and transport taxes⁶.

- For example, Finland's National Biofuel Promotion Policy has a national obligation for 30% of transport fuel to be renewable or bio-based. There are strong penalties for non-compliant fuel retailers⁶.

Policy documents alone are not sufficient to transform a sector; government investment and action will be needed to enable true transformation and show foreign investors New Zealand is committed to establishing a bio-products industry⁶.

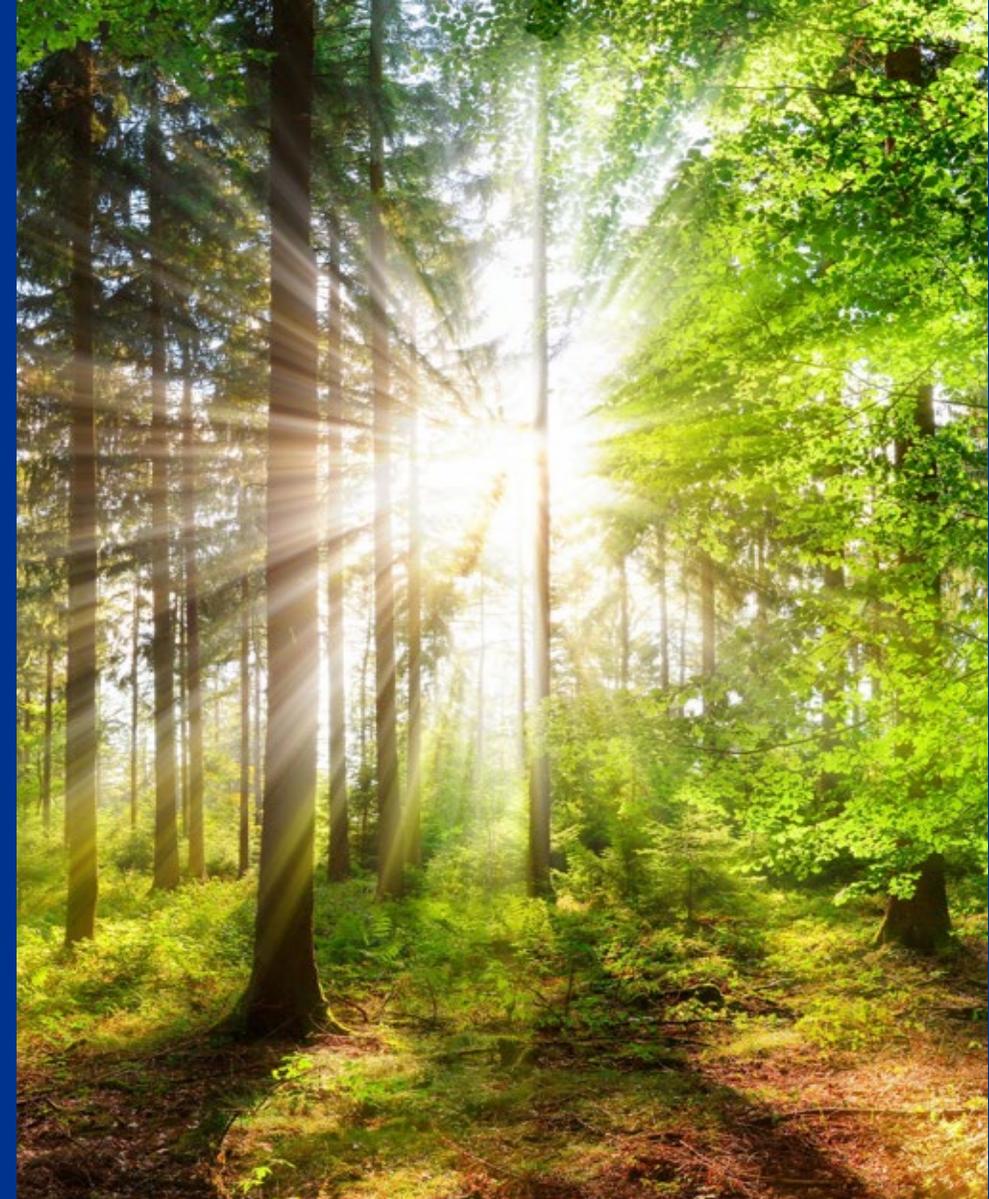
Footnote

6. Bio Pacific Partners. (2019)

1. Ministry of Primary Industries. (2022)

11. Irish Government Department of Enterprise, Trade and Employment. (2023)

The key enablers for a bio-products from forests industry



Key enablers: Government's role

Through both policy and non-policy measures the government will be a critical enabler for a bio-product forest industry.

1

Policy

As identified earlier, policy and regulation are mechanisms that can be used to make New Zealand attractive to foreign investors and support the research needed to establish an industry. In the case of the European Union nearly \$140 billion in funding through three key policies (Circular Bio-based Europe, Horizon 2020 and Bio-Based Industries Joint Undertaking) have been supporting their bio-economy's establishment to grow to its current scale¹².

Examples of international policy support at a country level include:

- Finland has a national Bioeconomy Strategy (2022-2035), which sets key national measures, as well as sector specific measures¹³.
- Finland also used strong commitments and pricing measures through their National Biofuel Promotion Policy to incentivise change for the fuel industry (refer page 18).
- Canada has used their Clean Fuel Standard policy regime with strict reduction targets, to ensure a commercial forestry bio-product sector will become an important problem solver for their transport, construction and manufacturing industries¹⁴.

2

Partnership through co-investment

The New Zealand government will have to be an active stakeholder in establishing the sector. Continued co-investment between the private and the public sector to modernise existing processing facilities and test commercial viability of technologies will help overcome initial cost barriers and support a fledgling industry. The government has recently (June 2023) announced a \$57 million co-investment Wood Processing Growth Fund to expand New Zealand's wood processing sector. International examples of government co-investment support at a country level include:

- Finland uses state grants to support research and development in the field of renewable energies, on average special 'energy aid' covered 23% of total project costs for new energy technology and large scale demonstrations progressing future energy technology¹⁴.
- Canada's forestry sector in the Quebec province has been considerably more successful in transformation than the British Columbia province, the key difference being direct financial support from the provincial government in the form of grants, low-interest loans and equity investments¹⁴.

3

Partnership through relationships

The government will also need to play a role beyond policy and co-investment. New Zealand agencies would need to be proactive with potential investors rather than waiting for investment opportunities to present themselves. This would require relationship building from senior government officials - visiting potential investors and companies, to understand their business needs, what conditions are needed for investment, and ideally solidify a relationship that results in investment.

The government also needs to play a stewardship role with existing New Zealand non-forestry manufacturers and corporates to encourage decarbonisation. Further partnerships, such as the recent Government-NZ Steel partnership (funded through the Government Investment in Decarbonising Industry (GIDI) fund) will not only reduce national greenhouse gas emissions but create market willingness for bio-fuel solutions. It is possible that large emitters could become key stakeholders, and even investors, in a bio-products from forests industry.

Footnote

All values are in NZD | 1EUR:1.76NZD

12. Stuart. (2023)

13. Finnish Government. (2022)

14. Indufor. (2021)

Government's Role

Investment

Designing a complete industry to be cohesive and competitive

Key enablers: Investment

Bio-products from forests is a capital intensive industry, major investment will be required from industry as well as capital from beyond New Zealand.

1 The ideal criteria for attracting investment

Investors are excited by green projects that have scale and are able to make good returns. To an investor, the ideal investment environment includes the following criteria:

- **A healthy macroeconomic environment:** New Zealand has a relatively stable economy that promotes competitive exchange and interest rates.
- **Affordable supply-chain costs:** the ability to use 'clusters' to reduce logistic costs making biomass more competitive. Residual woody biomass is currently around 20% more expensive than competitor countries⁶.
- **Access to sustainable forests:** continue to ensure sustainable forestry management.
- **Efficient infrastructure:** invest in modern mills with increased capability and capacity that can have multiple revenue streams (e.g. pulp and paper mill with bioprocessing capabilities).
- **Strong partnerships:** establish and strengthen relationships between government and key stakeholders.
- **Access to talent:** an environment that develops and nurtures future talent, but also attracts the best international talent.

2 International partnerships for both investment and market demand

Because of the high capital cost, it is likely that a New Zealand bio-product sector will need to seek international partners. In addition to the capital these partners would bring, many already have existing bio-product technology which they can bring to the partnership.

Because of the many different applications of bio-chemicals, bringing the end customer on as stakeholders at the start of the R&D innovation phase will be essential to ensure we produce products that will have future demand – “design their solutions with them”.

Example: Metsa Fibre⁶

Metsa Fibre is based in Finland. They are the largest investment in the history of Finland's forest sector, when in 2015 the company announced its €1.2 billion decision to build a bio-product mill.

Metsa Fibre produce pulp, sawn timber, bioproducts and bioenergy. Their ownership structure is 75% by a co-operative of local forest owners and 25% ownership by Itochu Corporation from Japan.

Footnote
6. Bio Pacific Partners. (2019)

Key enablers: Designing a complete industry to be cohesive and competitive

It is highly unlikely that a bio-products from forests industry will establish itself organically. The entire forestry supply and value chain will need to be disrupted to design a value chain fit for all by-product and revenue streams.

Government's Role

Production clusters drive innovation and collaboration within the sector

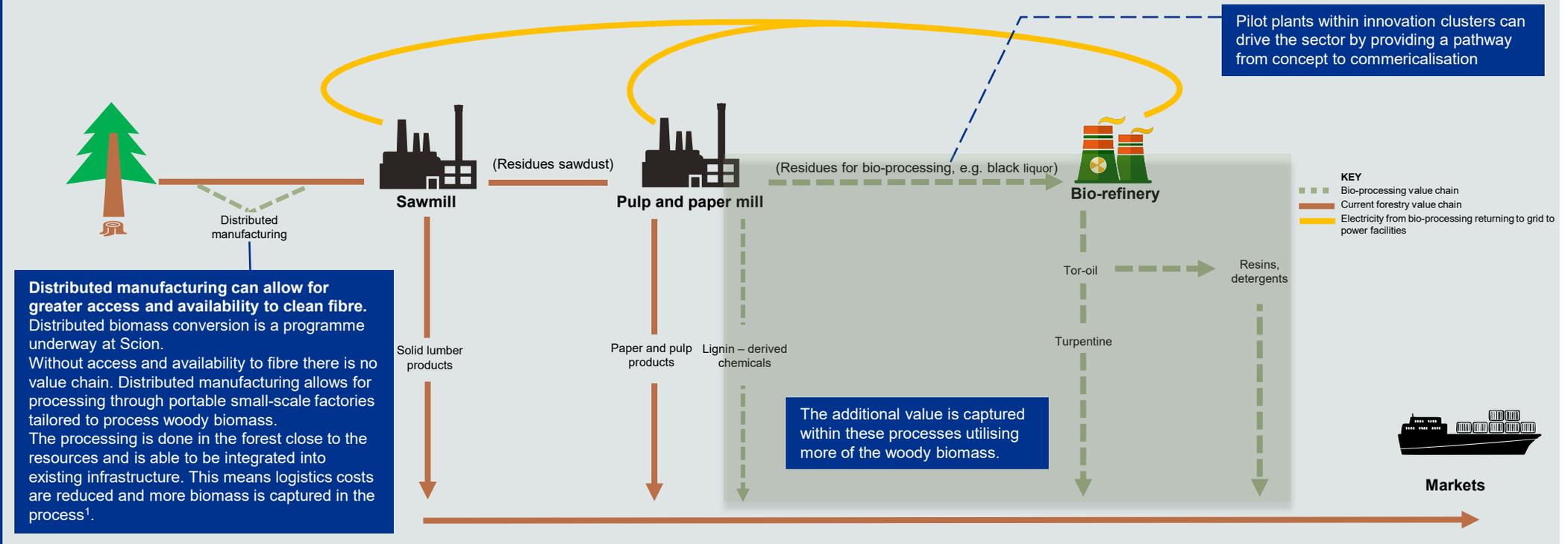
The value chain needs to be designed to take advantage of the multiple revenue streams possible from woody biomass. Illustrated below is a basic example of how the existing value chain of pulp and paper production could be extended to incorporate bio-product manufacture into the value chain, allowing access into new markets for bio-products.

Advantages of production clusters:

- Cost reductions from increased partnership
- Limited infrastructure replication
- Increased collaboration between stakeholders

Pilot plants within innovation clusters can drive the sector by providing a pathway from concept to commercialisation

Investment



Designing a complete industry to be cohesive and competitive

Footnote

1. Ministry of Primary Industries. (2022)

What happens next?

Bio-products from forests are not new or untested, much of the technology, science and chemical platforms exist already, so New Zealand does not need to 're-invent the wheel'.

Expert elicitation has highlighted that the science and technology is essentially all there.

To build a sustainable bio-products from forests industry there are a series of steps to enable change.

A collective effort – the need for collaboration

A bio-products from forests industry represents enormous opportunity for New Zealand, however it won't be possible to realise this value without the support of the wider forestry sector. Industrial symbiosis will be critical to leverage existing forestry knowledge and infrastructure to enable a bio-products from forests value chain.

Strong collaboration with government, and collective agreement on where within the competitive landscape to focus New Zealand's efforts will also be needed as a wider bio-products from forests strategy is developed.

Building the foundations of a bio-products from forests value chain

As a part of crafting a collective bio-products from forests strategy, a 'foundational bio-refinery value chain' would need to be developed. This would require key stakeholders to collectively agree on what products to focus on, existing gaps in the current capabilities (processes, technologies), and possible anchor firms who the value chain can build off of. Included in this discussion, as important stakeholders, should be future end-customers who can help share the key attributes they need from the bio-products.

Scaling from concept to commercialisation

There is significant capability and exciting research going on within New Zealand in our crown research institute, Scion, when it comes to possible bio-products from forests. What is needed next is to scale this from concept to commercialisation, something New Zealand has traditionally struggled with. Investment into innovation hubs that are focused on business model, scalability and implementation will be key.

Building human capability

If the sector is to benefit from higher skilled, and higher paying jobs, further development of our existing workforce will also need to occur. Equipping the current workforce to be able to take on these opportunities will also be important to achieve wider value from a bio-products industry.

References

This report uses references from the below sources.

1. Ministry of Primary Industries. (2022). *Te Ara Whakahou – Ahumahi Ngahere Forestry and Wood Processing Industry Transformation Plan*.
2. Spekregijse, J., Vikla, K., Vis, M., Boysen-Urban, K., Philippidis, G., & M'barek, R. (2021). *Bio-based value chains for chemicals, plastics and pharmaceuticals*. Publications Office of the European Union
3. Chui, M., Evers, M., Manyika, J., Zheng, A., & Nishbest, T. (2020). *The bio-revolution*. McKinsey Global Institute.
4. Brennan, T., Chui, M., Chyan, W., & Spamann, A. (2021). *The third wave of biomaterials: When innovation meets demand*. McKinsey & Company.
5. New Zealand Treasury, (2023). *Climate Economic and Fiscal Assessment*.
6. Bio Pacific Partners. (2019). *Wood Fibre Futures – Investments in the use of commercial forest biomass to move New Zealand towards carbon zero: Stage One Report*
7. Bioindustrial Innovation Canada (BIC). (2019). *Canada's Bioeconomy Strategy Leveraging our Strengths for a Sustainable Future*
8. The Borregaard Group. (2022). *Annual Report 2022*.
9. Finland Promotional Board. (2022). *Sustainable Growth from the Bioeconomy*. Finland Toolbox.
10. United Nations. (2022). *UN Comtrade Database*. <https://comtradeplus.un.org/>
11. Irish Government Department of Enterprise, Trade and Employment. (2023). *Foreign Direct Investment*. <https://enterprise.gov.ie/en/what-we-do/trade-investment/foreign-direct-investment-fdi/>
12. Stuart, P. (2023). *2022 is not 2010: Creating Competitive Advantage in the Bioeconomy*.
13. Finnish Government. (2022). *The Finnish Bioeconomy Strategy: Sustainably towards higher value added*.
14. Indufor (2021). *NZ Wood Fibre Futures Project Stage Two*. Prepared for Te Uru Rākau – New Zealand Forest Service.
15. Taylor, P. (2023). *Information supplied by Phil Taylor, Managing Director, Port Blakely NZ Ltd*.
16. Futurity Bio-Ventures. (2020). *Pioneering the science to market, replacing finite oil with renewable trees*.
17. Forest Owners Association. (2022). *Facts & Figures 2021/22: New Zealand Plantation Forest Industry*

Additional sources used as background to this report

- I. The Value Triangle.
- II. NZ Bio Forestry. (2022). *NZ Bio-Forestry Letter*.
- III. Port Blakely. (2023). *Capture the forest*. <https://portblakelynz.co.nz/>
- IV. Brazilian Tree Industry. (n.d) *Forest-based products*.
- V. O'Bryne, D. (2019). *Strategic Rationale for Bio-Pilot Plant for New Zealand*.
- VI. Hall, P. (2021). *Residual biomass fuel projections for New Zealand; 2021 – Indicative availability by region and source*. Scion.
- VII. Petrochemicals Europe. (2022). *Petrochemistry flow chart*.
- VIII. Bevin, A. (2023). *Wood petrochemical substitutes one step closer*. <https://www.newsroom.co.nz/pro/wood-petrochemical-substitutes-one-step-closer>
- IX. Warmington, A. (2023). *Biochemicals: A future path for textile production*. Specialty Chemicals Magazine
- X. Mulligan, W. (2023). *From volume to value*.
- XI. Polis Consulting Group. (2022). *NZ Circular Bio-innovation Network: Strategic Assessment*. Prepared for Scion, Te Uru Rākau & RotoruaNZ.
- XII. Business and Economic Research Ltd. (2023). *The Economic Benefit of a Large Sawmill in New Zealand - A Scenarios Approach*.
- XIII. Platt, R., Bauen, A., Reumerman, P., Geier, C., Van Ree, R., Gursel, I., Garcia, L., Behrens, M., Von Bothmer, P., Howes, J., Panchaksharam, Y., Vikla, K., Sartorius, V., & Annevelink, B. (2021). *EU Biorefinery Outlook to 2030*. European Commission.
- XIV. Canadian Council of Forest Ministers. (2022). *Renewed Forest Bioeconomy Framework*.

Semi-structured Interviews

- XV. Prof. Paul Stuart, EnVertis Inc. & Polytechnique Montreal
- XVI. Wayne Mulligan, NZ Bio Forestry
- XVII. Dr. Jon Ryder, Oji Fibre Solutions

Appendix – Potential economic value calculations

The calculations below demonstrate the logic and assumptions used in the economic values described on page 13.

1. Potential uplift in export value between \$12 billion and \$19 billion.

I. **Current log exports¹ value \$3.9 billion; current log export volume 22 million m³.**

II. **Convert m³ exported into mt.**

$$\begin{aligned} \text{mt} &= \text{m}^3 \times \text{density} && (\text{density of pine wood: } 480\text{kg/m}^3) \\ \text{mt exported} &= 22,000,000 \times \frac{480}{1000} \\ &= 10,560,000 \text{ mt} \end{aligned}$$

Calculate the average price per metric tonne exported

$$\frac{\text{Total log export value}}{\text{Metric tonnes exported}} = \text{Average price per metric tonne exported}$$

$$\frac{3,900,000,000}{10,560,000} = \$369.32/\text{mt}$$

III. **Potential export value if log volume was exported as bio-chemicals/bio-materials⁸.**

Extracted from Borregaard 2022 Annual report for their average price per mt

$$\text{\$ } 1,550/\text{mt} \times 10.56 \text{ million mt} = \text{\$}16.386 \text{ billion}$$

$$\text{\$ } 2,140/\text{mt} \times 10.56 \text{ million mt} = \text{\$}22.598 \text{ billion}$$

IV. **Potential uplift in export value**

Potential uplift in export value = (total potential exports) – (current value of exports)

Between \$12 billion and \$19 billion = (\$16.4 billion - \$3.9 billion) and (\$22.6 billion - \$3.9 billion)

*not all log export volume would be converted to the same bio-product export volume, this only demonstrates that the potential increase in export value from bio-products from forests could be somewhere between our current \$6.7 billion forestry industry and \$22.6 billion.

2. Potential offshore mitigation costs avoided between \$3 billion and \$24 billion⁵

Extracted from New Zealand Treasury, *Climate Economic and Fiscal Assessment 2023*: \$3.3 - 23.7 billion

3. Potential value through substitution between \$2.5 billion and \$6.2 billion.

I. **Import values from 2022 trade data¹⁰ of products that are currently petroleum-based, but could be produced as bio-products from forests:**

Products	HS Code	Import Value (NZD)	Volume imported (metric tonnes)
Plastics	HS-39	\$3,347,826,267	477,893
Fuel	HS-27	\$10,473,037,505	6,789,837
Adhesives	HS-3506	\$82,292,168	12,153
Paints	HS-32	\$495,174,883	40,477
Total		\$14,398,330,820	7,320,359

*Figures were sourced from the United Nations, *Comtrade Database* (2022) and converted into NZD using 1USD:1.66NZD

II. **Calculate the average price per metric tonne imported**

$$\frac{\text{Total imports value}}{\text{Metric tonnes imported}} = \text{Average price per metric tonne imported}$$

$$\frac{14,398,330,820}{7,320,359} = \$1966.89/\text{mt}$$

III. **It is assumed approximately 30% of woody biomass volume processed could be converted into bio-products¹⁶.**

* Conversion figures were provided by SMEs through interviews and reference documents provided by the Bio-Forests Products Working Group, but percentage is dependent on a specific bio-products.

Substitution could come from a variety of sources – this calculation assumes use of waste woody biomass residue estimated at 4.18 million mt¹⁷ or from the total current log exports at 10.56 million mt.

$$\begin{aligned} \text{Unutilised woody biomass residues:} & && 4.18 \text{ million mt} \times 30\% = 1.254 \text{ million mt} \\ \text{Current log export volumes:} & && 10.56 \text{ million mt} \times 30\% = 3.168 \text{ million mt} \end{aligned}$$

IV. **Potential substitution value if waste residues or log volumes are converted into bio-products for domestic consumption**

$$\begin{aligned} \text{Waste woody biomass residues:} & && 1.254 \text{ million mt} \times 1966.89/\text{mt} = \text{\$}2.466 \text{ billion} \\ \text{Current log export volumes:} & && 3.168 \text{ million mt} \times 1966.89/\text{mt} = \text{\$}6.231 \text{ billion} \end{aligned}$$

Footnote

All calculated figures have been rounded as estimates

1. Ministry of Primary Industries. (2022)

8. The Borregaard Group. (2022)

5. New Zealand Treasury. (2023)

10. United Nations. (2022) | 1USD:1.66NZD

16. Futurity Bio-Ventures. (2020)

17. Forest Owners Association (2022)



We would like to acknowledge the support of our partners who funded this report.