

2017 TIMBERLAND INVESTMENT OUTLOOK



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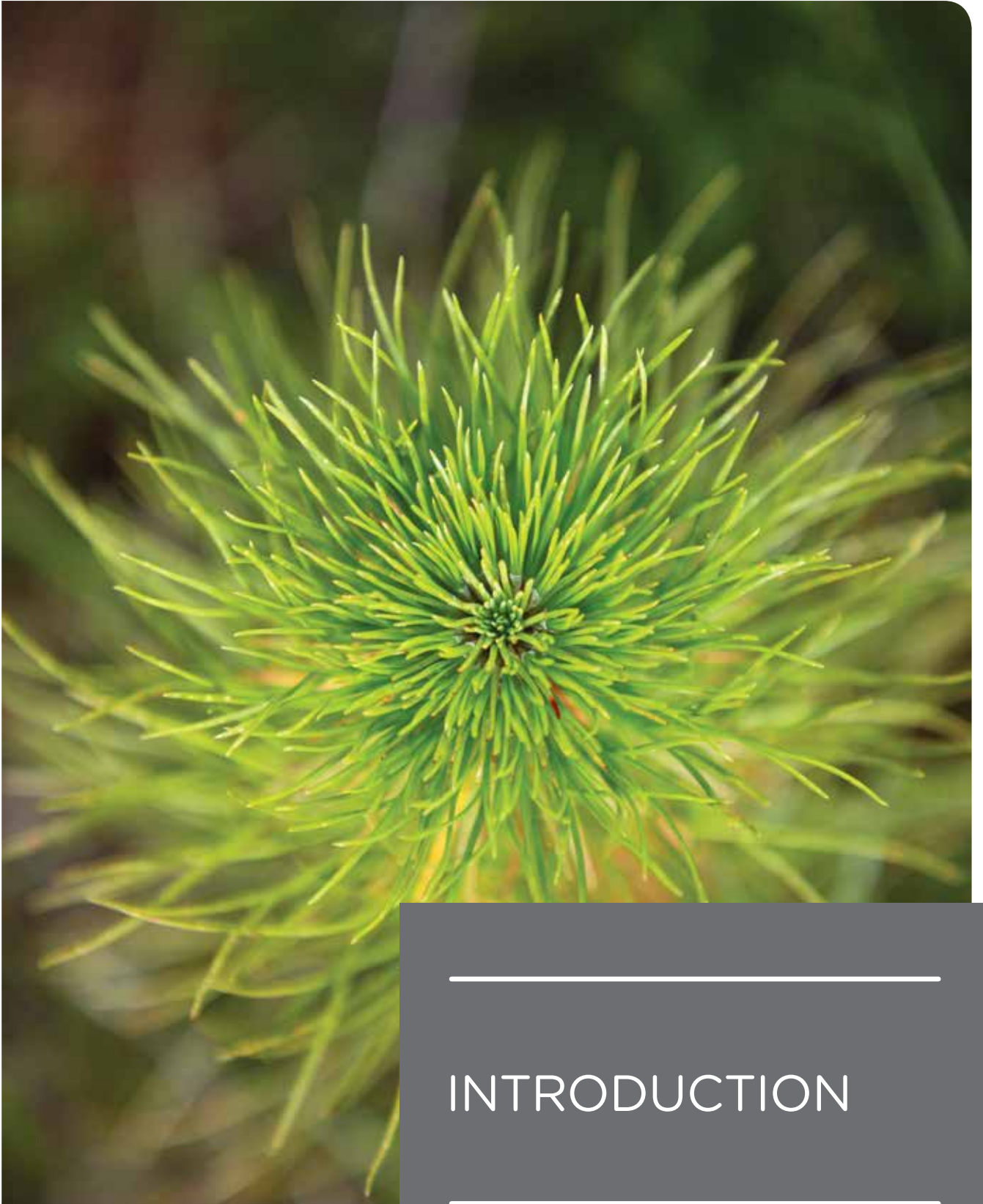
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INTRODUCTION

Introduction

Institutional investment in timberland, or forestry, is an expanding industry of more than USD 100 billion.¹

Investors often acquire timberland to generate returns from a combination of harvest income and long-term capital appreciation. Timberland has been an attractive asset class for institutional investors due to favourable portfolio attributes including low correlation to other asset classes, natural inflation hedging, and low volatility of returns. Sustainable and responsible management of forestry assets can also generate solutions to climate change, promote a shift to more responsible production and consumption, foster rural livelihoods and economies, and contribute to a growing range of renewable products made from wood fibre. In recent years the concept of a bio-economy has emerged where demand for timber and other biomass will increase from the manufacture and use of a growing array of materials, chemicals, and energy sources that aim to address critical sustainability challenges. The ongoing development of this bio-economy, alongside the evolution of timber markets serving a growing global population, provides institutional investors with diverse opportunities in a rapidly changing world.

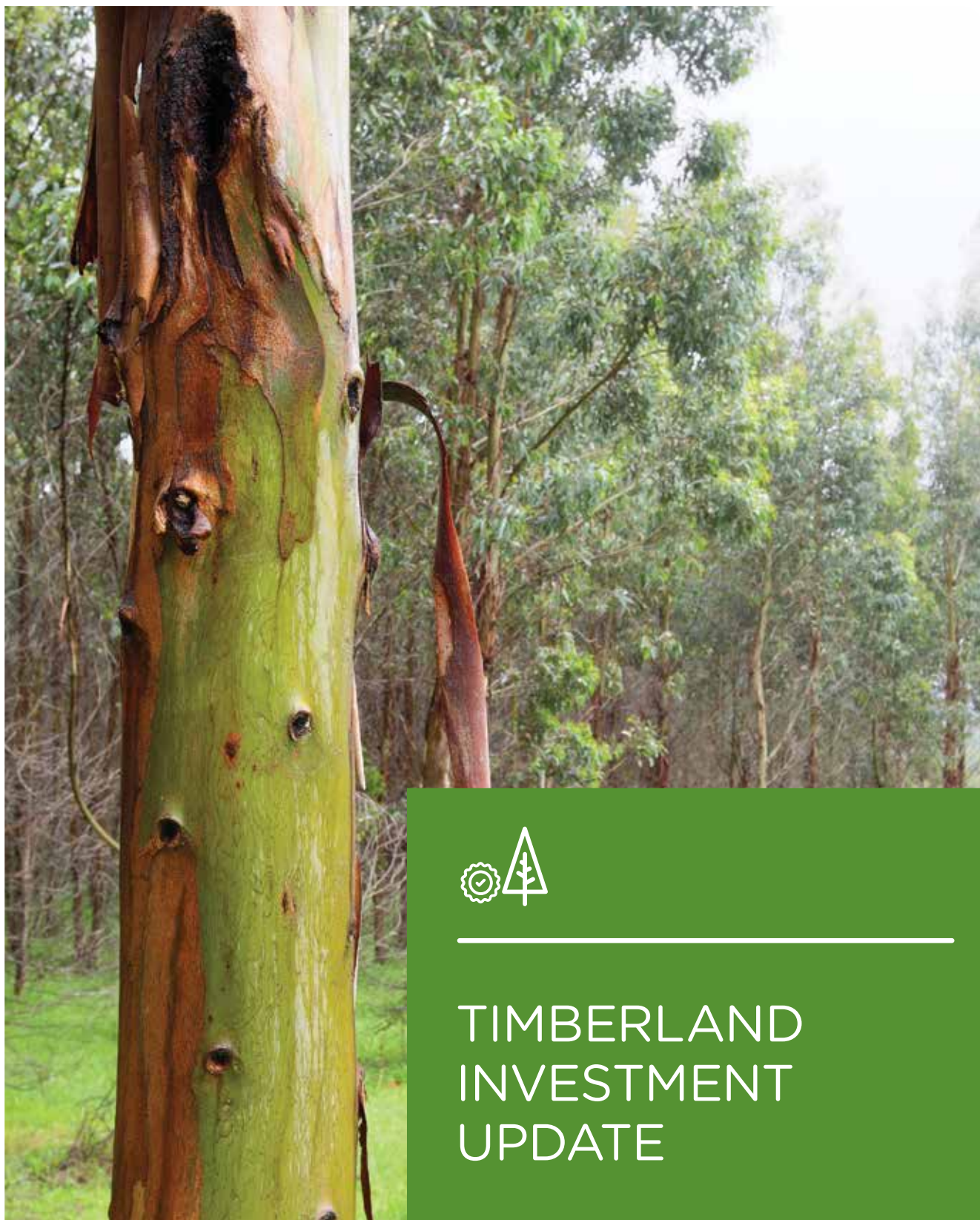
The 2017 Timberland Investment Outlook seeks to provide readers with a fresh perspective on the upcoming opportunities, strategies, and challenges facing institutional investors in timberland.

The report is an update in New Forests' biennial Timberland Investment Outlook series. This edition features increased emphasis on social and environmental sustainability, technology, and emerging segments of global timber markets that highlight new opportunities to add value to and reduce risk in institutional portfolios.

New Forests continues to see increased competition for large-scale, high-quality timberland assets in mature markets like the United States, Australia, and New Zealand. With growing asset scarcity in mature markets, institutional investors are seeking mechanisms to maintain long-term ownership of attractive forestry portfolios, including permanent capital vehicles. For Timberland Investment Management Organisations (TIMOs) to continue to be successful, they will need to pursue value-adding strategies in mature markets and develop capacity to access new geographies and markets, alongside participating in secondary timberland markets. New Forests also believes a focus on long-term investing and alignment with the shift to a renewable economy will be critical for managing long-dated timberland portfolios.

This publication aims to support debate around the opportunities for further expansion, maturation, and innovation in the forestry asset class.





TIMBERLAND INVESTMENT UPDATE

Timberland Investment Update



International institutional investment in timberland over the past 30 years has globalised the asset class. In this section, New Forests reviews key trends underpinning rising interest in timberland investment, the diversification of the asset class in terms of geography, market exposures, and investment structures, and how investment managers are responding to growth and structural changes in the market.*

Investor Appetite for Timberland

There are several market trends supporting investor interest in timberland. Since the 2015 Timberland Investment Outlook, geopolitical uncertainty has increased with, among other factors, a rise in populist politics and protectionist tendencies in the United States and other developed economies. The combination of a low-yield environment with political upheaval has institutional investors worrying about volatility and risk while looking for higher return and diversification in their portfolios. Natixis Global Asset Management's 2016 global survey of 500 institutional investors reported that half of those surveyed sought to increase allocations to alternative assets, and one-third were seeking to increase allocations to real assets in order to generate higher returns.²

Timberland is a relatively small asset class, but has characteristics that contribute to meeting institutional investment portfolio objectives:³

- Comparatively high historical risk-return profile
- Low or even negative correlation with stocks and bonds
- Positive correlation with inflation.

Timberland's comparatively high historical risk-return profile can be attributed to decades of a primary market where timber plantations were sold from government and industry owners to investors, leading to substantial efficiency improvements. In addition as the quantum of investment in timberland has grown and liquidity has improved, discount rates have declined, in common with other unlisted assets.

There is also an inherent optionality in timberland returns, where in periods of poor timber prices the harvest of timber can be reduced, with returns then relying mainly on capital appreciation from tree growth. The contribution of capital appreciation to the total returns also explains the low correlation with other asset classes as tree growth is not affected by financial market volatility.

Timberland is well positioned to address today's global challenges including climate change, population growth, urbanisation, and resource scarcity. Rising populations and increased urbanisation mean more demand for housing, furniture, food, and fibre, all of which are likely to translate into greater demand for soft commodities such as timber and agricultural products.

Growing environmental crises and climate change may also force societies to deliver technological solutions around energy and resource production and consumption. As a response, institutional investors can invest in real assets that have long-term exposure to these trends, in some cases to position their portfolios not only to manage future risk but also to invest in assets that can provide sustainability solutions and the productivity enhancements necessary for a growing global economy.

Timberland Risk-Return in Today's Investment Environment

Forecasts across asset classes suggest that downward pressure on returns will persist over the medium term and that both fixed income and equity returns over the next 20 years could be lower by 150 to 400 basis points for equities and 300 to 500 basis points for fixed income. This falls below the average over the past 30 years in the United States and Western Europe, but closer to average returns over the past 100 years as per Figure 1.⁴ These dynamics have implications for investors seeking to meet long-term liability profiles and generate overall portfolio-level returns.

Declining expected returns have pushed institutional investors to embrace risk and seek greater portfolio diversification through exposure to a wider range of assets.⁵ Real assets in particular, including real estate, infrastructure, agriculture, and forestry, have been steadily increasing as a proportion of investment portfolios (see Figure 2).

* Throughout this chapter, statements regarding areas and value of investment markets in each region are based on New Forests' knowledge and analysis of third party sources.

Timberland Investment Update

That represents trillions of dollars largely shifting from fixed income to cash-yielding equity investments. It also makes substantial changes in how assets are owned and managed in significant sectors of the economy.

As investors turn to real assets, there is going to be more need to increase the sophistication and understanding of the nature of the returns generated through attribution analysis. Following acquisition or entry valuation, the traditional rule of thumb is that the two most important factors in timberland returns are how fast the trees grow and the stumpage value of the timber. Timber value can also be affected by market cycles, currency, and operating and supply chain costs. Some investors have the view that a manager cannot control these things, so money is largely made by buying well and selling well. However, there is an increasing emphasis on investment managers that can execute active management strategies in order to reduce risk and generate value for investors.

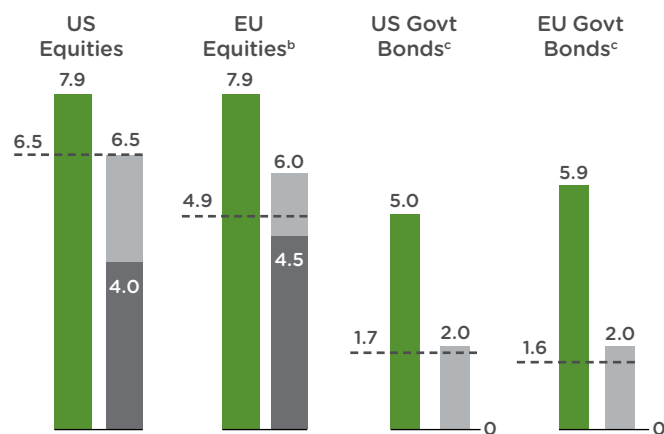
The timberland asset class is well suited for an active management strategy, with opportunities for silvicultural improvements, technological enhancements, market diversification, investments in emerging markets, and value enhancements from improved social, environmental, and governance management to add substantial value to forestry assets.

Global Pool of Investible Timberland Assets

The global pool of investible timberland assets is increasing as the sector is seen to offer renewable materials to support current and future needs of society.

New Forests estimates the total global pool of investible timberland assets is around USD 190-200 billion (see Figure 3), based on the area and value of potential assets suitable for institutional ownership. The total investible market size has increased in value moderately over the past two years, primarily as a result of higher prices being paid per hectare in the United States and New Zealand.

FIGURE 1: RETURN EXPECTATIONS^a



● Past 30 years, %

Next 20 years % (projected range for the future)

● Growth-recovery scenario

● Slow-growth scenario

-- Average for past 100 years, %

^a Numbers reflect the range between the low end of the slow-growth scenario and the high end of growth-recovery scenario.

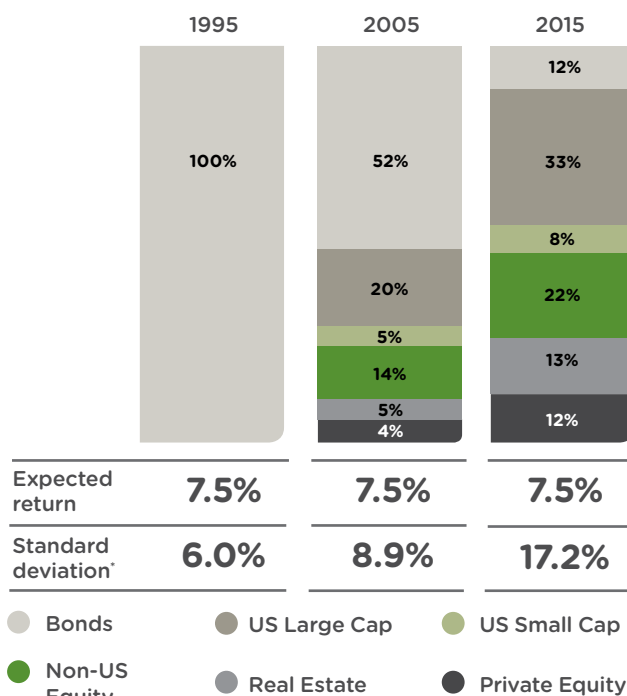
^b Weighted average real returns based on each year's Geary-Khamis purchasing-power-parity GDP for 14 countries in Western Europe.

^c Bond duration for United States is primarily 10 years; for Europe, duration varies by country but is typically 20 years.

Source: McKinsey Global Institute analysis⁴

FIGURE 2: DIVERSE AND DIVERSIFYING ASSET ALLOCATION TO ACHIEVE TARGET RETURNS

Estimates of what investors needed to earn 7.5%[^]



^{*} Likely amount by which returns could vary.

[^] Based on asset class risk, return and correlation.

Source: Wall Street Journal⁵



Growth in direct institutional ownership of timberland may be possible via the further privatisation of government-owned assets, exit by corporate owners from their forestry holdings, consolidation of smaller private forest holdings, and development of new plantations. A significant proportion of the high-quality timberland estates in the US, Australia, and New Zealand is already in institutional ownership, and these countries represent the most mature forestry investment regions. Much of the expansion in the asset class is expected to come from emerging and intermediate forestry markets, such as those of Europe, Latin America, Asia, and Africa.

The Landscape of Regional Investment Opportunities

In this section, New Forests considers regional trends and investment opportunities as well as changes occurring in how investment is organised in the forestry sector, focusing on four main investment regions: North America, Australia-New Zealand, Latin America, and Asia. Africa and Europe are also growing as timberland investment opportunities, and are discussed briefly in this section as well.

NORTH AMERICA

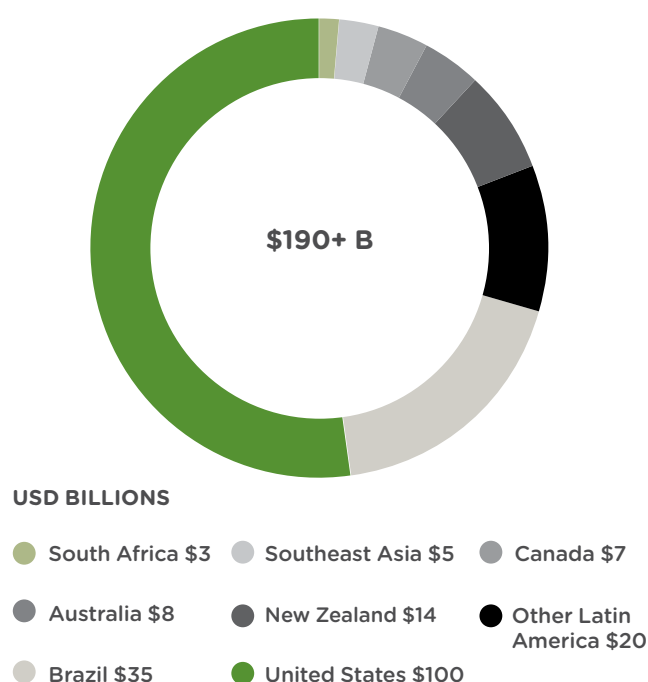
Over the past decade there has been a dearth of primary market transactions in the US, and the largest transactions have been consolidations—notably the sale of Forest Capital Partner's assets to Hancock Timber Resource Group and Molpus Woodlands in 2012 and the merger of Plum Creek and Weyerhaeuser in early 2016. In May 2017, Domain Timber Advisory acquired Timbervest's US timberland portfolio comprising more than 214,000 hectares with a USD 1 billion market value, along with mitigation and conservation banks valued at around USD 200 million.⁶

However, timberland transactions appear to be on the upswing as assets acquired in the heyday of 2003–2008 are now starting to be sold back into the secondary market. Asset prices have remained strong, but the question is how rising US interest rates will affect valuations and whether higher fixed income returns in the coming years will slow the seemingly ever-increasing demand for timberland assets.

Rising interest rates may also shift the competitive dynamic between timber REITs, which tend to trade on a multiple of cash yield, and unlisted private timberland investors who are seeking to maximise total returns. New Forests expects that timberland transaction turnover in the US market will likely increase from about USD 1 billion per annum over the past seven or eight years (net of the large consolidation transactions) to about USD 2 billion per annum over the next five years. This is based on a number of those funds maturing and possibly needing to liquidate.

Another change to the US timberland market has been the emergence of a carbon price signal. The Californian cap-and-trade system includes offsets from carbon storage in forests. Such projects can be developed across the US, excluding Hawaii. Californian businesses can currently use offsets to meet up to 8% of their emissions obligations, fuelling an offset market of around USD 200 million per annum.⁷

FIGURE 3: TIMBERLAND INVESTMENT UNIVERSE BY REGION



Note: does not include Europe.
Source: New Forests analysis

Timberland Investment Update



With the extension of the cap-and-trade program in July 2017 to 2030, the offset limit will move down to 4% in 2021 and then increase back to 6% after 2025.⁸ Cumulatively, by the end of June 2017, more than 44 million tonnes of Air Resources Board (ARB) offset credits were issued through compliance and early action projects associated with forests, equating to 66% of total cumulative ARB offset credits issued.⁹ New Forests calculated that nearly 10% of California's private timberland area was enrolled in the ARB offset scheme as of early 2017.¹⁰ There are, however, constraints and barriers for many timberland managers to access this offset opportunity. Forests must be managed for improved carbon sequestration and meet rigorous protocols for integrity in carbon quantification and social and environmental safeguards.

The majority of Canada's forest land is publically owned and managed by government at the province, territory, and federal level and under long-term forestry licenses. There may be opportunities for institutional investment in the future due to changes in forestry tenure arrangements driven by the restructure of the forest industry and a move to providing Canada's First Nations greater and more equitable access to forest resources.¹¹

AUSTRALIA AND NEW ZEALAND

Australia and New Zealand represent the second largest timberland investment market in the world after the US. It is also the market with the highest penetration of institutional ownership; institutional investors currently hold about half of the USD 22 billion pool of timber plantation assets. The sources of ongoing primary transactions will include the sale of remaining government plantations in Australia, continuing corporate sales in Australia and New Zealand, and consolidation in New Zealand as the 600,000 hectares of smaller plantation estates established in the 1990s approach maturity and smallholder owners choose to sell rather than manage the harvest.

One risk factor is the rising political issue of foreign ownership of land. Consent from the New Zealand Overseas Investment Office requires applicants purchasing sensitive land to meet the "benefits to New Zealand test." Australia applies a negative test, i.e. the investment must not be harmful to the national interest – as opposed to providing additional benefit. There is some political pressure to review the foreign investment approval process in Australia, but unlike New Zealand it has not gained significant



traction as a political issue. Nevertheless it is important for international investors to recognise that there is an obligation to operate investments in a way that can deliver real value to communities and local stakeholders.

Timber market conditions have been strong over the past couple of years in Australia and New Zealand. Strong housing market conditions in both countries, steadily rising demand for hardwood chips and softwood logs in China, a moderation in the Australian and New Zealand currencies, and low shipping rates have provided strong tailwinds to investment returns. In response, timberland managers are starting to reconsider the viability of greenfield forestry investments. In New Zealand in particular the combination of robust market conditions and the inclusion of plantations in the emissions trading scheme is making new plantation investments increasingly attractive. In Australia the cessation of new plantation establishment since the collapse of the Managed Investment Scheme (MIS) industry is leading to timber shortfalls and calls for incentive mechanisms to support greenfield forestry investments.

This has come, however, at a time when major agricultural commodities that compete for similar land (beef, lamb/mutton, dairy, and wool) are also in high demand.

New Forests expects asset turnover in Australia and New Zealand over the next five years will be in the order of USD 400-800 million per annum, or about a 2-4% turnover rate.

SOUTH AMERICA

Brazil dominates plantation forestry in South America. The country has about 7.5 million hectares of plantations which produce over 90% of the country's wood output and about 5.5 million hectares are for timber and pulp. There are 1.6 million hectares of pine plantation and 5.6 million hectares (with some suggesting up to 6 million)¹² of eucalyptus plantation. In the highest rainfall areas, the productivity of these plantations is impressive –up to 50 or 60 cubic metres per hectare per annum. This world-class plantation estate is largely owned by and linked to large pulp and paper facilities. These large new mills with access to low cost fibre are becoming the pulp market cost leaders and may ultimately force the shutdown of less efficient or higher cost producers in other regions of the world.

Timberland Investment Update

Despite this competitive advantage, plantation expansion in Brazil has slowed owing to the economic recession in Brazil, lack of access to capital, a government decision to disallow further foreign acquisitions of land, and some plantation projects for charcoal that have not performed well. Institutional investment in Brazil has so far been relatively limited.

Some funds raised with the goal of investing in Brazil have struggled to place capital. Changes in Brazil's economic policy could stimulate new investment in plantations, as it is seen as a core forestry region for investors seeking international diversification.

Uruguay and Chile have also developed excellent plantation estates. These two countries have about 3 million hectares of hardwood and softwood plantations between them. However, both countries have low land availability and high land prices, adversely affecting new plantation development. While Uruguay has been an attractive investment location for international timberland investors, Chile has been difficult to break into, with existing plantations tightly held in family-owned companies.

There have been USD 2–3 billion of successful timber plantation investments in Latin America over the past 10–15 years, but the degree to which this can be scaled up will depend on government policies related to foreign investment, the degree of attractiveness of holding plantation assets on corporate balance sheets, and risk premiums demanded by foreign versus domestic investors. New Forests anticipates that South America will likely support USD 250–500 million per annum of plantation investment going forward.

ASIA

Asia has a heterogeneous forestry investment landscape, and only a limited number of countries offer institutional forestry investment opportunities. Japan, while 70% forested with extensive plantations of hinoki and sugi, is unlikely to be commercially attractive because of a lack of labour, land tenure complications, and poor road access to the forestry assets. China has hosted several foreign investments in plantations, but overall, foreign ownership of plantations is unlikely to expand significantly. In some areas local governments are passing laws to prevent timber plantation expansion or even to require that plantations be returned to other land uses. India is also unlikely to support plantation investment, as laws require that industry work through local communities to get plantations established, and the process of getting to scale with smallholder plantations has proven very difficult.

Southeast Asia holds greater promise for forestry investment, although patience and discipline are required to navigate risks associated with social and environmental factors, commercial arrangements, and land tenure security.

Indonesia has a large plantation estate with about 2.3 million hectares of acacia and eucalyptus pulpwood plantations, principally owned by Asia Pulp and Paper (APP) and the APRIL Group. There are also several hundred thousand hectares of other plantations, notably teak, gmelina, and other species. Rubber plantations cover approximately 3.5 million hectares in Indonesia. To date, there have been foreign corporate investments in the plantation sector but limited institutional investment.

Malaysia, like Indonesia, actively seeks to expand timber plantations as the production of timber from logging natural forests steadily declines. There are opportunities to acquire and improve existing plantations, many of which were established with *Acacia mangium*, which has proven susceptible to disease. Newer plantations are increasingly using eucalyptus.

Vietnam has a large and thriving plantation sector primarily based on smallholdings. There are now approximately 3 million hectares of plantations, mainly acacia, but also eucalyptus and teak. Vietnam has become the leading producer of hardwood chips in the Asia-Pacific region, although the Vietnamese government



is orienting its forest sector policies to support more domestic processing. Vietnam now has one of the world's largest wood furniture production industries, heavily reliant on imported timber. There have been foreign corporate investments in Vietnamese plantations, and the government appears interested to encourage further direct foreign investment in this sector.

Another country with potential for plantation investment is Laos, where the government has set a goal of undertaking 5 million hectares of reforestation and plantation development. There is currently only about 70,000 hectares of timber plantation in the country with an additional 277,000 hectares of rubber, and the processing infrastructure is limited. Nevertheless New Forests expects to see the industry expand in the coming years. Cambodia is somewhat similar, in that there have been a limited number of plantation projects developed, and limited support for foreign investment in this area. Other countries that may provide investment opportunities include Thailand, Myanmar, Papua New Guinea, the Philippines, and some of the Pacific Islands. Overall, New Forests' view is that institutional investment in Southeast Asia will grow slowly but steadily, with opportunities for USD 100–200 million per annum of investment over the next five years.

OTHER REGIONS

There are about 1 million hectares of plantation in South Africa, another 400,000 hectares of plantation in East Africa (Kenya, Tanzania, and Mozambique), and another 500,000 hectares across the continent. There are several small to moderate sized forestry funds that include mandates for emerging markets forestry in Africa. In addition, development finance institutions and others are also supporting financing, including private equity and debt, for privately owned plantation development companies in Mozambique, Tanzania, Uganda, and Ghana. There is likely to be some opportunity for expansion or recapitalisation and consolidation in these investment vehicles and businesses.

Europe is also rising as a timberland investment region. Small investment management companies are developing funds and direct investments in Ireland, the UK, Scandinavia, and Eastern Europe. Demand for timberland assets denominated in British Pounds or Euros appears to be driving the increase in investment.



Timberland Investment Update

Forestry Funds, Direct Investments and REITS

Institutional investors have several options for timberland investment types and structures. These options include subscribing to commingled funds, pursuing direct investments or separate accounts, and investing in timber REITs.

Some of the largest institutional investors pursue direct investments, including co-investments alongside their fund investments, which aligns with a trend among the larger investors toward internal management of assets and efforts to reduce fees. New Forests, however, continues to see that most institutional investors are constrained by limited in-house timberland investment expertise and a lack of scale to undertake direct investments. Therefore, the majority of investors opt for external managers, such as TIMOs, while some asset managers may include forestry investments as part of broader real assets or combined forestry and agriculture mandates.

Over the past decade, the AUM of TIMOs have doubled from around USD 24 billion at the end of December 2006 to at least USD 44 billion by December 2016.¹³ Reports on total AUM by TIMOs vary among sources, with US-based investment adviser TimberLink LLC tracking TIMOs with AUM of USD 48 billion¹⁴ and RISI documenting USD 44 billion in AUM by the 11 largest TIMOs.¹⁵

Today's REIT marketplace is largely consolidated into three publicly traded companies, being Weyerhaeuser, Rayonier, and Potlatch, with market capitalisation of approximately USD 30.7 billion at the end of June 2017.¹⁶

REITs in general seek to create value through maximising operating revenues and by consolidating higher quality portfolios, which means selling off non-core or less strategic assets and improving cash yield efficiency in the portfolio. A 2017 Forisk survey showed that all indices that they track—S&P 500, NAREIT, NCREIF, and Forisk Timber REIT Index—showed positive returns in 2016. Interestingly, only privately held timberland returns demonstrated positive returns each year for the period 2012-2016 as shown in Figure 5.¹⁷

FIGURE 4: GROWTH IN TIMO AREA UNDER MANAGEMENT AND MARKET VALUE 2005-2016

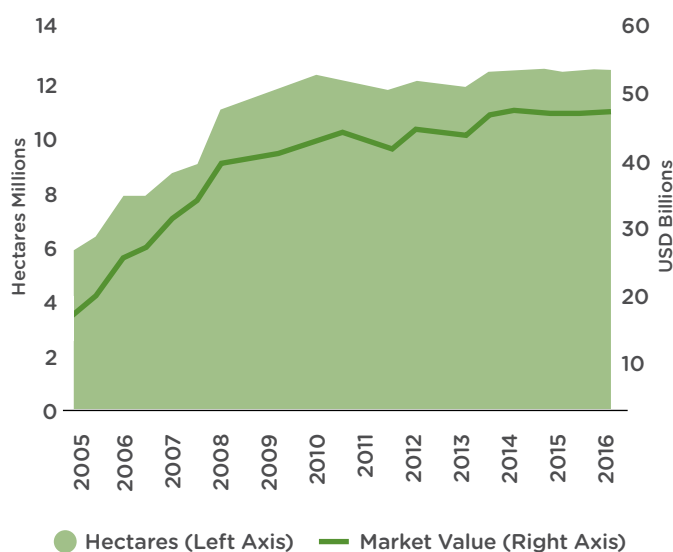
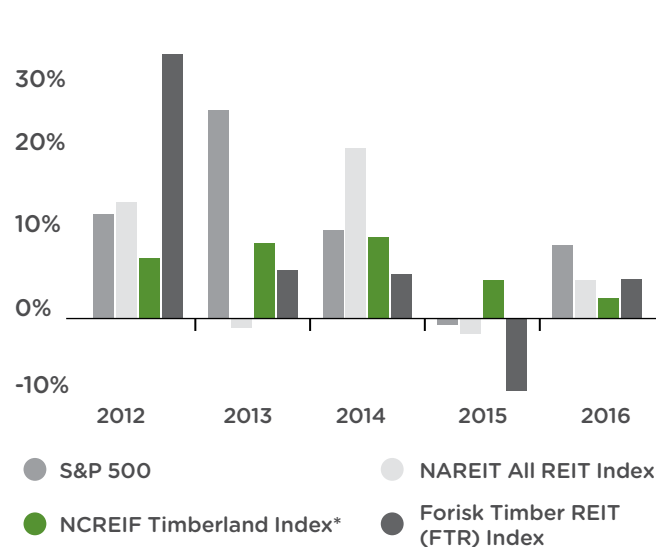


FIGURE 5: TIMBER INVESTMENT INDICES RETURN RELATIVE TO OTHER ASSET CLASSES



* The NCREIF Timberland Index represents US timberland properties covering the Pacific Northwest, South and Northeast.
Source: Forisk¹⁷

Source: TimberLink LLC¹³



This is likely due to the fact that independent valuations for privately held timberland are relatively less volatile than the market volatility associated with timberlands held under public ownership through the REIT structure. One contributing factor is that unit prices of timberland held under REIT structures can trade at a discount to their private market asset value because the market tends to discount the value of listed illiquid assets. Looking forward, a key question is whether REITs will come under pressure to improve cash yield as interest rates begin to rise in the US. This could create volatility of returns and potentially create a push toward delisting of timberland assets.



FIGURE 6: TOP TIMOS BY ASSETS UNDER MANAGEMENT

TIMO	AUM USD Billions	Area Hectares Millions (Net Area)	Headquarters	Geographic Focus
1 Hancock Timber Resource Group	10.6	2.1	USA	USA, Canada, Australia, New Zealand, Chile
2 Forest Investment Associates	5.5	1.1	USA	USA, Brazil
3 Campbell Global	5.3	1.0	USA	USA, Australia
4 Resource Management Services	4.5	1.1	USA	USA, China, New Zealand, Brazil, Australia
5 Global Forest Partners	3.1	0.4	USA	Brazil, Uruguay, Chile, Guatemala, Colombia, Australia, New Zealand, Cambodia
6 BTG Pactual	3.0	0.7	BRAZIL	USA, Brazil, Uruguay, South Africa, Hungary, Estonia, Guatemala
7 New Forests	2.8	0.4	AUSTRALIA	Australia, New Zealand, Malaysia, Indonesia, Laos, USA
8 Molpus Timberlands	2.8	0.8	USA	USA
9 The Forestland Group	2.4	1.3	USA	USA, Panama, Belize, Costa Rica, Canada
10 GMO Renewable Resources	2.2	0.6	USA	USA, Uruguay, Australia, Chile, Brazil, New Zealand, Costa Rica, Panama
10 Brookfield Timberlands Management^	2.2	0.5	CANADA	Canada, Brazil, USA

^ Includes only fee ownership, not Crown lands or Fibria lands where Fibria retains ownership of the tree crop.
Source: RISI, data as at end of March 2017¹⁵

Timberland Investment Update

What Does Active Management in Forestry Entail?

With the downward pressure on discount rates (and by extension, increases in asset values), there is a need for managers of real assets, including forestry, to understand the potential for value adding strategies to deliver higher performance. The days of setting a basic forestry regime and selling timber to local mills are over, and managers must continuously revisit the technologies, land management strategies, and market exposures that will provide higher risk-adjusted returns.

New Forests believes value-adding management in timberland investment in today's market environment includes three key elements:

1. *Identifying the right strategy that can segment markets, and/or identifying new assets/markets that will have a higher return.* In mature markets the challenge in extracting value is to understand market dynamics that are directional (for example positioning against the rise of Chinese timber demand), represent an arbitrage opportunity, or enable the capture of unrealised value (such as identifying forests that qualify for the carbon offset market in California or assets that could play into the Japanese feed-in tariff for bioenergy). Strategy is about identifying a market opportunity, determining how to exploit that opportunity, and putting in place the resources and skills in the management team to execute on the opportunity.
2. *Decoupling the underlying drivers of return in more granular fashion to help guide asset management decisions.* There are some simple principles for thinking about returns, as well as more complex analytical tools that can be deployed. From a simple value add basis, it can be assumed that if you are seeking a 10% nominal return, a \$1 million reduction in costs or increase in revenue, all other things being equal, will add \$10 million to the asset valuation. New Forests has developed a process of systematically analysing cost savings and revenue enhancements to determine their contribution to incremental returns. More complex drivers of returns include technology changes, currency volatility, optimisation of silvicultural management, and improving workforce skills and motivation. Such drivers can potentially be identified via simulation modelling and "tornado analysis" that looks at

return attribution to underlying factors and then determining how to invest in or manage those factors to push asset-level returns.

3. *Targeting and managing risk via a risk appetite statement, including conscious decisions about risk management, risk transfer, and risk acceptance.* It could be said that risk and return are opposite sides of the same coin. In general if you are prepared to take higher risk, you should be rewarded with higher returns. But it is also reasonable to ask what is the level of risk that is expected for a given return. A timberland investor who is seeking 5-6% real return from an illiquid asset would be expecting that those returns would be stable and predictable and that most risks would be well known and easily mitigated. This might for example, be the case for a US tax-free investor buying pine plantations in the US South. There is no currency risk, tax is known, markets are deep and liquid, and physical risks can be transferred by insurance. On the other hand, investors in emerging markets will expect a higher return but also accept that the assets will be exposed to additional risks. Looking forward, New Forests expects more work will be done by managers in defining the risk appetite associated with a given investment strategy, how that links to the expected returns, and then establishing a risk management framework. This framework would identify the main risks, document their potential likelihood and impact, identify mitigation strategies, and then define the residual risk that must be accepted.

Fundamental analysis of timberland risk-return is becoming more sophisticated and embedded in the investment and asset management functions. Timberland investment managers need to make progress in documenting their strategies, their management systems, and their risk management framework. This will allow investors to better understand the role forestry assets can play in a diversified portfolio, differentiate between managers, and choose particular market segments that meet their portfolio needs and risk appetite.



The Shift to Long-term Ownership

With rising allocations to real asset investments and a finite pool of such investments, institutional investors will increasingly seek to hold high-quality assets in their portfolio. Otherwise, they will be selling assets in a competitive market and then needing to deploy that capital to acquire assets in an increasingly scarce asset pool. New Forests has observed an increased interest by institutional timberland investors to hold assets for the long term (e.g. 20 to 30 years and potentially longer) as opposed to liquidating timberland portfolios after the end of a typical 10-year fund life.

This desire to shift to long-term ownership creates unique challenges in identifying the proper structure to ensure ongoing alignment among investors and between the investors and the timberland manager, including consensus on investment philosophy and objectives for the management of the portfolio. Moreover, the investors must have confidence that the manager has the capacity and is equipped to pursue an active management strategy in the face of dynamic market conditions.

A major challenge is also determining the appropriate remuneration approach under a long-term structure, such as a fund with a long term or a permanent capital vehicle that is open ended. In the typical closed-end fund structure used for timberland investment, a management fee is charged on the fund's committed capital during the investment period and thereafter typically on the invested capital of the portfolio. The performance fee is set by a hurdle rate for the portfolio and paid upon realisation events, usually when assets are liquidated after the fund's term is over. Under a long-term model, factors for consideration include what is the appropriate level of the management fee over a long period of time; how will the manager be compensated for inflation; and how to reward active management through up and down market conditions.

Setting the performance fee can be even trickier. There are several models to consider, such as a profit share model or payment on total returns (income plus capital appreciation). The profit share model is relatively straightforward; from the investors' perspective, the manager is only rewarded as distributions are made, and from the manager's perspective, performance can lead to regular income. However, this model is potentially misaligned with long-term objectives, as it creates

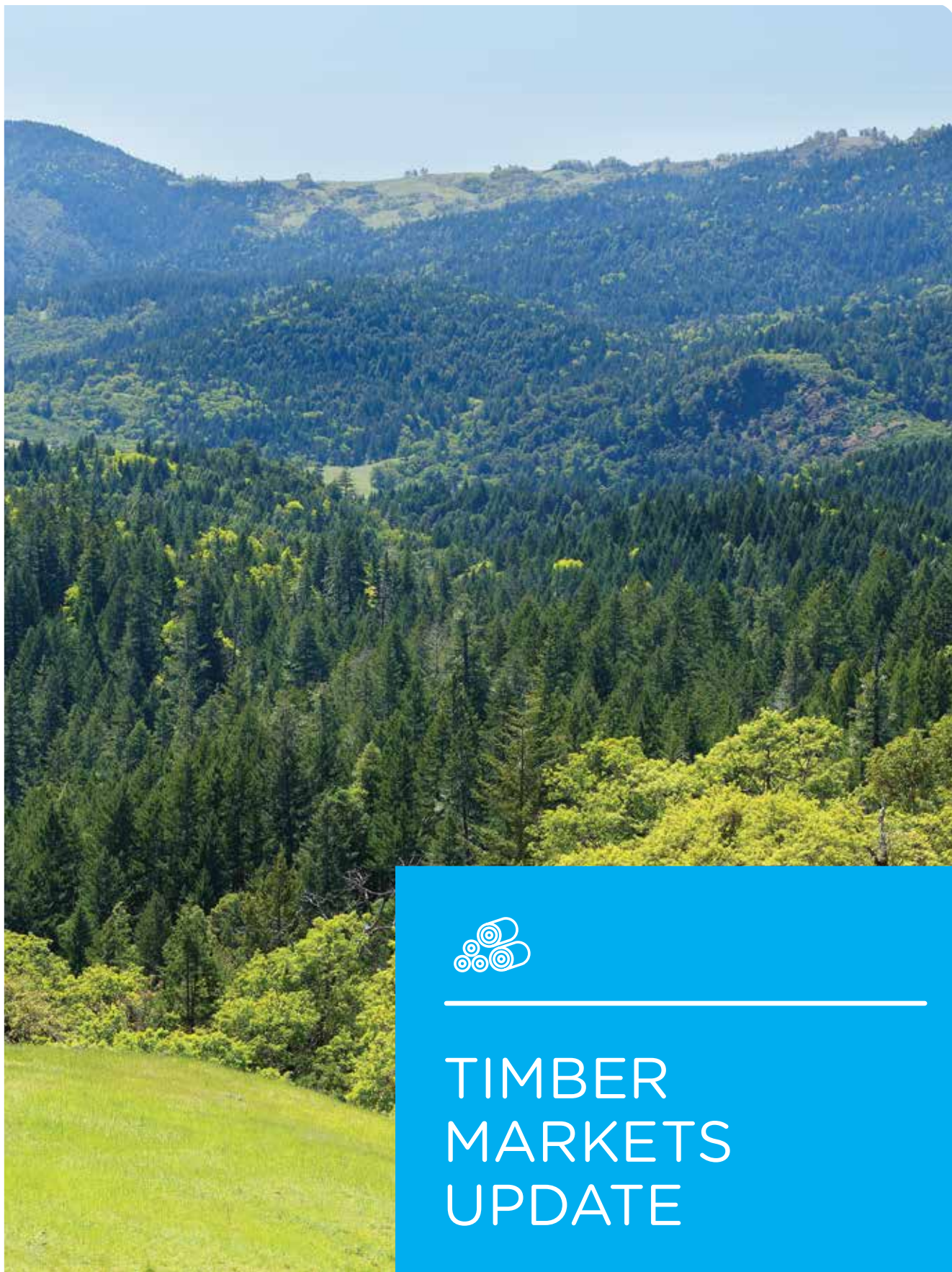
an incentive for yield rather than value preservation or creation. An income-driven strategy also may be misaligned with the sustainability objectives of a growing number of institutional investors.

The total returns-based model is more focused on long-term value preservation; however, it requires reliance on, and confidence in, independent timberland valuations. In this model, an appropriate hurdle rate for the portfolio must be determined for a period of time and the manager remunerated for total performance associated with income generated and net asset value as determined by independent valuations. Some investors may be reticent to pay performance fees on unrealised gains; however, this is a structure that is well understood in sectors like infrastructure.

New and innovative structures will need to be developed to support long-term ownership of assets. New Forests has explored blended structures where the investment manager has exposure to regular payment of distributable income from an asset assuming a total returns-based hurdle rate is met. Structures like this can create better alignment with investors, with the manager taking on more risk in exchange for increased exposure to the performance of the asset.

New Forests anticipates that the shift to long-term ownership will be one strategy institutional investors and TIMOs employ to maintain timberland portfolios. This should also demonstrate the rising need for benchmarking timberland returns outside of the United States, as well as the need for managers to demonstrate return attribution.





TIMBER MARKETS UPDATE

Timber Markets Update



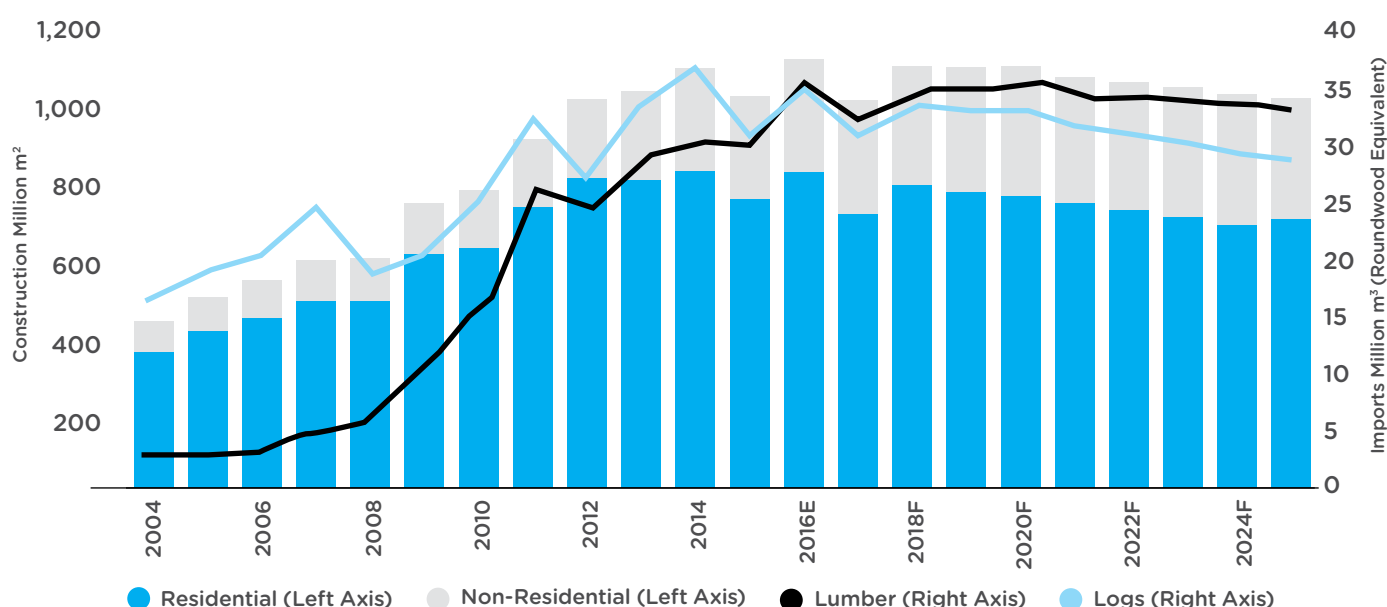
Key trends since the 2015 Timberland Investment Outlook

- Strong trade flows reflect China's increasing appetite for softwood log and lumber imports, with record-high volumes of softwood lumber and logs in 2016, dominated by supplies from Russia and New Zealand, respectively.
- US softwood lumber demand for residential housing construction continues to recover, underpinned by favourable demographics, strong labour markets, and lower interest rates
- US-Canadian trade relations have become a focal point in light of the Trump Administration's protectionist stance; the continuing softwood lumber tariffs are a case in point.
- Japan and China dominated global hardwood chip imports in 2016, with China surpassing Japan as the largest hardwood chip consumer.
- The impetus from a range of forces including changing societal expectations, technological disruption, and responding to climate change is leading to an evolution in traditional pulp and paper end-categories and the emergent bio-economy.

Chinese Softwood Demand Fundamentals Remain Strong

Housing construction has been an important driver of Chinese economic growth following the emergence of a private housing market in the late 1990s. Chinese real estate investment as a percentage of the economy more than tripled between 2007 and 2014, growing from 4% of GDP to 15% during that time period.¹⁸ At the time of publication of the 2015 Timberland Investment Outlook, the Chinese residential market faced oversupply and falling prices in some areas (particularly outside of tier 1 cities). During 2014, the Chinese government introduced stimulatory measures, but by 2016, they returned to macroprudential measures to dampen the rapid rise in house prices.^{19,20} While real estate demand is expected to soften over the coming decade (see Figure 7), an additional 150-175 million new homes will be required by 2030 as the Chinese government seeks to reach an urbanisation rate of 60% by 2020 and 70% by 2030.^{21,22} Therefore the long-term outlook for Chinese softwood demand remains strong due to supply-demand fundamentals.

FIGURE 7: CHINESE RESIDENTIAL AND NON-RESIDENTIAL CONSTRUCTION, CHINESE SOFTWOOD IMPORTS - LOG VS LUMBER IMPORTS, 2004-2015 ACTUAL, 2016-2025 FORECAST



Source: RISI China Timber Supply Outlook 2015²⁴

Timber Markets Update

Rising imports reflect China's increasing appetite for softwood logs and lumber, with record-high import volumes in 2016. In 2016, softwood lumber imports were 21.1 million m³ and softwood log imports were 33.7 million m³, growth rates of 20% and 13%, respectively, compared to 2015, as reported by International Wood Markets Group. China imported over half of its softwood lumber from Russia in 2016. Russian lumber exports to China increased by 38% to 11.6 million m³ in 2016, facilitated by expanded capacity and high margins attributable to the weakening of the Russian rouble through 2014 and 2015. New Zealand continues to be the largest exporter of softwood logs to China, supplying 35% of Chinese imports or 11.6 million m³ in 2016, an increase of almost 12% for the year.²³

Interestingly, Chinese lumber imports are outpacing import of logs, propelled by attractive pricing from major supply sources such as Russia and Canada relative to an equivalent log basis. Over the last decade, Chinese softwood lumber imports grew ten-fold from approximately 2 million m³ to over 21 million m³, while log imports rose from 20 million m³ to 34 million m³.²⁴ The pricing of lumber compared to logs is shown in Figure 8. A Russian export tax on unprocessed logs (introduced in 2008) promoted investment in Russian sawmills and prompted Chinese mills to relocate into Russia to avoid the export duty.²⁵ Russian suppliers also realised they could supply more lumber than logs, by volume, on rail cars, reducing freight costs. Annual Chinese softwood imports from Russia since 2008 have remained steady on an aggregate basis, but there has been a clear shift in the log and lumber mix, in favour of the latter.²⁶

It is worth noting that China is increasing its import of processed forest products faster than its import of raw logs and woodchips. The steady rise of labour rates and government efforts to reduce growth of high energy demand industries are pointing to a likely peaking of raw log and woodchip imports over the next five years. This suggests that countries that can do the primary conversion of logs to lumber or woodchips to wood pulp will see stronger export market growth in China.

The US Housing Recovery and North American Lumber Trade

New US residential housing starts, the key driver of US lumber consumption, remain on a steady upward trajectory, driven by favourable demographics, strong labour markets, and lower interest rates, reaching 1.17 million total units in 2016, compared to a long-run average of 1.44 million units (1967-2016) and the pre-financial crisis level of approximately 2 million.²⁸ US housing starts are forecast to reach 1.5 million units in 2020-2021, a similar forecast to that discussed in New Forests' Timberland Investment Outlook in 2015.²⁹

The United States, the world's largest consumer of softwood, has traditionally imported softwood lumber from Canada for its residential construction sector. Canadian softwood lumber comprised a third of the US softwood lumber market in 2016, taking the lion's share of US total lumber imports at 95%.³⁰

Approximately 70% of Canadian softwood volume is exported to the US.³¹ Since the 1980s, the US has argued that Canada has subsidised its lumber by selling wood from government land at lower rates to Canadian lumber producers than the price paid by US lumber producers to private US forest owners.

FIGURE 8: CHINESE SOFTWOOD LOG VS LUMBER IMPORT PRICE, AVERAGE JANUARY TO MAY 2017

Source Country	Average Log Price USD/m ³	Equivalent Log Price for Lumber USD/m ³
Russia	118	118
Canada	156	122
New Zealand	128	169

Source: RISI²⁷



Under the US-Canadian 2006 Softwood Lumber Agreement (SLA), which expired at the end of 2015, the US levied tariffs and quotas against Canadian lumber imports in relation to prevailing market prices. In late November 2016, the US Lumber Coalition filed a countervailing and anti-dumping petition with the US Department of Commerce (DoC) and the US International Trade Commission (ITC) against Canadian lumber imports, creating speculation and price volatility, particularly in light of the incoming Trump Administration's protectionist stance.³²

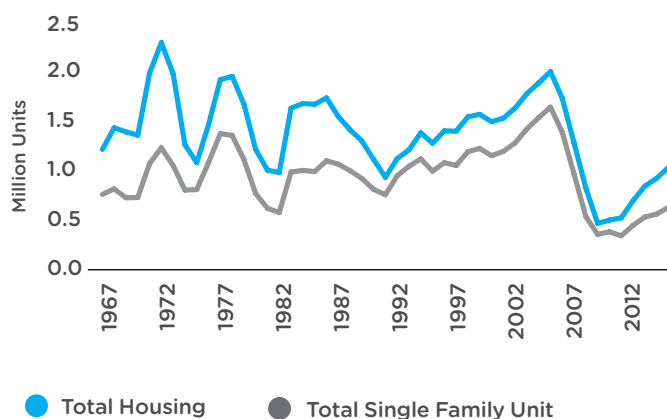
In April 2017, the DoC set a preliminary countervailing duty (CVD) rate averaging 19.88% as compared to 18.79% under the previous agreement. At the end of June 2017, the DoC announced its anti-dumping (AD) findings and determined Canadian exporters sold lumber at an average of 6.87% below fair value as compared to 8.43% under the prior assessment. As a result, the combined duty rates (CVD plus AD) average at 26.75% compared to 27.22% under the 2006 SLA.³³ The DoC is anticipated to finalise its determination in September 2017, followed by the ITC in October of 2017.³⁴ Canada has avenues of appeal through the North American Free Trade Agreement, the US Court of International Trade, and the World Trade Organization.³⁵ The impact of these trade policies has seen Canada's share of the US softwood lumber market fall to 27% in May 2017 compared to 31% a year earlier.³⁶

At the same time, it imposes increased costs on American industries, businesses, and consumers. A study examining how markets respond to price changes suggests the 26.75% tariff would result in US customers paying 8.8% more for lumber.³⁷

The Trump Administration may also create changes in the business environment influencing forestry investment. Protectionist policies could benefit the US domestic forest sector at least in the short term; however, these policies may ultimately stifle new home building if lumber prices rise. Significant corporate tax cuts may lead to the forest industry expanding and re-tooling for new opportunities. A massive infrastructure investment could also drive demand. However, the degree to which these policies will be translated into legislation and budgetary approvals is uncertain.

With US housing construction gaining momentum, and therefore increasing US softwood lumber consumption, and Canadian softwood lumber supply curbed through trade and capacity (mountain pine beetle infestation or policies that reduce timber harvests³⁸) restrictions, a supply deficit is likely to eventuate and put upward pressure on softwood lumber prices.³⁹ The unique factor in play as US housing construction heads back toward a cyclical upswing is the large competing demand in China for Pacific Rim softwood logs and lumber, which was far lower when the US housing cycle last peaked.

FIGURE 9: US ANNUAL HOUSING STARTS, SINGLE FAMILY AND TOTAL 1967-2016 (NOT SEASONALLY ADJUSTED)



Source: US Census Bureau New Residential Construction²⁸



Timber Markets Update

Asia-Pacific Hardwood Chip Trade

The Asia-Pacific region dominates the global hardwood chip market, representing approximately 70% of the global chip trade volume with 35.6 million tonnes of woodchip traded in 2016. Japan and China accounted for 84% of global hardwood chip imports.⁴⁰

China has surpassed Japan as the largest consumer of hardwood chip, driven by its large-scale investment in pulp mill capacity. Over the last decade, China's share of global paper and paperboard production expanded from 18.6% to 27.1%.⁴¹ China is forecast to account for 40% of the global consumption of market pulp by 2030.⁴²

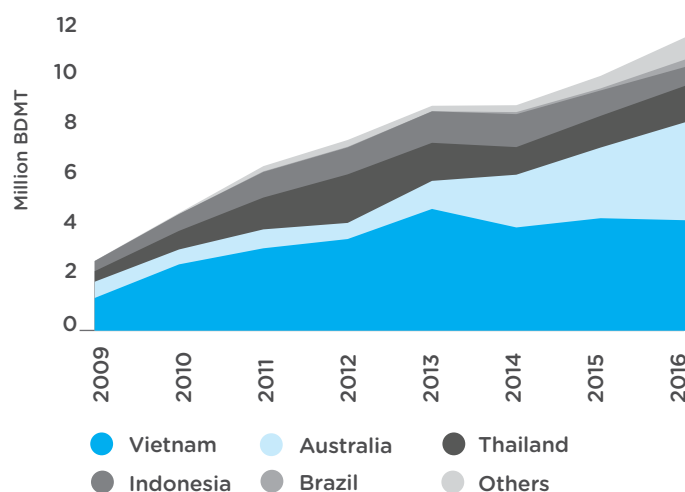
There have been concerns about a potential pulp supply glut in the next few years as operators in China (and other countries such as Brazil) have invested in production capacity in response to historic demand growth. Increased pulp and paper mill production capacity is starting to come online, but the demand is not expected to absorb this until the 2020s.⁴³ However, the Chinese Government has also forced closure of older facilities while some bleached hardwood kraft pulp mills (the key production grade category) can be modified to handle dissolving pulp production. In 2016, 80% of hardwood chips were used to produce bleached hardwood kraft and 12% dissolving pulp in China.⁴⁴ Woodchip

import levels are expected to be maintained as Chinese manufacturers shift their production mix in response to pulp-type demand and prices.

Emerging markets tend to represent the bulk of increased wood fibre consumption, and in some cases, such as India, are starting to increase imports to supplement domestic paper production. Between 1996 and 2006, Indian wood pulp consumption increased 10%. In the following decade (2006 – 2015), wood pulp consumption increased by 77%.⁴⁵ India consumed more than 16 million tonnes of paper in 2016. This is expected to rise to 23.5 million tonnes in 2024–25.⁴⁶

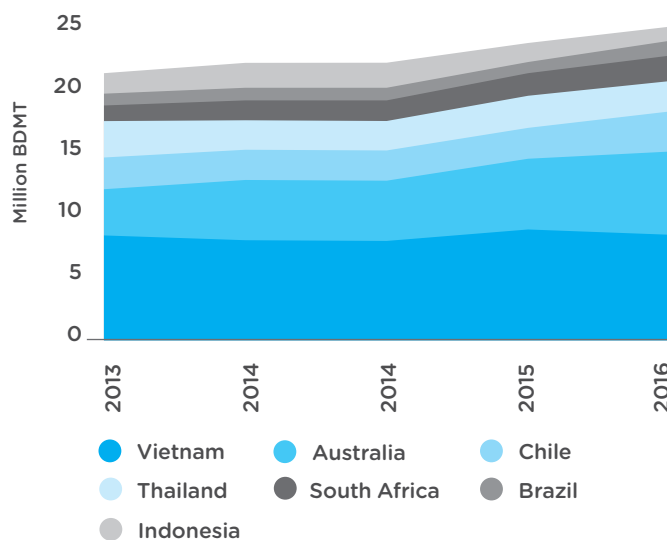
The Indian pulp and paper industry is dominated by small-scale producers and is in the process of building a more efficient and effective fibre supply through farm forestry programs. This involves amalgamating tens of thousands of individual landowners to ensure a flow of pulpwood supply. Despite this initiative, India faces an ever-widening gap between domestic wood resources and demand. Timber supply from these farm forestry plantations is expected to increase rapidly, with most companies sourcing at least 75% of their wood fibre from these plantations.⁴⁷ However, this local supply is not yet sufficient to meet market demand and the industry is dependent on pulp log imports.⁴⁸ India therefore presents a potential growth opportunity for the forest products industries from

FIGURE 10: TOTAL CHINESE HARDWOOD CHIP IMPORTS BY SOURCE 2009–2016



Note: Others include Chile, South Africa, Malaysia, and Cambodia.
Source: RISI International Pulp Trade Review 2017⁴¹

FIGURE 11: HARDWOOD CHIP ANNUAL SUPPLY TO THE ASIA PACIFIC 2013–2016



Source: RISI Asia Pacific Woodchip Market Update⁴¹



Asia, Australia, and New Zealand. However, India is likely to follow China in becoming more of a wood pulp rather than woodchip importer. Indian pulp and paper mills are typically located inland, and poor port and road infrastructure makes importing woodchip expensive.⁴⁹

Asia-Pacific Supply and New Sources of Competition

Vietnam and Australia have dominated hardwood chip supply to the Asia-Pacific region in recent years, supplying predominantly eucalyptus and acacia chips into China and Japan.

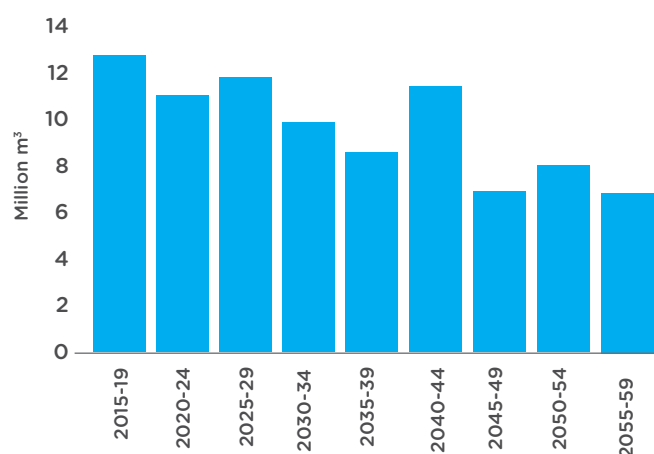
However, both countries will likely see supply contract over the medium term. Australian total hardwood plantation area peaked in 2009 and after the collapse of the country's Managed Investment Scheme sector—which created tax incentives for development of new plantations—the area has gradually decreased as forest owners have opted to convert plantation areas after harvest to higher value agricultural production. Forecasts anticipate Australian supply starting to tighten from 2020, potentially declining by as much as 30% in the longer term.⁵⁰

Following the Vietnamese Ministry of Agriculture and Rural Development's announcement in 2014 of policy measures to encourage local timber processing and reduce woodchip export to half of 2015 levels by 2020, the government levied an export duty in 2016.⁵¹

Brazil has rapidly risen as a pulp manufacturer and exporter. Pulp production increased 133% between 2000 and 2015, and the industry's expanding pulp production capacity is geared towards exports.⁵² In 2007, 55% of its pulp production was exported compared to 70% in 2016. China has been a key destination for Brazil's eucalyptus pulp, representing more than 30% of Brazil's exports in 2016 compared to 23% five years earlier.⁵³

Rising competition in woodchip markets means that active marketing strategies are increasingly important. One example is New Forests Timber Products. Established in 2015 the company acts as the export marketing business for New Forests' Australian hardwood plantation woodchip sales into Asia in order to capture value at the timberland asset level through cost containment, coordination of large-scale supply, and demonstration of consistent plantation woodchip quality.

FIGURE 12: AUSTRALIAN HARDWOOD PULPLOG PRODUCTION FORECAST 2015-2059



Note: forecasts annual average merchantable volume potentially available from Australia's commercial plantation estate for each five-year period. Source: ABARES Australia's plantation log supply 2015-2059⁵⁰



Timber Markets Update

The Changing Paradigm for Forest Products

Technology, socioeconomic, and demographic shifts are driving transformations in wood product markets. Forest product innovation and the bio-economy offer new and potentially expanded markets for timber as a renewable input to many innovative and value-added products.

PULP AND PAPER CATEGORIES

The rise of digital content, e-readers, and increasing internet penetration have put newsprint and writing papers in decline. In response, forest product markets are re-shaping to accommodate new end uses for hardwood and softwood chip and pulp across diverse markets and industries.

Packaging

The paperboard packaging market is expected to expand at 7.1% compound annual growth between 2016 and 2024. Paperboard is manufactured from wood pulp or layers of paper, and approximately 70% comes from recycled fibre.⁵⁴ The push for sustainable packaging favours paperboard over plastics, metal, and glass.⁵⁵ Food and beverage packaging in the Asia-Pacific region captured 35% of the global paperboard packaging market in 2015.⁵⁶ Expansion in the e-commerce and cosmetic and personal care industry in countries such as India, China, and Japan is likely to propel further demand for paperboard packaging in the Asia Pacific, with a similar trajectory anticipated for Latin America.⁵⁷

Tissue and Fluff Pulp Products

Tissue and fluff pulp production are linked with improving living standards, affluence, and hygiene. Consumer end uses include baby diapers, hygiene products, and household wipes. The industrial segment has similar uses, but typically sold business to business for commercial operations, including general purpose, food service, and healthcare.⁵⁸ Growth is expected to average 3.1% per annum to 2020, with emerging markets leading growth at 5.1% per annum compared to developed markets at 1.0% per annum during this horizon. Bleached hardwood kraft pulp (virgin material) is replacing recovered paper as the source of tissue fibre.⁵⁹

DEVELOPMENTS IN THE BIO-ECONOMY

The global bio-economy is advancing, supported by overall market and policy shifts toward the development of bio-based energy and materials, and a shift away from fossil-fuel based energy and materials. In particular the Sustainable Development Goals (SDGs) and the Paris Agreement both create additional impetus for nations to invest in and develop the bio-economy. These agreements are expected to drive new investment in renewable energy sectors, including the greening of supply chains and increasing responsible production practices. Cumulatively, this is supportive of the bio-economy, but further investment and innovation will be required to meet ambitious global targets.

As renewable energy steadily expands, there is still ongoing debate around the ultimate sustainability of bioenergy and biofuels.⁶⁰ Confusion about the sustainability of the sector may undermine the credibility of wood and other biomass as sustainable feedstocks. The major concern is the origin of feedstock material, including factors such as whether the harvest is legal, provides for a sustained yield, or includes material from high conservation value forests. There are also issues about the energy intensity of industrial manufacturing processes as well as other supply chain factors. These concerns have raised questions about the climate neutrality of bioenergy and biofuels. If developed on a sustainable basis, the bio-economy is poised to be a major source of renewable materials and a significant benefit to certified timber producers that can meet both regulatory and consumer demand for sustainable feedstock.

New Forests expects the bio-economy will continue to grow and have a broadening impact, driven by the demand for renewable materials. This section discusses several areas of innovation that are beginning to influence timber markets.



Biofuels

Biofuels include solid, liquid, and gas fuels that are derived from plant biomass and other living organisms. While biofuels can utilise a variety of feedstock, the issue of securing stable supply continues to be problematic for developers of new biofuel technologies that are seeking to achieve scale. To date, the most common biofuels and applications are bioethanol (made from corn, wheat, or sugarcane) and biodiesel (made from soybean, canola, barley, or palm oil) for use in transport fuels. While the early 2000s saw rapidly rising interest in biofuel investment and development, the industry has faced headwinds in relation to sustainability issues, increasing land area devoted to agriculture, heavier use of polluting inputs, and higher food prices. Although the initial biofuel boom has contracted, bioethanol and biodiesel have gained traction in North America and Europe through better management of sustainability issues in relation to land use, environmental safeguards, and government incentives such as biofuel blending mandates.⁶¹

The shifts and innovation created by the growing bio-economy have led to advanced biofuels that utilise non-food feedstock including waste and residues. Second generation biofuels have entered commercial production and include cellulosic ethanol and biomass-to-liquid biodiesel. The US and China dominate in terms of installed cellulosic ethanol capacity at 490 million and 340 million litres per annum, respectively, which equated to 35% and 24% of the total global capacity as of 2015.⁶²

Biofuel technology is likely to play an important role in decarbonising the transport fuel industry. Projections for second generation biofuels anticipate a 50% growth in the market between 2014 and 2020 with an estimated value of USD 23.9 billion in 2020. Global biofuel consumption is forecast to grow from 122.6 billion litres a year in 2013 to over 193.4 billion litres in 2022.⁶⁶



Flying on Forest Fuel

In late 2016, an Alaska Airlines Seattle-Tacoma to Washington DC commercial flight used a 20% blend of renewable fuel made from forest residues. Biofuels for jet aircrafts are known as “biojet” fuel.⁶³

While biofuels have been deployed into commercial flights since 2011 and airlines are starting to set up off-take agreements with biojet producers, this was the first flight using biojet made from cellulose, the most abundant organic compound on Earth and a key component of trees. The advantage of advanced biojet made from wood-based feedstock is its higher emissions-reduction potential.⁶⁴

If Alaska Airlines were to replace 20% of all its fuel supply at the Sea-Tac Airport with this woody biojet, it is estimated that the airline’s greenhouse gas emission would reduce by 142,000 metric tonnes of CO₂e, or the equivalent of 30,000 passenger vehicles being taken off the road each year.⁶⁵

Timber Markets Update

Bioenergy and Wood Pellets

Commercial bioenergy markets are currently centred on wood pellets, which provide a moderately high calorific load considering their energy to density ratio and can be used in residential heating, co-firing applications, or dedicated bioenergy plants. Demand for wood pellets is rising, driven by government mandates for renewable energy, which include policy instruments such as feed-in tariffs, tradable renewable energy certificates, and direct government subsidies. Wood pellets made from by-products, such as sawdust and forest waste, offer attractive bioenergy material as they come from waste products, offering both economic and environmental benefits. However, there is now increasing interest in dedicated bioenergy feedstock from timber plantations.

The switch from coal to wood pellets can be an effective way of meeting renewable energy or greenhouse gas emissions reduction targets. However, this depends on using a sustainable supply of wood fibre and understanding the full life cycle analysis. Global pellet demand is expected to almost double between 2015 and 2025, with Europe's share moving down from 81% to 74% as Asia's demand picks up.⁶⁷ Advanced wood pellets, which are processed for higher calorific output than traditional pellets, are anticipated to take on an increasing role in commercial energy production over the coming years.

Potential large-scale commercial markets for alternative uses of bioenergy, such as in manufacturing, home heating, and the energy power sector, are significant and expected to grow. Global wood pellet production continues to rise, from just short of 20 million tonnes in 2012 to 28 million tonnes in 2015, a 42% increase. The current global wood pellet industry is still fairly concentrated.⁶⁸ Together, Europe and North America account for almost all global pellet production and consumption. Renewable energy targets of 15% in the UK and 20% in the EU by 2020 have successfully spurred infrastructure investment in bioenergy plant conversions that create a steady demand for wood pellets.⁶⁹

New renewable energy policies in Asia are now also driving demand for biomass energy. The Japanese government has introduced a feed-in tariff for renewable energy, and one of the priority areas is bioenergy, based on both domestic and imported biomass.

This could generate a large market in the next five to 10 years for both conventional and advanced wood pellets, with some market commentators suggesting demand for 9 million tonnes of pellets per annum by 2025.⁷⁰

In addition, China is also a major consumer, with demand forecast to outpace North America, increasing from less than 1 million bone dry metric tonne (BDMT) consumption in 2009 to 10 million BDMT by 2020.⁷¹ Global pellet demand is projected to double in the next 10 years from approximately 26 million tonnes to almost 50 million tonnes of pellets in 2025.⁷²

Biomaterials

The world of biomaterials is ever expanding and includes a vast range of materials derived from plant fibre. Innovation in this area ranges from industrial applications to consumer goods and even to pharmaceutical and medical uses. Biomaterials can include, for example, bio-chemicals, bio-plastics, polymers, cellulose-based fabrics (manufactured from dissolving pulp), and cellulosic fibres. In many cases biomaterials can substitute for or supplement other materials, such as those derived from petroleum, which positions biomaterials as a sustainable alternative.

Dissolving pulp is the raw material for manufacturing viscose, lyocell (also marketed as Tencel), modal, and rayon. Dissolving pulp refers to pulp with cellulose content above 90% and can be manufactured from a variety of plant sources. Viscose fibre, which uses wood pulp, accounts for 75% of total consumption of dissolving pulp.⁷³ These wood-based textiles compete with cotton and petroleum-based synthetic fabrics such as polyester.



The world of biomaterials is ever expanding and includes a vast range of materials derived from plant fibre. Innovation in this area ranges from industrial applications to consumer goods and even to pharmaceutical and medical uses.



Dissolving pulp will be a strong driver of woodchip demand in Asia with global growth projected at 5% per annum.⁷⁴

Biomaterials development is a key focus of R&D within forest and bio-supply chains. In some cases, governments fund R&D to offset declines in traditional pulp and paper sectors and to promote a shift to renewable-based economies while supporting primary industry. At the same time some of the largest forest sector corporations are directing R&D into biomaterials to diversify or recover from declining traditional forest industry sectors, such as newsprint. New products offer the possibility to re-purpose existing processing plants by shifting from traditional products into innovative biomaterials with seemingly endless applications.

An emergent field is applying nanotechnology to wood by breaking down the wood fibre into its nanocellulose components, which are light, stiff, conductive, and transparent. Nanocellulose is also eight times stronger than steel in tension. Nanocellulose, in the form of nano-scale crystals, nanofibres, or nanofibrils, has potential applications including paper and packaging, food, health, automotive, construction, sensors, and electronics.⁷⁷

Engineered Wood and Cross Laminated Timber

Timber has a long tradition as a building material, but large-scale construction with engineered wood products is changing the face of architecture in cities around the world. High rise timber buildings are now a reality thanks to Cross Laminated Timber (CLT). The Forte building in Melbourne, Australia was profiled in our 2015 Timberland Investment Outlook, and at 10 storeys and just over 32 metres, it was the world's tallest modern wooden building. This has been surpassed by the University of British Columbia's Brock Commons Tallwood House at 18 storeys, or 53 metres, and completed in 2016.⁷⁸

The dormitory complex will not hold the record for long, as the 24 storey (84 metre) HoHo Vienna in Austria, a mixed-use commercial and residential complex, is under construction and scheduled to complete in 2018.⁷⁹ Plyscrapers—skyscrapers made entirely of wood—are currently on the drawing board including the proposed 80 storey, 300 metre tall residential Oakwood Tower in London. If constructed, it could be the second tallest building in London.⁸⁰



Forests and Fashion

There is growing consumer and business awareness and preference around environmental and ethical considerations in consumption and the value chain that involves forests and wood products.⁷⁵ One example is in the fashion industry. Canadian environmental non-profit group, Canopy, identified the issue of deforestation and the global fabric supply chain, particularly for endangered forests in Indonesia, Canada, and the Amazon; the need to maintain biodiversity; and the growing demand for dissolving pulp.

Through the CanopyStyle campaign, started in 2013, there has been effective engagement with fashion designers, retailers and fabric manufacturers and recyclers. Sustainable sourcing with forest certification and supply chain transparency will support fashion brands in ensuring their clothing does not come from endangered or poorly managed forests while still showing demand for new bio-based fabrics from responsible sources.

As of 2017, 100 fashion and apparel brands from across all regions had signed to the initiative.⁷⁶



Timber Markets Update



WHAT IS CLT?

CLT combines the advantages of large load-bearing panels (a jumbo version of plywood), stability, fire resistance, and long-term carbon storage in a renewable building product.⁸¹

CLT is an engineered wood product and composite building material manufactured from low-grade wood inputs such as small-diameter timber. It is created by bonding together several layers of timber boards with their grains at right angles to one another with non-toxic adhesives and hydraulically pressing to produce a solid timber panel. Cross-laminating layers of wood veneer improves the structural properties of wood by distributing the along-the-grain strength of wood in both directions, and this means that CLT panels can be used to form complete floors, walls, and roofs.⁸²

CLT offers unique properties when compared to concrete or steel. As a general principle with timber materials, a charred layer will form around the material core during a fire, which helps to retain its load bearing capacity and delay the charring rate. It is less energy intensive to produce than steel or concrete, hence a smaller carbon footprint in addition to the stored carbon of the wood itself. The pre-fabrication of the panels can minimise waste and also help shorten construction time. Because wood is a poor conductor of heat, it improves the effectiveness of insulation and the building's "green" performance. Within the built environment, the use of wood materials is noted for its warm aesthetics and being positive for health and well-being.⁸³



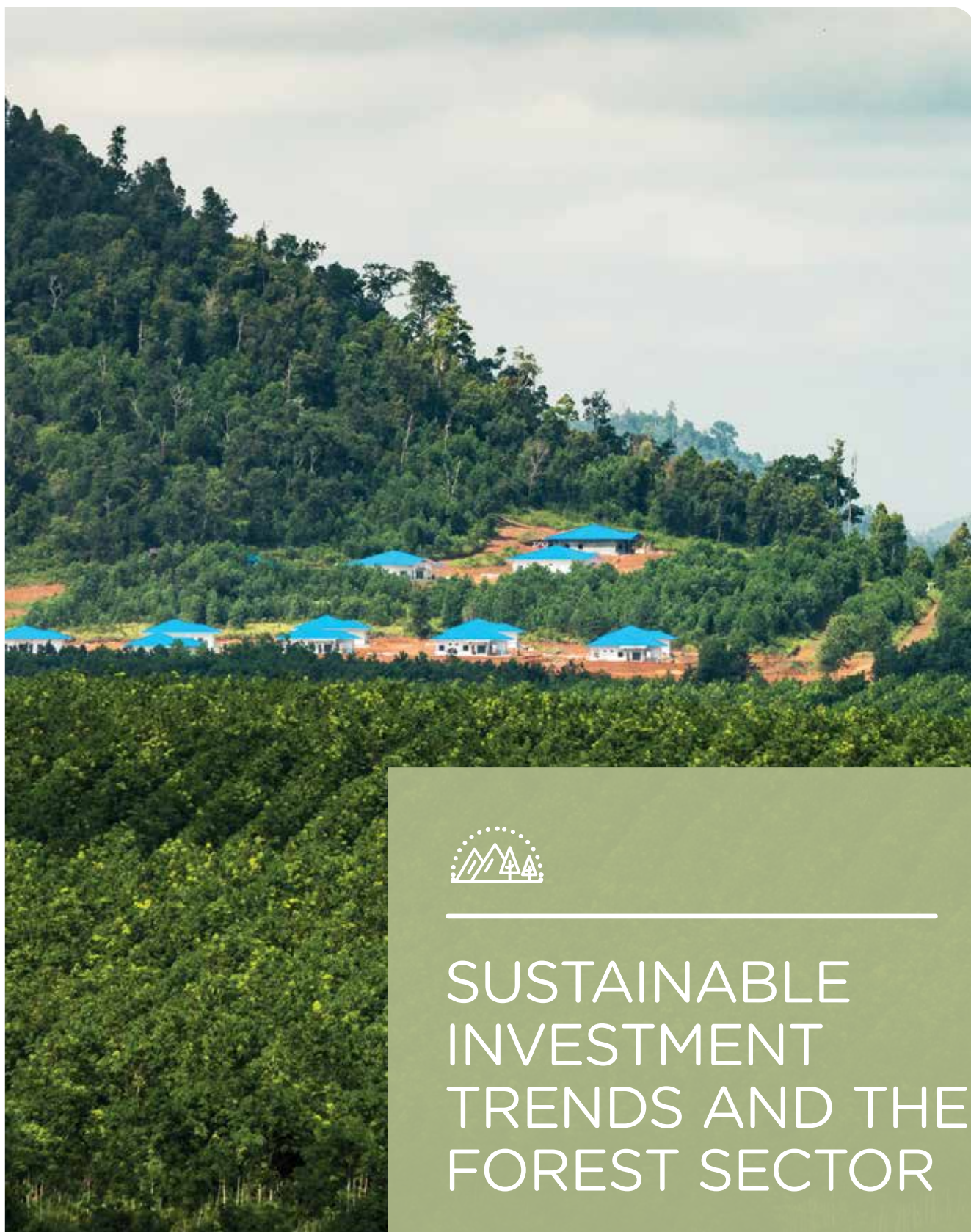
To date, the majority of the mass timber buildings are in Europe, due to the early adoption of CLT and supportive planning policies and initiatives that encouraged the use of low embodied emissions material, renewable resources, and energy efficiency in construction. In Europe, more than 70% of CLT production is used for townhouse construction.⁸⁴

Building codes have been the main impediment to faster uptake of CLT use, limiting the height of wooden structures due to fire safety concerns. As these have been addressed through consultation and verification, various jurisdictions have begun easing the height restriction and subsequently, tall wood buildings projects in Canada, the US, New Zealand, and Australia have started to take place. Production capacity is also constrained by the number of certified CLT manufacturers, with three plants in North America, 14 in Europe,⁸⁵ and one in New Zealand. Relative to other mainstream building materials, CLT is still relatively expensive. For example, in Europe, CLT costs 10% to 15% more than masonry or concrete.⁸⁶

- In New Zealand, CLT has featured in the rebuilding following the 2010 Canterbury and 2011 Christchurch earthquakes, with a focus on seismic engineering.⁸⁷
- Australia's National Construction Code changed in 2016 to facilitate mid-rise timber buildings (not more than 25 metres),⁸⁸ and a New Zealand timber company is setting up Australia's first CLT production plant, expected to be operational in 2018.
- In 2014, Canada and China announced the Sino-Canadian Low-Carbon Eco-District Demonstration Project in Tianjin, which is China's first large-scale community-sized demonstration area for wood in construction including use of CLT.⁸⁹
- China's Ministry of Housing and Urban-Rural Development will start to permit wooden buildings up to five storeys, and in some cases, up to 18 storeys (56 metres) in the later part of 2017.⁹⁰

CLT opens a growing timber building market for mid-rise and potentially high-rise buildings. The adoption of wood procurement, green buildings, and low-carbon building standards will further support the progress of CLT buildings in the rise of timber construction to new heights.





SUSTAINABLE INVESTMENT TRENDS AND THE FOREST SECTOR

Sustainable Investment Trends and the Forest Sector



New Forests sees the opportunity to align portfolio management objectives with an emphasis on sustainability outcomes in timberland.

The forest sector touches upon many of the leading responsible investment concerns for institutional investors, including climate change, sustainable development, and rural livelihoods. The rise of sustainable investing also brings an emphasis on innovation and improved management of environmental, social, and corporate governance (ESG) issues that is suited to investment in sustainable forestry. In this section, New Forests explores the trends arising from international sustainable development efforts, progress in ESG reporting and impact measurement, and the development of conservation finance within institutional investment and what these developments mean for the forestry asset class and investors in the years to come.

Sustainable Investment Trends

As investors move to decarbonise their portfolios, to understand sustainability risks and opportunities, and to ensure accountability and transparency in financial services, timberland investment can help meet new sustainability requirements and goals.

DECARBONISATION

A critical mass of institutional investors has already embraced the concept of portfolio decarbonisation, seeking to decrease their exposure to greenhouse gas emissions intensive investments and associated climate risk. The Portfolio Decarbonization Coalition reports more than USD 600 billion in decarbonisation commitments.⁹¹ Investors with such commitments must navigate a path from understanding their portfolio impact through carbon footprinting to taking action to decarbonise – or lower their carbon exposure – through alignment with a lower carbon economy. The Montreal Pledge,⁹² promoted by the Principles for Responsible Investment (PRI), has garnered the support of more than 120 investors representing more than USD 10 trillion in assets under management. Under the Montreal Pledge investors agree to measure and publicly disclose the carbon footprints of their portfolios.

New Forests measures and reports annually on the carbon sequestration of the timber plantation investments it manages in order to support clients in their carbon footprinting.

Conservation of natural forests, restoration of degraded lands, enhancing forest productivity, and utilising technologies such as biochar can all enhance carbon sequestration and storage in forests and plantations.

In the supply chain, engineered wood products, construction timbers, bioenergy, and biomaterials offer a vast range of low-carbon products and materials that substitute for higher-carbon and less renewable materials. Investors can promote the shift toward higher productivity plantations, enhanced productivity, and innovation in the supply chain that will generate emissions reductions and move toward a low-carbon future.

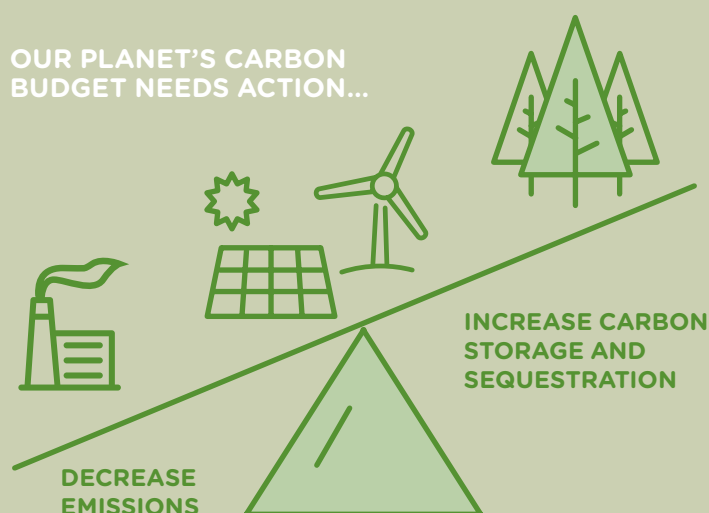


Sustainable forestry investment can deliver both climate mitigation and bio-based resources for a low-carbon world. Responsibly managed natural forests and timber plantations offer potential for significant negative emissions – where carbon dioxide is removed from the air – at scale, which makes forestry investment a unique component of portfolio decarbonisation.

Institutional Investment and Sustainable Forestry Solutions

With global commitments to take action to limit climate change to less than 2°C, conventional mitigation is not enough. Negative emissions – where carbon dioxide is removed from the atmosphere – are necessary.

OUR PLANET'S CARBON BUDGET NEEDS ACTION...



20%–60%
OF MITIGATION BY 2030 CAN
COME FROM THE LAND SECTOR

AN ESTIMATED
2.7–9.4
GIGATONS
THROUGH 2020, FORESTRY AND OTHER LAND USE
ACTIVITIES OFFER GREATER NEAR-TERM CARBON
MITIGATION THAN ANY OTHER STRATEGIES

Investors are looking to decarbonise their portfolios, align with the Sustainable Development Goals, and position their investments to succeed in a carbon-constrained future.

THE PARIS
AGREEMENT OPENED
\$23
TRILLION
OF INVESTMENT OPPORTUNITIES
IN EMERGING ECONOMIES ALONE

INVESTOR
COMMITMENTS
TO DECARBONISE
\$600
BILLION AUM

\$200
BILLION PER YEAR
NEEDED FOR DEFORESTATION-FREE
COMMODITY INVESTMENT AND FINANCING

Sustainable forestry investment can deliver both climate mitigation and the forest resources for a low-carbon world.

CONSERVATION OF NATURAL FORESTS	RESTORATION OF DEGRADED LANDS	ENHANCED FOREST PRODUCTIVITY	BIOCHAR	ENGINEERED WOOD PRODUCTS	BIOENERGY	NEGATIVE EMISSIONS TECHNOLOGIES
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3x
THE AMOUNT OF WOOD WE TAKE
FROM FORESTS AND PLANTATIONS
EACH YEAR MAY NEED TO TRIPLE
BY 2050 TO MEET THE WORLD'S
GROWING DEMAND
THE WORLD NEEDS AN ADDITIONAL 250 MILLION HECTARES
OF PLANTATIONS BY 2050

TREE PLANTATIONS
MAKE UP ONLY **7%**
OF TOTAL
FOREST COVER
BUT PROVIDE **50%**
OF INDUSTRIAL
ROUNDWOOD

Sustainable Investment Trends and the Forest Sector



ESG REPORTING AND MEASUREMENT ON THE RISE

As investors gain clarity around how their portfolios may align with sustainability goals, there is maturation in the areas of ESG reporting and impact measurement. At the core of ESG performance is the ability to monitor progress on key ESG issues and to measure impacts. When impact investing⁹³ emerged as a concept, it was the exception rather than the norm for investors to intentionally seek environmental and social impacts alongside financial returns, and measurement of such impacts was rare. Over the past several years, more impact fund managers and products have arisen, and the concept of impact measurement is increasingly mainstreaming.

Forestry currently constitutes only a small part of the impact investment market but has significant opportunity for growth. The Global Impact Investing Network (GIIN) reported 18% compound annual growth in the AUM of impact investors under its annual investor survey, with a total of more than USD 113 billion in 2016 and nearly USD 25 billion of this in real assets.⁹⁴ If forestry investments can also deliver positive environmental and social impacts, then these will qualify as impact investments. In New Forests' case, all of our investments meet these criteria and contribute to the rising AUM of impact investment globally.

In 2017 the GIIN and Cambridge Associates introduced a new benchmark for real assets impact investments. Impact funds focused on the timber sector include sustainable timber production, land conservation, and biodiversity conservation. As at June 2016, the impact timber peer group generated a net internal rate of return (IRR) of 5.9%, comparing favourably with conventional timber funds, which returned 3.3% over the same period using the same set of 1997-2014 vintage years. Top quartile funds returned at least 8.6% compared with at least 4.2% for conventional timber funds.⁹⁵

Best practice in impact measurement and management is emerging and expected to continue evolving in the years to come. Leading investors use impact measurement data to manage their impact performance and to identify business opportunities. New Forests believes that investors who can link improved ESG management and impact performance to improved financial returns will be positioned to capture additional value from sustainable investment opportunities. As of mid-2017, the Natural Capital Coalition is

developing its forest sector guide, which is expected to provide methodological guidance on natural capital accounting in the forest sector and support understanding of ecological values in forest production and the supply chain. As natural capital accounting approaches continue to develop, methods are emerging to ascribe financial value to the underlying ecosystem services—the benefits that society receives from ecosystems.

As investors continue to advance in their understanding of sustainable development and to articulate how their activities may support achievement of the international goals, New Forests expects that forestry investment will increasingly become an area of interest for mainstream investors seeking to integrate high sustainability investments in their portfolios. New Forests also expects a growing shift from a narrow focus on forest-climate issues to a more integrated understanding of ESG issues and opportunities in timberland investment.

Forests within the Sustainable Development Agenda

Since the 2015 Timberland Investment Outlook, sustainable investment trends have accelerated, fuelled by rising demand for transparency in financial services as well as global consensus around key environmental and social goals, including the Paris Agreement and the UN Sustainable Development Goals.⁹⁶

WHAT PARIS MEANS FOR THE WORLD'S FORESTS

The Paris Agreement represented the greatest advance in climate diplomacy since the signing of the Kyoto Protocol in 1997 and is the first agreement under which nearly all countries – developed and emerging economies alike – committed to undertake actions to combat climate change. The agreement sets the framework for mitigation, adaptation, and finance activities from 2020. Since its signing at the UNFCCC Conference of the Parties in December 2015, the Paris Agreement has come into force with ratification by more than 140 nations. Since then, however, President Trump notably announced in June 2017 that the US would withdraw from the Agreement. In response many US corporations, cities, and states have instead committed to uphold the Paris Agreement at subnational and private sector levels. The IFC estimates that the Paris Agreement presents a USD 23 trillion investment opportunity.⁹⁷

Sustainable Investment Trends and the Forest Sector

Private sector investment is expected to be critical to achieving the objectives of the Agreement, and financing mechanisms that encourage private investment are emerging.

The Paris Agreement recognises the vital role of the forest sector in generating meaningful climate action. Reducing emissions from deforestation and degradation, known as REDD+, is included with reference to the role of sustainable forest management and conservation. To date private investment in REDD+ has been limited by the inconsistent and weak market signal; however, the Paris Agreement is expected to motivate investment into conservation of forests for REDD+ markets. Furthermore, REDD+ includes a range of forestry activities and not just avoided deforestation. New Forests anticipates increasing attention to sustainable forest management, afforestation, and reforestation as contributors to climate-smart land use.

SUSTAINABLE DEVELOPMENT GOALS AS AN INVESTMENT FOCUS

The SDGs were adopted in September 2015 by countries as part of a new global sustainable development agenda to end poverty, protect the planet, and ensure prosperity for all.⁹⁸

The SDGs focus both on tackling climate change and encouraging investment in the future we all want through 17 goals and 169 targets. While the Goals are integrated and indivisible, they present a framework for investors to identify areas in which their investment activities can make the greatest contribution.

Forests are directly included through Goal 15, Life on Land, which establishes the goal to sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss. Moreover, links to forest management issues have been drawn to every one of the 17 SDGs. In the forest sector, these links are diverse and highly integrated, allowing investors flexibility to pursue SDG impacts that align with their own goals.

While governments are expected to take ownership of the sustainable development agenda, investors are also responding to this call for sustainable investment in alignment with the 17 Goals.

Interest in SDG-related investing is occurring across the full range from specialised impact investors through to some of the world's largest and most sophisticated pension funds.

- The Global Impact Investing Network (GIIN) developed a set of investment profiles that highlights the experiences and approaches of impact investors who are actively investing in activities that have individual impact goals that can be mapped to the global agenda.⁹⁹
- In 2016 a coalition of Dutch investors launched the Dutch SDG Investing Agenda, which encourages the Dutch Government to raise the profile of the SDGs and provide policy support and catalytic funding for sustainable finance opportunities, but moreover reinforces the coalition's commitment to SDG investment action within Dutch value chains.¹⁰⁰
- The Danish Government announced the SDG Fund,¹⁰¹ which will be managed by IFU, the Danish development finance fund. The SDG Fund is intended to raise USD 750 million for SDG investments in emerging markets, including for climate action, affordable and clean energy, clean water, and sanitation. Danish pensions have already expressed interest to join the fund, with a view toward using the SDG Fund as an accelerator fund, which would stimulate additional co-investment into large-scale projects.
- Some of the world's most sophisticated and well-known asset managers have developed dedicated impact funds, many of which are based around contribution to SDG-related impacts. Such firms include private equity manager TPG, which debuted the USD 2 billion Rise Fund including large-scale transactions in the tens and hundreds of millions,¹⁰² and Swiss bank UBS, which announced a USD 5 billion initiative to invest in the global Sustainable Development Goals.¹⁰³ Other asset managers like the Dutch APG are leading in articulating how the SDGs link to targets for high sustainability investments to meet ambitious portfolio sustainability targets.

Collectively, the SDGs constitute a platform that can support communication, strategy, and goal articulation for investors. This common vocabulary and global agenda may help the investment community in explaining how investments provide environmental and social benefits alongside financial returns. With respect to the forest sector this could be an important driver of capital to assets that are positioned to deliver SDG impacts. Forestry investment is able to overcome some of the commonly cited barriers to impact investing as there is a well established track record of timberland investment and returns, experienced managers, and



SUSTAINABLE DEVELOPMENT GOALS



pipelines of quality transactions with institutional scale. These combined factors mean that forestry investment can be a leader alongside other areas of SDG focus like energy, healthcare, and infrastructure.

New Finance for Sustainable Forestry

Large-scale funding for sustainable forestry has traditionally come in the form of international aid, government grants and subsidies, and other donor funded or not-for-profit initiatives. However, there is increasing emphasis from these traditional funders to establishing new ways to work with the private sector and to catalyse additional private investment into sustainable forestry and landscapes.

BLENDING FINANCE

With ambitious goals and emerging clarity on the amount of investment required to achieve these goals, a new field of blended finance is emerging. The World Economic Forum (WEF) defines blended finance as the strategic use of development finance and philanthropic funds to mobilise private capital flows to emerging and frontier markets, resulting in positive results for both investors and communities.¹⁰⁴

Blended finance can be used to mitigate risk for financial investors, to demonstrate new business models, and to generate financial returns from activities and impacts that are not typically

monetised. WEF's 2016 survey found 74 funds accounting for more than USD 25 billion in blended finance, with financial returns meeting general market expectations while development objectives were also achieved or exceeded. The key to blended finance is not just financial structure, but the commingling of expertise and objectives – impact and finance – in a way that provides more and better returns than can be achieved through traditional approaches.

In forestry and conservation investments, blended finance may increase investments into emerging and frontier regions as well as into landscape management, conservation, and restoration – activities that typically come at a cost to businesses but that deliver positive environmental and social impacts. New Forests believes that blended finance can complement forestry investment in several ways:

- De-risking investments into new geographies or technologies
- Catalysing private investment
- Addressing pre-commercial barriers to investment
- Underwriting additional impact outcomes within investments.

Ultimately, blended finance should be a tool that can either increase the amount of investment into sustainable forestry or amplify the potential positive impacts of forestry investments.

Sustainable Investment Trends and the Forest Sector

CONSERVATION, RESTORATION, AND LANDSCAPES

With sustainable development and climate change mitigation at the centre of global policy initiatives, investors face the challenge of linking responsible production and conservation together as part of operating a sustainable business. Market-based mechanisms for conservation have been in use for decades, but the opportunities globally are heterogeneous and heavily dependent on local regulatory regimes and operating environments.

Encouraging reports suggest growth in conservation investing, a small but rising field that is well aligned with responsible forestry investment. At a White House roundtable in February 2016, investors announced commitments of a cumulative USD 2 billion in private-sector investments to protect natural resources, including a commitment from New Forests to develop its US-based carbon forestry investments.¹⁰⁵ These commitments join a reported USD 8 billion of investments that seek measurable environmental outcomes alongside financial returns, according to the Forest Trends' Ecosystem Marketplace "State of Private Investment in Conservation 2016" survey.¹⁰⁶ This represents a climb from USD 5 billion in 2013, while the report authors estimate the survey may only have captured around one-third of the actual conservation investment market. The largest segment of these investments is in sustainable food and fibre at USD 6.5 billion, which includes sustainable forestry, followed by USD 1.3

billion in habitat conservation. Dedicated funds for mitigation banking and species conservation have been successfully raised in the US, with scale in the hundreds of millions of dollars. Such funds are supported by the regulatory-backed markets for conservation finance, which remain uncommon elsewhere in the world. The lack of such policy platforms means that public institutions and civil society continue to fill the gap, but increasingly with a view toward moving beyond non-market approaches and risk mitigation to actively supporting market creation and private investments in conservation.

At the same time, growing corporate commitments mean there are more for-profit actors looking to monetise conservation. A raft of corporate commitments emerged in the run-up to the Paris Conference of the Parties, with subsequent commitments strengthening a movement toward zero-deforestation commodity production. The New York Declaration on Forests, a voluntary international declaration to take action to halt deforestation, was first endorsed in 2014 at the UN Climate Summit and grew to include endorsements by 40 national governments, 20 sub-national governments, numerous civil society organisations, and, perhaps most notably, 57 multi-national companies.¹⁰⁷ For companies directly involved in the production of commodities, like timber, pulp and paper, palm oil, soy, and beef, this means directly addressing the need

FIGURE 13: PRIVATE CAPITAL COMMITTED TO CONSERVATION INVESTMENTS



Note: Based on responses by 98 private organisations that reported making conservation commitments out of a total of 128 organisations responding to the survey.

Source: Forest Trends' Ecosystems Marketplace¹⁰⁶



to conserve and restore natural ecosystems. While companies have different ways of ensuring “zero deforestation,” many are looking to “zero net deforestation” to meet their voluntary commitments, which means that these companies will not only have to conserve natural areas but may include restoration activities to ensure no-net-loss. The Supply Change initiative, designed to track corporate commitments to reducing deforestation, reports 760 public commitments from 446 companies, including publicly traded and privately held companies.¹⁰⁸ Along with preventing deforestation, some of these policies are now designed to ensure wildlife and habitat protection.

There is a growing array of collaborative initiatives underway to incentivise zero-deforestation policies and to implement programs for restoration and conservation alongside commercial agriculture and forestry production. Examples include the Forest Stewardship Council® (via Motion 12 of the FSC General Assembly 2014 and Motion 7 of the FSC General Assembly 2017¹⁰⁹); the Roundtable on Sustainable Palm Oil and its Compensation Mechanism; and the Private Sector Roundtable of the Asia Pacific Rainforest Partnership.

Forestry investors may seek to engage with such initiatives in order to provide investment perspective and on-the-ground experience with the investment structure, design, and implementation of such activities.

The responsible investment movement is also taking notice of deforestation in supply chains. The PRI’s Palm Oil Working Group has an established engagement program already and in 2016 announced an expanded effort for shareholder engagement on deforestation in other commodities with CERES.¹¹⁰ The Australia-New Zealand regional Investor Group on Climate Change also plans to launch an initiative focused more broadly on addressing deforestation in investment portfolios, which may look beyond publicly listed companies to address deforestation in private assets and other finance.

The diversity and prevalence of these new efforts show the heightened scrutiny investors and companies face and that can fuel demand for conservation finance. This introduces opportunity for timberland investors to incorporate conservation finance in their investment strategies.



Note: New Forests is FSC® non-certificate license holder FSC-N002114. FSC is not responsible for and does not endorse any financial claims on returns on investments.



TECHNOLOGY AND INNOVATION AT NEW FORESTS AND BEYOND

Technology and Innovation at New Forests and Beyond



The forest sector has embraced technology and digitalisation to improve knowledge, understanding, and decision making. Given the scale involved in timberlands, in terms of space and time, technology not only offers improved efficiency and quality of information but also can bolster strategic asset management, resulting in reduced costs, improved revenue, and more reliable valuation for forestry assets. This section uses examples from New Forests' investments and elsewhere to explore the opportunities for technology and innovation to drive better forestry returns.¹¹¹

Eyes in the Sky – Drones, LiDAR, and Satellite Information

The availability of more affordable and user friendly drones, particularly for commercial applications, means that they are accessible for forest managers to integrate into operational activities.

MAPPING AND ESTATE MANAGEMENT

Camera-equipped drones can cover large areas in a short period of time, providing an aerial view while also flying low enough to capture images at an individual tree level. New Forests' investments in the Tropical Asia Forest Fund use a hand-launched UAV (unmanned aerial vehicle) to conduct aerial photography to monitor and improve the accuracy of plantation mapping. Fixed-wing drones like these can cover as much as 300 hectares per day. The camera takes a photo every two seconds, with each image GPS tagged with sufficient overlap to reduce distortion, and an image resolution of approximately 10 cm per pixel. The images are pieced together to create a single georeferenced image, which can then be imported into the GIS (geographic information system) to enable remapping at a scale not previously available. Examples of drone surveys include:

- Prior to harvesting to improve the description of the harvest area boundaries;
- Six months after replanting to evaluate tree survival and confirm plantation boundaries;
- After thinning operations (age 18 months to 2 years) to evaluate stocking and growth; and
- Ad-hoc needs, such checking for forest loss after fires or to survey for unauthorised access and encroachment.

OPERATIONAL PLANNING AND TREATMENTS

UAVs can also be equipped with infrared cameras in order to capture data for planning and operations. Infrared images can help determine accurate stocking assessments and have been

used particularly for planning second rotation management regimes on some of New Forests' Australian hardwood plantations. Broad-leaf trees, such as eucalyptus, tend to be asymmetrically shaped and have complex structures, particularly when canopy closure starts, compared to cone-shaped trees such as fir or spruce, and there can be a high level of variability across a plantation. With infrared aerial surveys, foresters can assess specific areas of the plantation that may need replanting to ensure maximum potential growth. In the analysis, a proprietary tree detection algorithm able to identify individual trees was used to analyse the images. Ultimately this enables very specific re-planting prescriptions that ensure better stocking and growth.

Infrared technology shows promising potential for detecting warm-bodied animals in the forest. A pilot project to detect koalas in plantations using drones with infrared cameras has been tested in Australia. Koala management in the Green Triangle hardwood plantations is an integral component of harvest operations, including pre-harvest surveys and physical koala "spotting" using ground-based workers within active harvesting operations. The infrared and UAV technology offers a safe and more efficient prospect for accurately identifying the location of koalas near harvest operations.

Satellite data is also used to support operations and planning. With the increasing availability of earth observation satellites, remotely sensed data through continuous satellite imaging can be used to monitor harvest and plantation performance, plantation security, and health on a more frequent basis. Tailored geospatial routines can be automated such that what may have taken four to five days of processing can now take a day to process and monitor changes over large forest estates. This technology can provide quantitative inputs for forest estate planning decisions including wood flow logistics and developing greenfield plantations as well as monitoring of conservation areas.

Technology and Innovation at New Forests and Beyond

ADVANCED APPLICATIONS OF LIDAR DATA

LiDAR (light detection and ranging, or light radar) brings further sophistication to forest measurement and monitoring. It has the potential to capture distribution of trees, health, species, and size. The LiDAR sensor sends out thousands of laser light rays per second in a scanning pattern, rapidly sampling distances through its arc of movement. By using GPS to locate the sensor and speed of light, it can calculate distance and height, creating a dense cloud of 3D data points than can be used to generate maps and other quantitative data.

New Forests has tested LiDAR data by capturing top height, basal area, age, total standing volume, and total recoverable volume to refine the ability to predict the growth rate of individual forest stands. This has been helpful for stands within a plantation that have no conventional inventory data. The LiDAR information was found to improve data quality and accuracy, enabling New Forests' operations and investment analytics teams to better project growth, provide forward estimates, and support more reliable valuations. As a result, this has been deployed across some of the firm's Australian softwood and hardwood plantations.

LiDAR can also be used for a variety of operational planning activities to improve information quality and enable greater analysis. Pre-harvest inventory can be conducted by LiDAR and even analysed to determine wood quality and planning for harvest access roads. In Southeast Asia, where New Forests looks at landscape-level planning considerations in new plantation establishment, LiDAR is under consideration to support hydrology studies that are important for understanding where to locate plantation areas, roads, and other infrastructure in order to minimise disruption to local water resources. These examples show how LiDAR can improve the planning of complex operations, which can boost productivity and contain operations costs.

CARBON HOTSPOTS

California has created a market for forest carbon sequestration in the US through its cap-and-trade program. Identifying forest carbon projects that meet appropriate return on investment criteria can be challenging and require extensive data inputs and analysis. New Forests has developed tools to rapidly evaluate forest carbon potential on forests throughout the US using a combination of technology and unique technical analysis.

In 2016, New Forests facilitated a unique carbon-linked transaction with the Chugach Alaska Corporation, an Alaska Native Corporation with extensive landholdings in the Gulf of Alaska. New Forests is developing a forest carbon offset project for the California greenhouse gas emissions trading system on timberland held by Chugach. As part of the innovative transaction, the revenue from the forest carbon offset project enabled New Forests' Forest Carbon Partners fund to purchase and permanently retire 62,000 acres (25,000 hectares) of coal rights in the Bering River Coal Field around Carbon Mountain. The Alaskan coal field was estimated to contain between 69 million to 3 billion tonnes of coal.

The remoteness of the Chugach timberlands makes it challenging to access and manage, including as a carbon offset project. To verify the range of likely carbon offset credit issuance to the project, New Forests used a range of tools and information, including satellite imagery, LiDAR, drone-collected data, and plot data collected on Chugach and third-party land. By combining these information sources, New Forests was able to reduce investment risk without requiring extensive field surveys.

New Markets from Advanced Wood Processing Technology

FROM BIOMASS WASTE TO A GREEN FUEL SOURCE—DEVELOPING PELLETS FOR JAPAN

Biomass energy is an established market segment, with a long history beginning with firewood and today developing efficient wood pellets that can substitute for coal in power production. This new advanced pellet market is poised to become a commercial reality, and New Forests is positioning FSC-certified biomass to be part of this environmental solution for clean energy.

The opportunity centres on demand from Japanese power companies, seeking to transition their energy mix away from fossil fuels and nuclear power,¹¹² and to capture the Japanese feed-in-tariff that subsidises the cost of bioenergy production.

The Japanese market is looking for reliable long-term supply at competitive prices with feedstock that is legally and sustainably sourced.¹¹³ New Forests is considering the opportunity to manufacture an attractive product known as advanced pellets (also called black pellets) from plantation-sourced processing residues, forest thinnings, and pulp logs for long-term supply into the Japanese market.



Regulations introduced in 2016 require Japanese electricity generators to increase their thermal generation output efficiency. Even the most advanced Japanese coal-fired technology will fail to meet the government's carbon emissions goal so there is an increasing role for woody biomass co-firing in coal-fired plants.¹¹⁴ Several major utilities are currently co-firing wood pellets at a 3% ratio, with indications of increasing interest.^{115,116,117}

Two types of pellets can meet co-firing needs: traditional white pellets (the first-available type of densified biomass at commercial scale, which is widely used in Europe) and advanced pellets (a newer technology). Advanced pellets require additional processing: thermal treatment through steam explosion that results in a greater reduction in material mass but less energy loss.

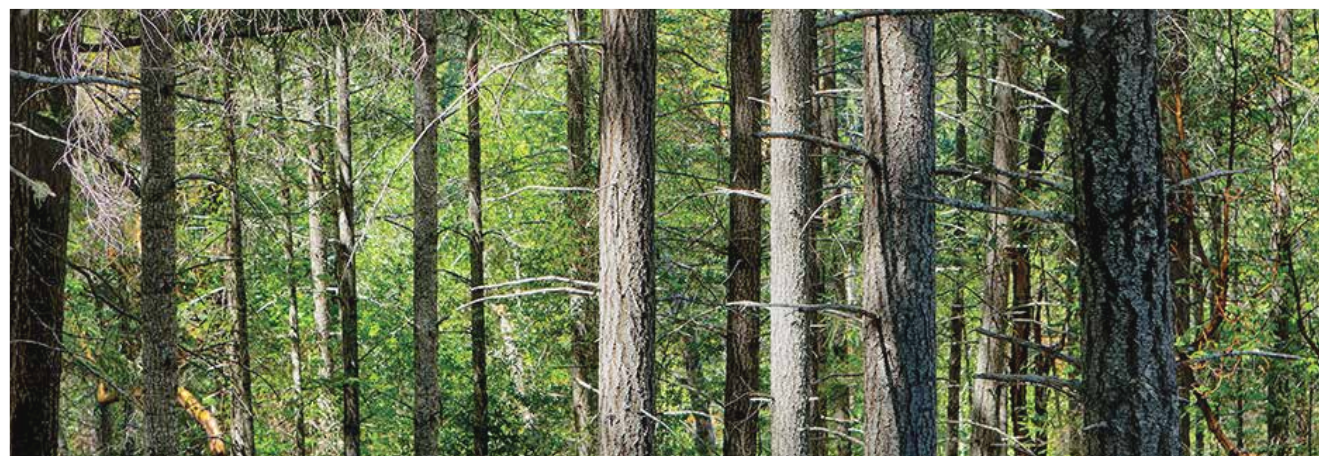
New Forests has undertaken feasibility to construct an advanced pellet plant in northern Tasmania. Advanced pellets are commercially and environmentally attractive. They are a direct substitute for coal in coal-fired plants, are water-resistant, have materially higher energy content (calorific value), higher bulk density, and can be stored outdoors with no degradation.

The advanced pellets can be transported, stored, and handled in the same way as coal, while utilising the existing equipment for pulverising and combustion. In addition, advanced pellets can be co-fired with coal at higher ratios than white pellets. See Figure 14 for a comparative. The proposed advanced pellet plant incorporates best-in-class environmental design and an assessment of its embedded carbon intensity or footprint. While the proposed advanced pellet plant is still in feasibility stage, New Forests believes the technology of advanced pellets – combined with effective policy and market conditions for cleaner energy – opens a promising market for sustainable timber and biomass resources.

FIGURE 14: COMPARING WHITE AND ADVANCED PELLETS TO THERMAL COAL

Attributes	White Pellets	Steam Exploded Advanced Pellets	Thermal Coal
Calorific Value (GJ/t net AR)	17.0-17.5	19.0-20.0	~25.0
Bulk Density (kg/m³)	650	720-780	800
Energy Density (GJ/m³)	11.0-11.4	13.7-15.6	20.0
Ash Content (% weight, dry)	<3%	3-4%	11-17%

Source: Hawkins Wright (2016 report prepared for New Forests)



Technology and Innovation at New Forests and Beyond



Going Cellular with Trees

The forest industry faces the challenge of maintaining ecosystem services while meeting society's need for forest products. Increasingly accessible and affordable biotechnology offers the potential of significant productivity gains while respecting the need for integrated management that conserves ecological function and value.

MAPPING A TREE'S DNA

Genomic tools are a major R&D focus in forest science to improve yield and quality, reduce disease, and improve nutrition. Tree genomes are large and diverse making it challenging to identify the DNA variation and underlying genes that affect the appearance and performance of the trees.¹¹⁸ Genomic selection (GS) helps improve accuracy in selecting traits, such as biomass productivity or non-biological stress tolerance. Ultimately, GS could substantially fast track developments through rapid cycles of breeding, selection, and propagation. Some of the potential focus areas for genomics include resilience to climate change, extreme conditions, pests, and disease; enabling restoration of natural forests and less commercialised timber species; and improving timber qualities for various end uses.

EUCALYPTUS AND BIOTECHNOLOGY

Clonal forestry is a driver of productivity gains in the sector. Propagation techniques allow for selective breeding and production of identical copies, or clones, of selected individual trees that possess excellent genetic potential.¹¹⁹ Being able to identify genetic markers related to the variation in phenotypes (the observable, physical properties of an organism such as appearance, development, and behaviour) offers the potential to genetically improve tree species at a much faster pace than traditional breeding approaches.¹²⁰

There is sensitivity around genetically engineered trees, and typically the introduction of genetically modified trees must be approved by governments and should be done with full environmental impact and risk assessment. For example, frost-tolerant eucalypts are currently being reviewed by the United States Department of Agriculture for approval, and biotechnology firm ArborGen argues the fast-growing trees could help meet growing demand for sustainable bioenergy material.¹²¹ Environmentalist concerns include high water uptake of eucalyptus trees and potentially unknown environmental impacts if the trees are planted at scale.



Meanwhile, genetic marker-assisted selection is proving to be highly accurate in predicting tree performance and delivering substantial gains. For example, teratospaeria leaf disease (TLD) is the most common leaf disease among plantation *Eucalyptus globulus*, the dominant plantation eucalyptus species grown in mainland Australia. The identification of genetic markers associated with TLD can be used to screen seedlings and identify TLD resistant lines.¹²²

Technical services can be used to determine pulp yield for *E. globulus* prior to harvest. Pulp yield determines how much of the woodchip actually ends up as finished paper, and higher pulp yields can attain higher prices in woodchip sales. Using infrared analysis to determine pulp yield can be done in minutes and only cost tens of dollars by testing wood samples, extracted using an electric drill, from a standing tree. Plantation stands can be identified so that the combined pulp yield for all stands harvested at any point in time is above the target pulp yield demanded by customers, which will increase confidence in the consistency and quality of the wood supply.¹²³

LIGNIN MODIFICATION

The break down of plant cell walls is a major limiting factor to large-scale, industrial production of biofuels and value-added biochemicals. The plant cell wall is a complex chemical composite, consisting of cellulose, binding sugars, and lignins. This composite forms a rigid structure surrounding the plant cell.¹²⁴ Trees that have less lignin or more extractable lignin can be more easily pulped, thus reducing the amount of chemicals and energy required in order to produce biofuels, biochemical, and pulp-based products such as paper, packing, and pulp fluff.^{125, 126} Genetically improved bioenergy tree crops could be engineered to produce high biomass yield with easily digestible lignin. Genetically engineered poplar with reduced lignin content has been shown to enhance the competitiveness of bioethanol with conventional fuel by reducing the overall costs by approximately 41%.¹²⁷





CONCLUSION

It is an exciting time to consider investment opportunities in the forestry sector. Markets are strengthening, new opportunities are emerging, and there is a real need to find ways to expand the supply of timber from intensively managed plantations. The global forest sector has changed dramatically over the past decade and will continue to change.

New Forests' outlook suggests that the majority of new timber supply will come from plantations in the southern hemisphere and tropics and, aside from cyclical recovery in US housing, the majority of demand growth will come from Asia. Further, New Forests anticipates the global shift from the declining markets for newsprint and printing and writing paper towards the growing demand for biofuels, bioenergy, packaging, tissues and hygiene products, biomaterials and fabrics, and engineered wood materials to be a continuing trend.

The management of timberland assets is also going through substantial change. Automation is changing how people work, information technology is systematically increasing efficiency and knowledge, new genetic technologies are spurring increasing growth rates, and the expansion and diversification of markets is increasing the utilisation of biomass.

New Forests also finds sustainable and responsible investment is more and more critical to successful outcomes. Rising public concerns about foreign investment, protectionist or nationalist political movements, and changes in the job market all point to a need for investors to make community benefits as important a goal as financial returns. Facing increasing demand for transparency and reporting against environmental and social performance measures, the role of the active manager in forestry will not only be to drive financial returns but also create community benefits, ensure positive environmental impacts, and enhance the fundamental economic sustainability of forestry assets.

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New Forests

As global demand for resources grows, there is a need to increase productivity while ensuring the conservation of the world's remaining natural forests. New Forests seeks to create investment strategies that provide lasting solutions to this challenge. Through responsible management of forests and other real assets, we create shared benefit for investors and local communities alike. We believe that meeting the needs of a broad range of stakeholders will provide better returns over the long term.

New Forests has international reach, with offices and assets in Australia, New Zealand, Southeast Asia, and the US. This gives us a global perspective combined with local expertise that allows us to understand and manage our assets more effectively. Wherever we operate in the world, our strength lies in our people and their drive to make investments that create the best possible outcomes. By investing with integrity and transparency we aim to generate strong returns while helping tackle some of the world's great sustainability challenges.

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