

FUTURE PROSPECTS FOR FOREST PRODUCTS AND TIMBERLAND INVESTMENT

IMPORTANT INFORMATION

Dasos Capital Oy (Dasos) has prepared this report to provide information on the evolution of the timberland asset class with focus on new trends and issues which are influencing investment opportunities and performance. Dasos has based this document on information obtained from sources it believes to be reliable but which may contain errors and omissions since they have not been always independently verified. All charts and graphs are from publicly available sources or proprietary data. Dasos makes no representation or warranty (express or implied) of any nature, or accept any responsibility or liability of any kind for the accuracy or sufficiency of any information, statement, assumption or projection in this document, or for any loss or damage (whether direct, indirect, consequential or other) arising out of reliance upon this document.

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Dasos is an Investment Advisory and Fund Management Company located in Helsinki, Finland providing timberland investment advisory services to institutional investors, foundations, endowments, family offices and private equity clients. Dasos acts as an investment advisor for Dasos Timberland Funds I and II, private equity funds specialised in sustainable timberland investments in Europe and emerging markets.

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ABBREVIATIONS AND ACRONYMS

AFOLU	Agriculture, Forestry and Other Land Uses
CBI	Climate Bonds Initiative
CEN	European Standards Institute
CEPI	Confederation of European Paper Industry
CHP	Combined Heat and Power
CIF	Cost, Insurance and Freight
CIS	Commonwealth of Independent States
CLEEN	Cluster for Energy and Environment
CLT	Cross-laminated timber
CNC	Cellulose nanocrystals
CO ₂	Carbon dioxide
COP	UN Conference of the Parties
CPI	Consumer Price Index
Dasos	Dasos Capital Oy
EC	European Commission
ESG	Environmental, social and governance
ETS	EU Emissions Trading Scheme
EU	European Union
EUA	EU emission allowance
EUCO	European Council
EUR	Euro
FAO	Food and Agriculture Organisation of the United Nations
FOB	Free on Board
FSC	Forest Stewardship Council
GBP	British pound
GDP	Gross domestic product
GHG	Greenhouse gas
GJ	Giga joule
HBU	Higher and better use
HSBC	Hong Kong and Shanghai Banking Corporation
ICT	Information and communication technology
iLUC	Indirect land use change
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
ISO	International Organisation for Standardisation
IWC	International Woodland Company
Kg	Kilogram
Kt	Kiloton
LCA	Life cycle assessment
MTCO ₂	Million tonnes of carbon dioxide
Mtoe	Million tonnes of oil equivalent
NAREIT	National Association of Real Estate Investment Trusts
NCREIF	National Council of Real Estate Investment Fiduciaries
NGO	Non-governmental organisation
NREAP	National Renewable Energy Action Plan
OECD	Organisation for Economic Cooperation and Development
OTC	Over-the-counter
p.a.	Per annum
PEFC	Programme for the Endorsement of Forest Certification
PEI	Private Equity International
PES	Payments for environmental/ecosystem services
REDD	Reducing emissions from deforestation and forest degradation
RES	Renewable energy sources
S&P GSCI	Standard & Poore Goldman Sachs Commodity Index
SBP	Sustainable Biomass Partnership
SIASA	The International Institute of Applied Systems Analysis
Sitra	Finnish Innovation Fund
SNPF	Semi-natural planted production forest
SRI	Sustainable, responsible and impact investing

T	Tonne
tCO ₂	Units of metric tonnes of carbon dioxide equivalent
TCP	Timberland capital productivity
TIMO	Timberland investment management organisation
TWh	Terawatt hour
UK	United Kingdom
UN	The United Nations
UNECE	The United Nations Economic Commission for Europe
UNFCCC	UN Framework Convention on Climate Change
US	The United States
USD	United States Dollar
VTT	Technical Research Centre of Finland
WBCSD	World Business Council for Sustainable Development

MESSAGE FROM DASOS CAPITAL OY

The present study is the fourth edition of the timberland research paper which Dasos Capital (Dasos) has updated every second year or so. As previously, the need for the up-date is determined by the continuing evolution of the timberland investment environment. With the recent substantial growth in Europe, the US and other regions, the global institutional timberland investment business is now a EUR 100 billion industry.

Timberland as an Investment Business

The global timberland investment business has gradually, over the past 25 years, sprouted as a part of the overall private equity sector which has been growing at the speed of about 15-20% per annum worldwide since the early 1990s. The private equity growth is expected to continue faster than the global GDP growth rate, and due to the surge of investor interest in *real assets*, the timberland investment business might in some cases grow even faster.

The private equity industry, and the timberland investment business with it, has become an essential component in the engine of a modern market economy which is continuously renewing itself through the *Schumpeterian process of innovation and creative destruction*. The destruction/innovation -process drives the economic growth and overall well-being through increasing productivity by spin-offs and re-allocation of assets, such as timberland, to the hands of the active core competency owners with focus to enhance profitability and to expand via innovation. From this angle, the trend of establishing larger timberland entities with more substantial industrial rationale from the fragmented European smallholder property base will continue. The activity is generating sizeable timberland portfolios, also suitable for larger timberland funds in the secondary market. Based on a potential securitization in the retail investment market, it is furthermore possible that the larger timberland portfolios may eventually facilitate the re-formation of the household forest ownership, thus closing the investment circle. Rather than the ownership change *per se*, the ultimate outcome of the European timberland investment activity might thus actually emerge as re-establishment of the forestry business in the form required by a modern society.

Technology and Information

Global megatrends are changing the essence of forestry. In general, the commercial and social link between forestry and the other sectors of the economy is being strengthened and the role of technology underlined. The wood selling process is currently becoming digitalised, and *digitalisation* has since many years shaped the forest inventory data systems with the development of ever improving forest management software. The quest for the *bioeconomy* has made wood subject for innovative product development and the resulting new applications are currently expanding the market for wood. From the viewpoint of the *circular economy*, forestry *per se* represents an opportunity to recycle carbon dioxide from the atmosphere emitted by multitude of human activities. Also, residual flows resulting from various traditional wood uses are being increasingly efficiently re-fed into the economic system in terms of valuable raw materials.

Globalisation ensures that information on the emerging timberland opportunities and forestry technologies reaches in real time all corners in the world. The so-called “frontier” opportunities for timberland investment with higher risk/reward profiles exist only as long as the information gap gets filled and the opportunity becomes generally known in the market. Ultimately, the improving information will contribute to the capitalisation of the biological growth in the land price, which will increase. In the increasingly efficient market, the timberland investment business is converging towards an equilibrium in which all timberland will yield the same economic return on a risk-adjusted basis. The bottom line is that the biological growth as a determinant for the economic return is in the long term much less important than generally believed whilst the efficiency of the market does matter more.

This development path is stipulated by “*The Theory of the Efficient Timberland Markets*” and it yields the following propositions for an investment strategy. First, an early entrance in the inefficient market with frontier nature will bear the fruit due to the expected land price increase. Correct timing is here essential as a geography may lose its frontier nature surprisingly quickly once the opportunity gets broadly spotted in the market – this is exemplified by the rapid land price increase in such countries as Estonia, Uruguay and

Southern Brazil. Second, after the opportunity has been widely realized in the market, the economic return converges for the late arrivals – as it has done in the above countries in spite of representing different environments for the biological growth.

Third, the inefficiencies for an individual timberland asset may play a role even in an efficient market environment. Here we have the situation of an owner-specific information gap. In Europe, a major source for timberland return is often represented by upgrading a sub-optimally managed timberland asset towards forest certification and improved marketability of wood. In general, sustainable forest management typically involves employing all the above technology trends, building on wood sales logistics as well as connecting the asset with the wood buyers in the relevant assortment segments.

During the past 15 years, the wood processing industrial capacity has largely sought locations in South, i.e. (sub-) tropical zones with high biological growth and low land price, typically characterised by market inefficiencies. With the information gaps getting removed, and due to the resulting unavoidable increase in the land price and the wood cost at mill gate, it seems that the investment pendulum is currently partly swinging back to North, especially to Europe. Indeed, the already decided industrial investments will substantially increase the wood demand at least for the next few years in the Northern Europe. For the success of the industry, the new capacity has to have the technological edge to take advantage of the new markets evolving around the bio- and circular economy. At the same time, fresh investment frontiers are likely to gain ground in new geographies in the South.

Evolving Forest Products

During the past years, woody biomass has emerged as an increasingly important source of bioenergy (heat, power, biofuels), providing a valuable market for small-scale and residual wood. In Europe, various models have been proposed to produce energy wood. These models range from the dedicated greenfield tree plantations established on high-fertile (agricultural) land to sourcing wood from the industry processes in terms of residual flows. It seems that the greatest efficiency is achieved when sustainable forestry is taken as an exercise of a *joint-production* where energy wood grades are being produced besides more traditional wood assortments, such as pulpwood and sawlogs. In contrast, the economics of the dedicated energy wood plantations seems to be vulnerable and too exposed to CO₂ price, regulatory changes and the land cost. In general, as a result of the advancing utilisation of the wood residue streams, bioenergy production is gradually growing towards an important segment in the wood-processing industry.

The ecosystem services of forests are substantial. The annual growth of the current Dasos forests absorbs more CO₂ from the atmosphere than emitted by 60 000 cars during one year. The amount of CO₂ having been cumulatively removed from the atmosphere and stocked in the current Dasos forests corresponds to 43% of the total industrial CO₂ emissions in Finland per annum. Dasos forests also yield extent conservation and biodiversity services which are to some extent recognised by the market and for which a compensation is received. However, most of them remain for the time being as global public goods generated without commercial reward. With the increase of the world population and growing wealth, the demand for the ecosystem services will accelerate in the coming years. It would be important to create worldwide, or at least European, markets and instruments to match the need.

Timberland Futures

Over the past 50 years, the land globally available per capita has been reduced by some 50% due to the increase in the world population. In the future, the land will become scarcer, driven by the competing food, fuel and fibre uses, suggesting the need to establish new forests largely on lands with no or very low alternative use. More than 200 million hectares of forests are likely to be lost by 2050, reducing further the role of natural forests in the global supply of wood and environmental services. Wood prices are expected to reflect the growing scarcity, providing an incentive to expand the resource base by more productive plantations and more efficient management of existing forests. With the limits of the world's natural resources getting closer, the *renewability* of forests will become a more important investment criteria. Since new forests need to be created by an investment activity with considerable inputs of capital and know-how, *reproducibility* of forestry is gaining more attention underlining the imperative of human intervention in the desired forestry ventures.

Thus, the timberland investment market is likely to continue to deepen to match the opportunity. From the viewpoint of a timberland equity investor, it is interesting to note that the forestry futures are increasingly being discounted also by the debt market. The market for a real asset green bonds is currently emerging with the investment capital underwriters accounting for such risk reducing factors as sustainable forest certification and social responsibility management. In general, the role of the timberland investment sector will become more pronounced in mobilising funds for sustainable forestry development appreciated by the market. In this process, specialised know-how on value creation of the biological real asset will play an increasingly important role.

August 20, 2015



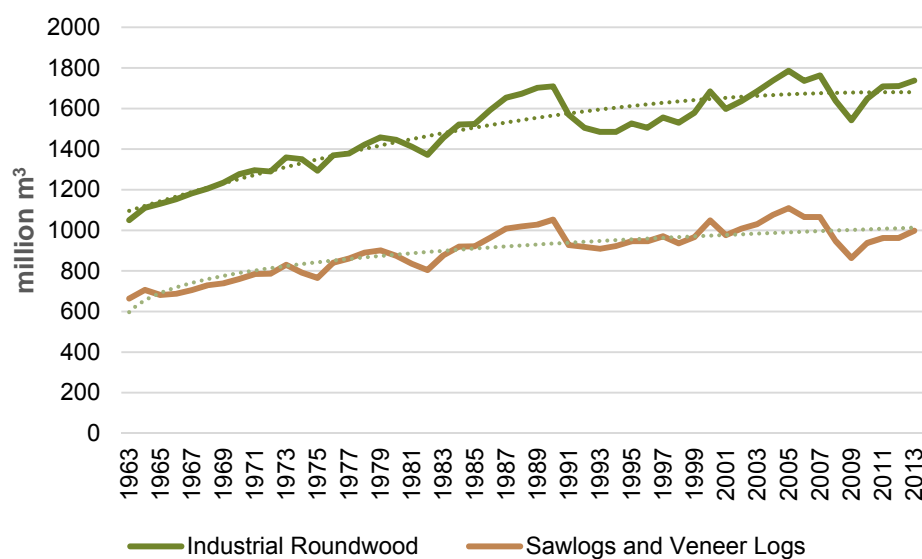
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1. GLOBAL MARKET PROSPECTS FOR INDUSTRIAL FOREST PRODUCTS AND WOOD

1.1 Global Demand for Wood Continues to Increase

The long-term growth prospects for industrial roundwood are positive. In 2014, the global production of industrial roundwood reached almost the all-time high of close to 1.8 billion m³ (Figure 1). Since 2009, the global production of industrial roundwood has increased by 3.1% p.a., and that of sawlogs by 3.8% p.a. allowing the production to recover to the pre-financial crisis levels.

Figure 1 World Industrial Roundwood and Sawlog and Veneer Log Production, 1961–2013



Source: FAOSTAT 2015; Dasos Capital 2015

A worldwide rise in demand for forest products in 2013 resulted in the highest timber harvest in the United Nations Economic Commission for Europe (UNECE) region¹ in six years. Removals of industrial roundwood have been trending upward for five years. (UNECE/FAO 2014). Harvest levels have increased mainly because of the developments in Europe and the Commonwealth of Independent States (CIS).

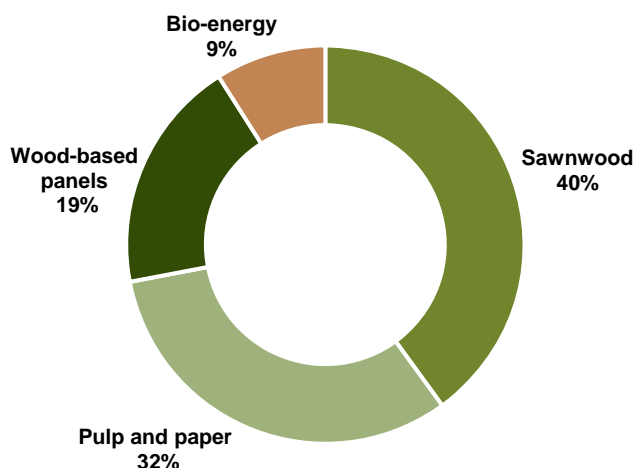
Increased global roundwood demand reflects the steady growth of production of all major wood products worldwide for the fourth consecutive year. The production of industrial sawnwood and wood-based panels has recovered from the economic downturn in 2008-2009, and the production of wood pellets has escalated. However, the pulp log production growth has been slower because the global production of pulp and paper stagnated in 2012-2013.

In Europe, the consumption of all major forest products, with an exception of paper, has increased slowly but steadily during the last four years, though at rates below the UNECE average. The consumption of industrial roundwood in Europe (excluding the CIS countries) grew by 12.3% in 2009-2013 and in CIS countries by 74.9% during the same period (FAOSTAT 2015; UNECE/FAO 2014).

Sawnwood production for construction and value-added production accounts for most of the industrial wood use (Figure 2), and even more for the value of roundwood, followed by the use of wood for pulp. The market for sawnwood and plywood plays a key role for European timberland investors because it absorbs some 35-40% of wood while generating up to 70-75% of wood sales revenue given the high unit-value of sawlogs.

¹ Europe, North America (Canada, United States), and Commonwealth of Independent States.

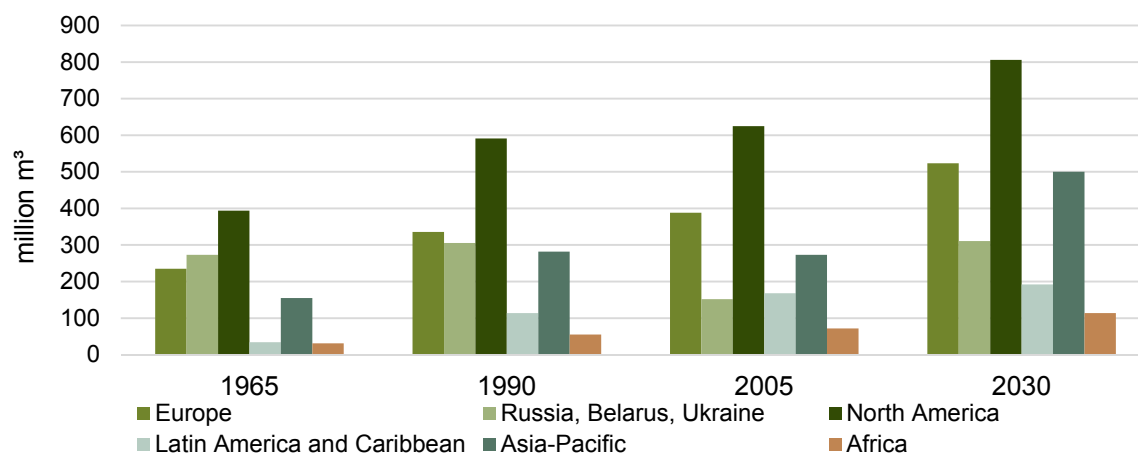
Figure 2 Shares of Global Industrial Roundwood Consumption (m³) by Use in 2013



Source: FAOSTAT 2013

The trend lines in Figure 1 suggest slow but steady global growth for industrial roundwood and sawlogs and veneer logs. The Food and Agriculture Organisation of the United Nations (FAO 2009) estimates that global industrial roundwood production will increase by over 30% in 2010-2030 (Figure 3). The consumption is predicted to grow the fastest in Asia, driven by China.

Figure 3 Historical and Projected Consumption of Industrial Roundwood, 1965–2030



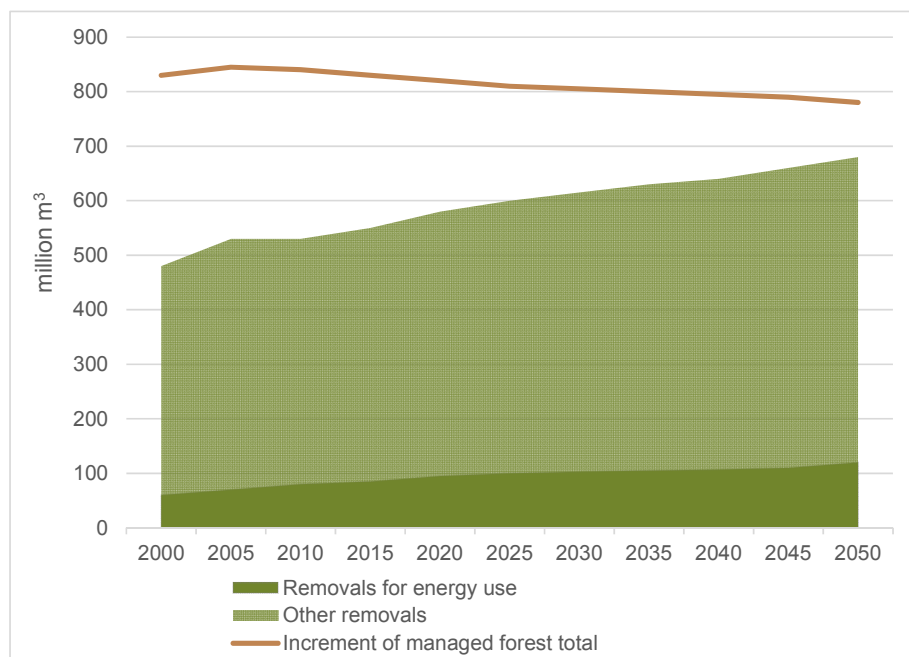
Source: FAO 2009; FAOSTAT 2015; adapted by Dasos Capital 2015

It is likely that FAO projections are overestimates, in particular for North America and Europe, due to not properly accounting for reduced wood fibre demand as a result of increased digitization of media.² On the other hand, these projections do not properly account for the recent developments in the wood demand for commercial wood-based bioenergy. The demand for wood for industrial uses and energy is becoming more and more integrated.

² Hurmekoski & Hetemäki (2013) reviewed long-term outlook studies including those prepared by FAO and UNECE/FAO, and concluded that these studies do not capture adequately structural changes in global paper markets and tend to overestimate paper demand, and consequently also fibre demand.

The European Commission (EC) with support from the International Institute of Applied Systems Analysis (IIASA) and other research organisations, have estimated future harvesting levels for industrial and energy use up to 2050 (EC 2014). These projections suggest increasing wood consumption in the European Union (EU) driven both by industrial uses and energy use (Figure 4).

Figure 4 Estimated EU-28 Harvest Removals 2000-2050



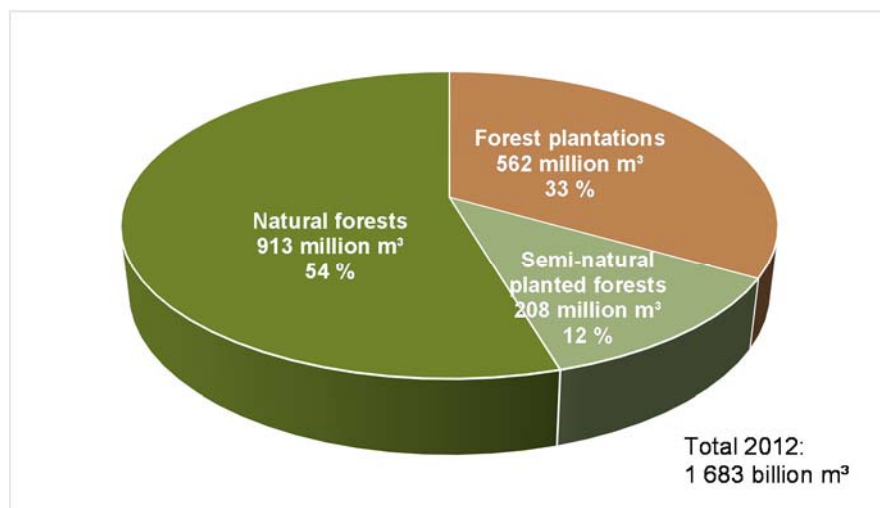
Source: EC 2014 (EU Energy, Transport and GHG Emissions Trends to 2050)

New forestry investments are needed to realise the industrial roundwood and woody biomass supply to meet the growing forest products and bioenergy demand. Globally, most of the incremental industrial wood demand must be met through new plantations and more efficiently and sustainably managed natural forests.

According to the recent FAO study (Jürgensen et al. 2014), forest plantations and semi-natural planted production forests (SNPFs) accounted together in 2012 for 45% of the world's industrial roundwood production, the share of forest plantations being 33% or 562 million m³. South America and Oceania produced more than 80 percent of their industrial roundwood in forest plantations. The majority of the plantation investments during the last ten years have taken place in Latin America followed by Asia. In the boreal zone, such as in the Nordic and Baltic countries, a major share of industrial roundwood originates from semi-natural planted forests (Figure 5).

Forest Stewardship Council (FSC)/Indufor (2012) estimated the production of industrial roundwood from forest plantations at 520 million m³ in 2012, corresponding to a 31.4% share of the total industrial roundwood production. The same study predicted that by 2050, the supply from plantations will at least double exceeding 1 billion m³, or may even reach 1.5-2 billion m³, depending on the scenario. These projections imply a need for accelerated investment in the development of new productive forest resources, including also improved management of existing natural forests.

Figure 5 Industrial Roundwood Production by Source in 2012



Source: Jürgensen et al. 2014

1.2 Emerging Markets and Bioenergy as Demand Drivers

1.2.1 Structural Change in the Global Pulp and Paper Industry

The global consumption of paper-making fibres is at all-time high level. At the same time, the global pulp and paper industry is continuing to evolve through structural changes reflecting the strong contrasts in the prospects for growth between different paper types and between developed (mature) and emerging countries. Structural change is also driven by the uneven access to fibre resources globally.

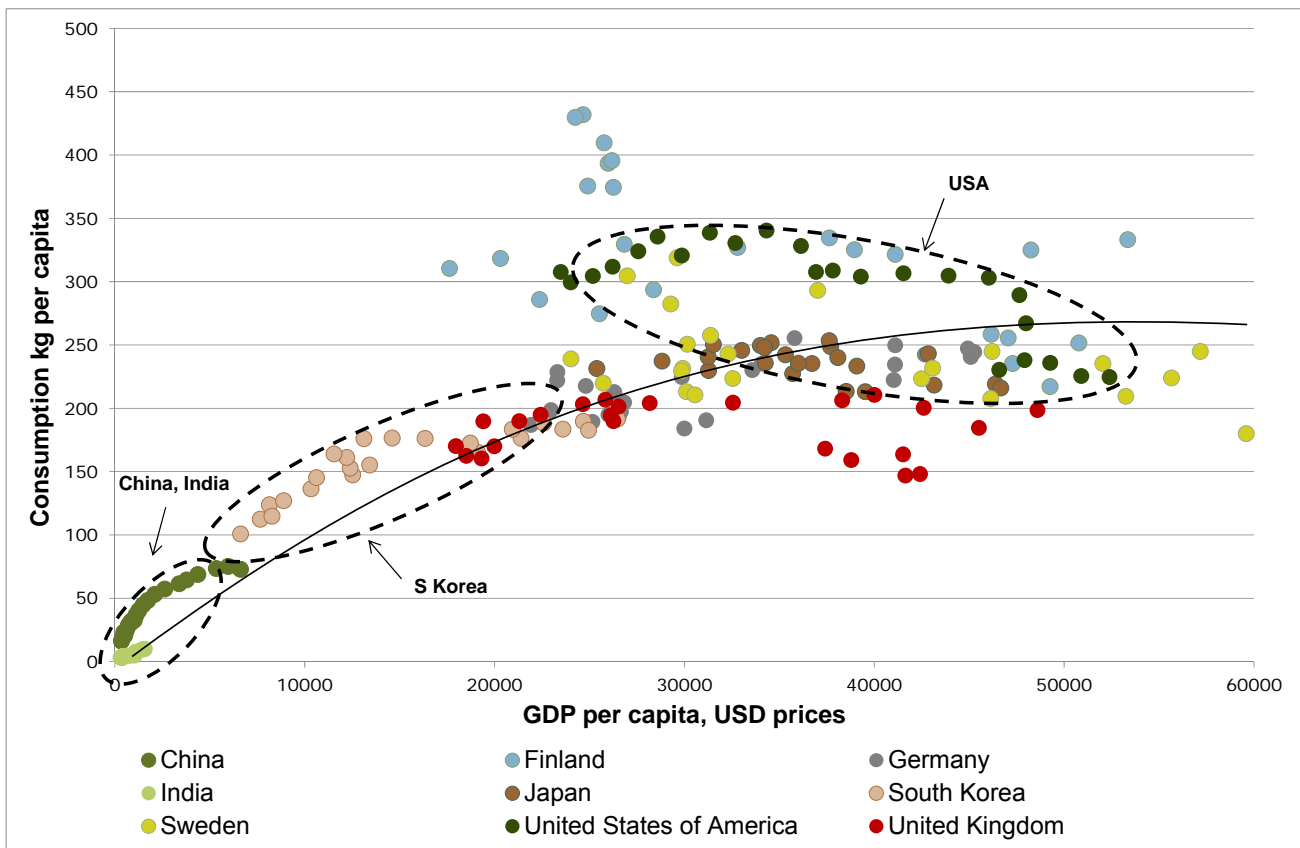
The demand prospects for paper vary depending on the product and region because of the differences in the underlying demand drivers. A recent study “World Paper Markets up to 2030” (Pöyry 2015) forecasts the global average demand for paper and paperboard to increase by 1.1% p.a. in 2014-2030. This represents a much lower growth rate than Pöyry’s earlier 2009 projection of 1.9% p.a. (in 2009-2025). This reflects lightly the fact that the substitution of electronic for printed media has been even faster than expected; the projections were based too much on historical development.

The overall increase in aggregate paper demand is driven the rapid overall market growth in the emerging countries, with China at the forefront, and increased demand for packaging boards as well as tissue paper globally. These positive developments compensate for the reduced demand for some paper grades. The demand in North America, Western Europe and Japan is predicted to decrease by around 0.8 per cent per year up to 2030 (Pöyry 2015). CLEEN (2014) also projects significant reduction in the European paper consumption by 2030.

The substitution effects of the information and communication technology (ICT) and digital media concern mainly printing and writing paper, and especially newsprint and graphic papers, in general, in the developed countries. As a result, the production capacity in graphic papers has been reduced in Europe while at the same time new investments have been made in the emerging markets (Hetemäki & Hänninen 2013).

Although it is apparent that the future growth paths of emerging countries will not follow the developed countries, paper consumption in the emerging countries can be expected to increase significantly since their per capita consumption levels are still very low compared to the more developed countries. However, the demand is likely to start flattening out much earlier and will never reach the levels of high-income OECD countries. The case of China in Figure 6 suggests that the flattening of demand may already have started (the slowdown is also partly due to the economic downturn). Figure 6 also shows how per capita consumption has been declining in countries such as the United States (US), Japan and Finland, i.e., the positive relationship between gross domestic product (GDP) growth and consumption has definitely broken down for these products.

Figure 6 Historical Paper and Paperboard Per Capita Consumption Trends in 1961-2013



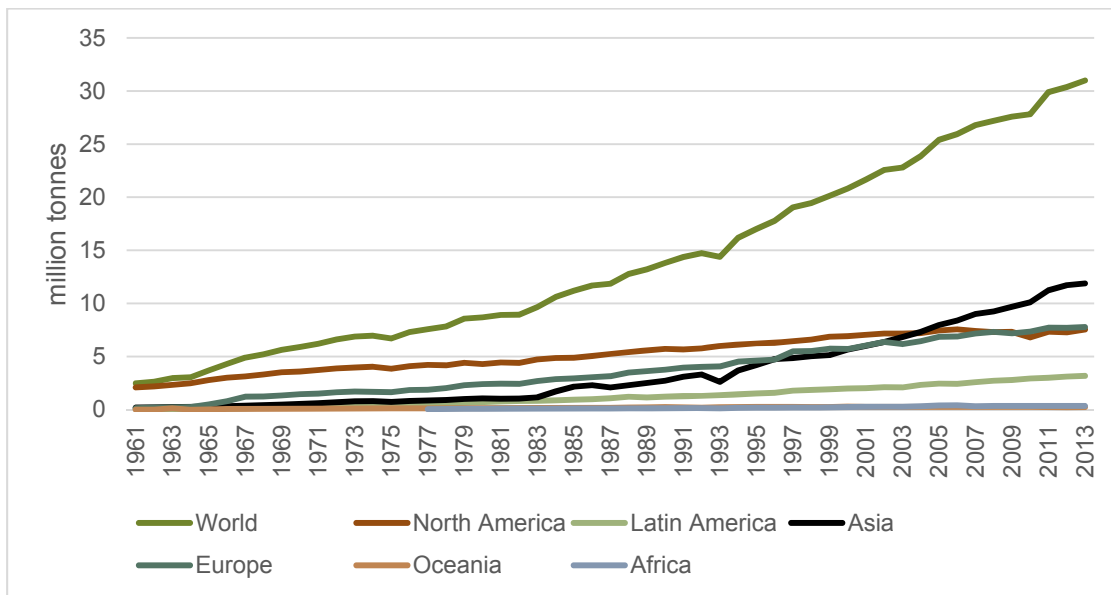
Source: FAOSTAT 2015; Dasos Capital 2015

In 2013, per capita paper and board consumption was only about 73 kg in China and 10 kg in India, compared to 224 kg (305 kg in 2005) per person in the US and 218 kg (325 kg in 2005) in Finland.

Packaging board and tissue market prospects are good worldwide. Packaging drives particularly long and tissue short-fibered raw material demand. The global consumption of packaging paper and paperboard has been increasing during the last two decades on average 3.3% p.a. The Pöyry study (2015) predicts that the annual consumption of containerboards and cartonboards and tissue/hygiene products will rise on average by 2.9% p.a. up to 2030. The growth is driven by increasing packaging needs in emerging markets, booming eCommerce and the growing demand for convenience food and consumer goods brands. Increased trade due to shifting the production of consumer and production goods to low cost countries and internet-based trade are increasing the use of packaging board. However, at the same time packing paper consumption and also production have been shifting accordingly. The future demand will depend on the competition between wood-based packing materials and especially plastic packaging materials, and also on the new product development such as intelligent packaging (e.g. Raflatac in Finland) (Hetemäki 2014; Hetemäki & Hänninen 2013).

Tissue production is growing steadily in all regions; it is typically a product that is not transported long distances (Figure 7). The tissue paper consumption is driven by the population and economic growth, reduction in poverty rates and customer preferences.

Figure 7 Global Tissue Paper Production Trends in 1961-2013



Source: FAOSTAT 2015

Figure 8 summarises the demand prospects for various paper products with implications on the market pulp (fibre) demand.

Figure 8 Summary of Demand Prospects for Pulp by Region and End-Product

	Printing and writing paper	Paperboard (packaging)	Tissue	Specialty products
World	Green arrow pointing right	Green arrow pointing right	Green arrow pointing right	Green arrow pointing right
Europe	Red arrow pointing down-right	Yellow arrow pointing right	Yellow arrow pointing right	Green arrow pointing right
North America	Red arrow pointing down-right	Yellow arrow pointing right	Green arrow pointing right	Green arrow pointing right
Latin America	Yellow arrow pointing right	Yellow arrow pointing right	Green arrow pointing right	Yellow arrow pointing right
Africa	Yellow arrow pointing right	Yellow arrow pointing right	Yellow arrow pointing right	Yellow arrow pointing right
China and India	Yellow arrow pointing right	Green arrow pointing right	Green arrow pointing right	Green arrow pointing right
Japan	Red arrow pointing down-right	Yellow arrow pointing right	Yellow arrow pointing right	Yellow arrow pointing right
Rest of Asia	Yellow arrow pointing right	Yellow arrow pointing right	Yellow arrow pointing right	Yellow arrow pointing right

Red = definitive decrease
 Yellow = modest growth
 Green = definitive increase

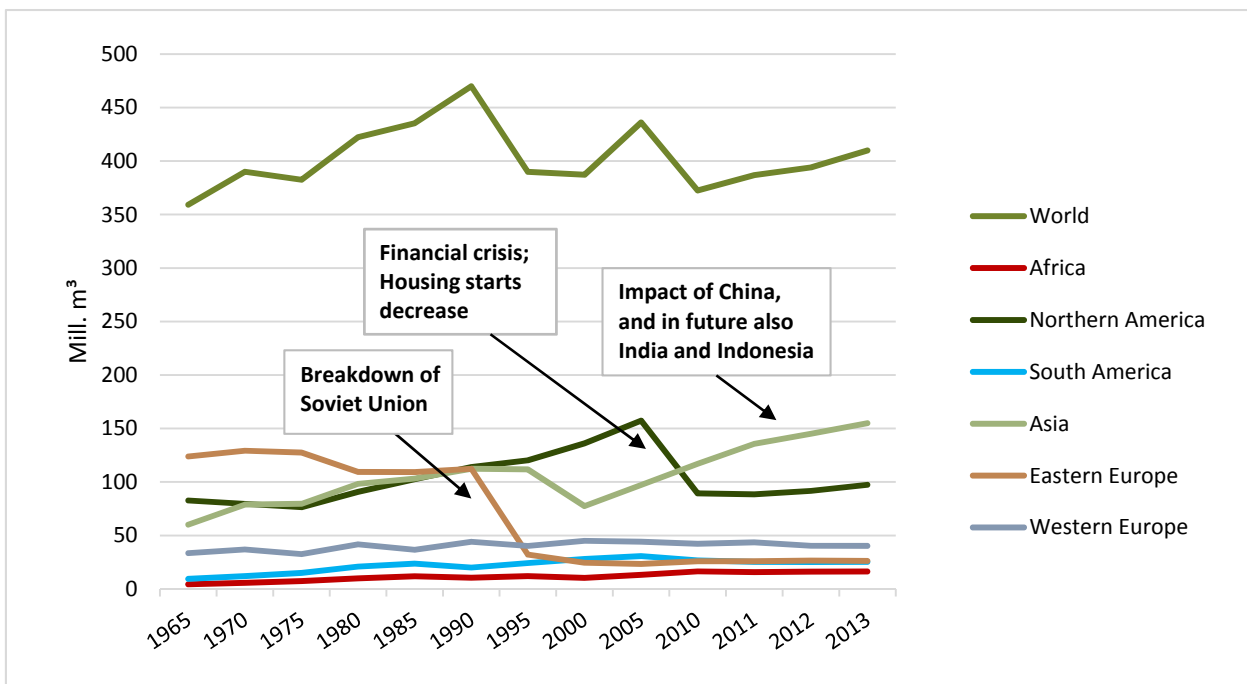
Source: Dasos Capital 2015

1.2.2 Global Demand for Sawnwood and Wood-based Panels

Long-term sawnwood and wood-based panel market prospects as well as the markets for engineered wood products are positive both in developed and emerging countries with regional variations. The demand for sawnwood is growing steadily all over the world driven mainly by the construction sector and manufacturing industry that requires packaging material. Growth is fastest in the developing economies of Asia, Latin America and also Africa, where annual consumption has been increasing at rates exceeding 5%. In Europe, the growth in sawnwood markets is predicted to be low in the next 15 years because of relatively stable levels of construction, linked to the demographic and economic development (CLEEN 2014, UNECE/FAO 2011).

Europe and Asia are the largest markets for wood-based panels. In Europe, wood-based panels markets have grown faster than sawnwood. China has emerged as world's biggest panel producer and consumer and its growth will continue at high rates (Figure 9).

Figure 9 Global Sawnwood Consumption Trends in 1965-2013



Source: FAOSTAT 2015; Dasos Capital 2015

Per capita consumption of sawnwood and wood-based panels is increasing on average worldwide driven, especially by accelerated housing activities in China and India, and emerging countries in general. There are significant differences in per capita consumption levels not only between developing and developed countries but also within Europe. In many European countries, per capita sawnwood consumption is around 0.2 m³ compared to about 1 m³ in countries, such as Finland and Sweden (Figure 10). These differences are partly explained by history, culture (including also architectural traditions) and availability of forest resources (which has in the history affected culture and use of materials in construction). Figure 10 illustrates these differences well.

There is no reason to assume that developing and emerging countries would over time reach the per capita consumption levels of the United States, Finland or Sweden. However, the trend analysis does not provide evidence on declining per capita consumption rates like in the case of the printing and writing papers for countries such as the US and Japan.

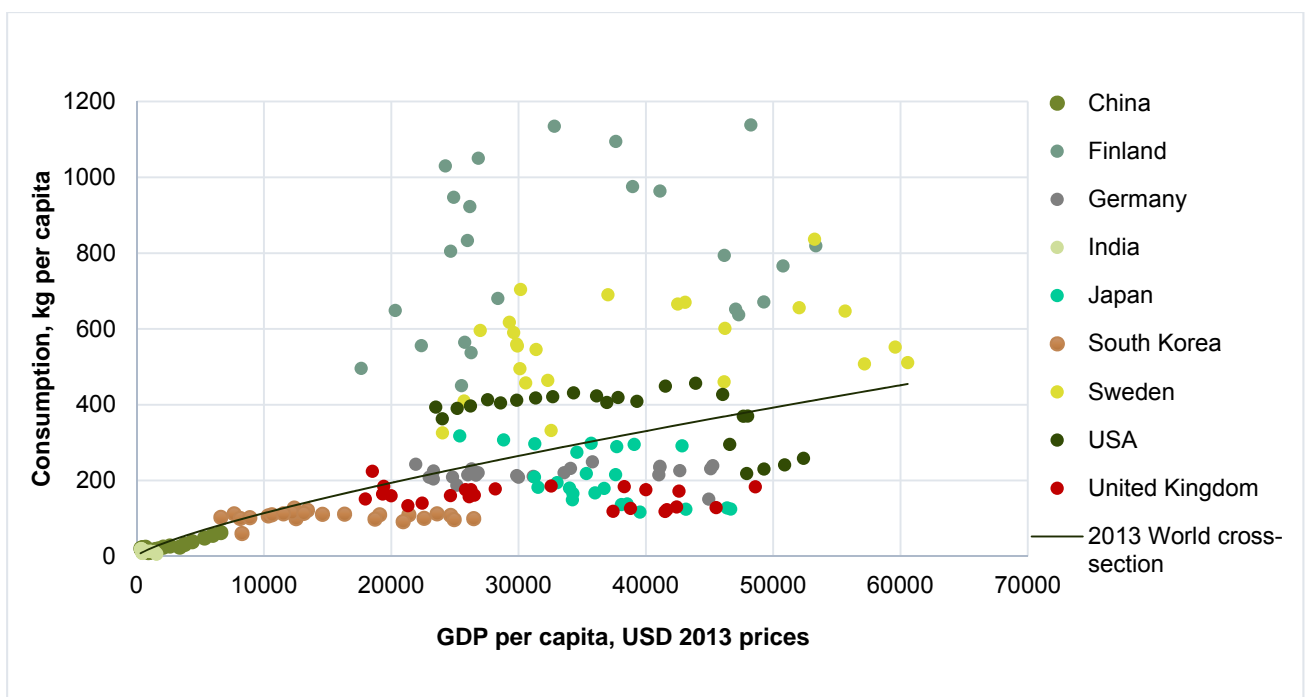
In developed countries, wood products are being used increasingly in construction, including renovation, due to environmental reasons, such as renewable nature of the raw material, low fossil energy needed to manufacture wood products and carbon storage capacity of wood-based building materials and furniture. Further, it is difficult to identify any existing or new construction materials that could substitute significantly for wood. Wood-based panels have in the past substituted for sawnwood in construction, and more recently

so-called engineered wood products, such as cross-laminated timber (CLT), but they are all forest products. According to the Hetemäki 2014 study, newly emerging engineered wood products and industrialisation trends have the potential to change the construction sector in some European countries, especially the pre-fabricated wood construction outlook is promising.

The construction sector consumes about 65% of the sawnwood production. According to these trends, sawlogs will continue to provide the highest share of forestry revenue also in the future due to high volume growth, high end-product value and revenue from waste wood (fibre). Sawnwood and sawlogs will remain key drivers for timberland investment returns.

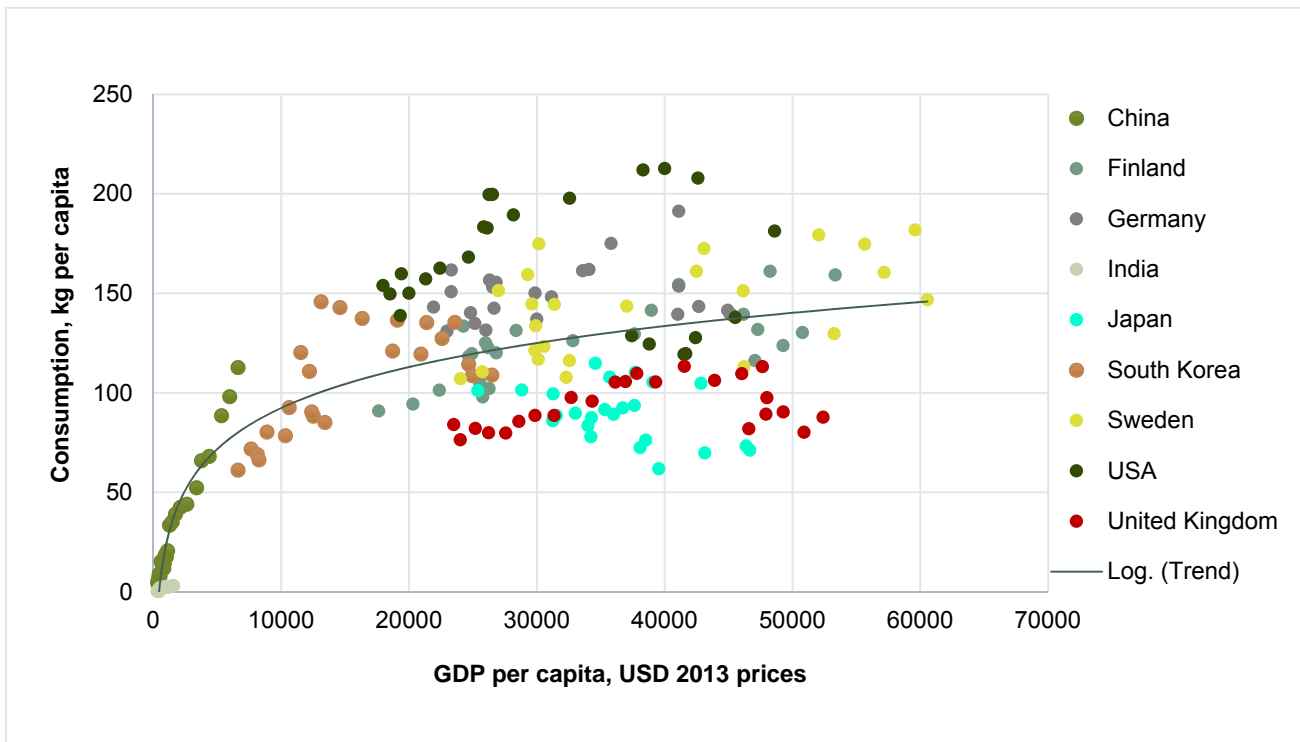
The production and consumption of wood-based panels is growing faster than sawnwood. The per capita consumption growth pattern of developing and emerging countries appears to track the growth path of the developed countries. As Figure 11 indicates, the consumption of wood-based panels has escalated in China.

Figure 10 Gross Domestic Product and Sawnwood Consumption Per Capita Trends for Selected Countries, 1961-2013



Source: FAOSTAT 2015; Dasos Capital 2015

Figure 11 Gross Domestic Product and Wood-based Panel Consumption Per Capita Trends for Individual Countries, 1961-2013



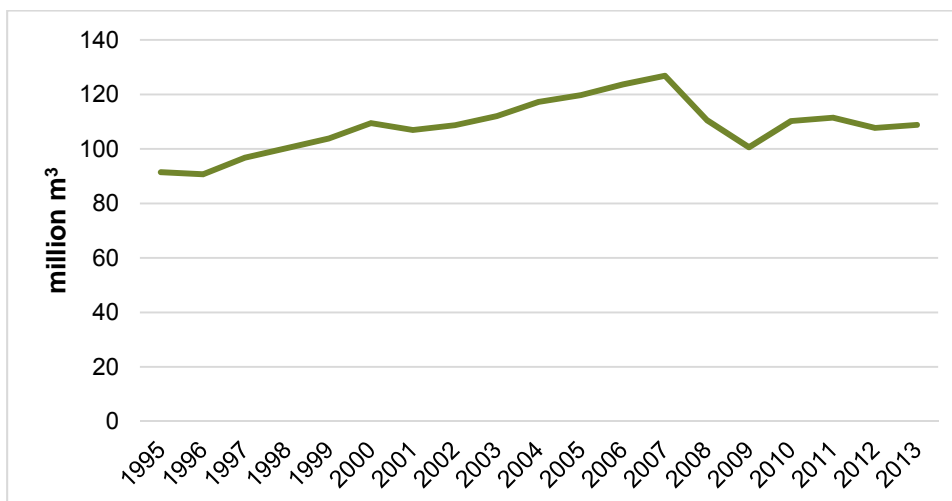
Source: FAOSTAT 2015; Dasos Capital 2015

1.2.3 Sawnwood and Wood-based Panel Market Prospects in Europe

The sawnwood and wood-based panel markets are expected to grow in the long-term in the Western and Eastern Europe. Short-term prospects in Western Europe are still somewhat bleak due to the continuing financial crisis and associated low housing starts but the demand is expected to accelerate and move towards the positive trend growth path.

Since the European population is staying relatively stable and economic growth rates are predicted to be relatively low, major increases in the sawnwood market volume are unlikely. However, steady but slow long-term growth – with fluctuations due to the business cycles – can be considered a realistic assumption. It will though take some time before production has recovered to the pre-financial crisis level (Figure 12).

Figure 12 Sawnwood Consumption Trends in Europe (excluding Russia) in 1995-2013



Source: FAOSTAT 2015; Dasos Capital 2015

There are also some positive growth prospects which may influence the future markets for sawnwood and wood-based panels. Sawnwood consumption doubled in Finland in the 1990s; this type of developments can take place also in other European countries. In Estonia, per capita consumption of sawnwood tripled in ten years close to the Scandinavian levels. If softwood sawnwood per capita consumption in Europe would rise on average even to half of the levels prevailing, e.g. in Sweden, sawnwood consumption in Europe would double by 2020 compared to the average levels in the recent years (Hetemäki & Hänninen 2013).

The low-carbon and low-energy policies of the EU and related regulations have emerged as important new demand drivers. Remodelling and growing value-added markets (glulam, CLT) as well as “Green housing” supported by the EU policies and regulations create demand for sawnwood even at times of low housing starts. The introduction of accounting rules for greenhouse gas (GHG) emissions, including carbon storage in panels and sawnwood, can promote over time the use of wood in construction (EU 2013).

Most of the CLT is produced in the Central Europe where the production of CLT grew by almost 17% annually in 2008-2012 despite the economic recession (UNECE/FAO 2014). According to the same report, the annual growth rate of CLT consumption in Europe is forecast to continue well above 10% for the foreseeable future. The consumption of glulam and finger-jointed wood products in Europe is also predicted to continue to increase.

CLT and related new standardised house construction technology based on prefabricated components provide good examples of environmentally friendly forest products meeting new design and architectural requirements (Box 1).

Box 1 Cross-laminated Timber: A Versatile, Environmentally Friendly Wood Product



- CLT is an innovative product based on (spruce) sawnwood
- Produced in the form of large-format planar elements
- Consists of individual cross-glued lamellas, i.e. layers of wood 3, 5, 7 or more layers
- Massive, flexible wood construction material; basically no limits are set to the form of CLT

Source: Kasurinen 2012



- Very cost-efficient in multi-storey construction; can be erected in half the time needed for a concrete building
- New technological development and standardisation allow modular construction system; accurate and ready for erection



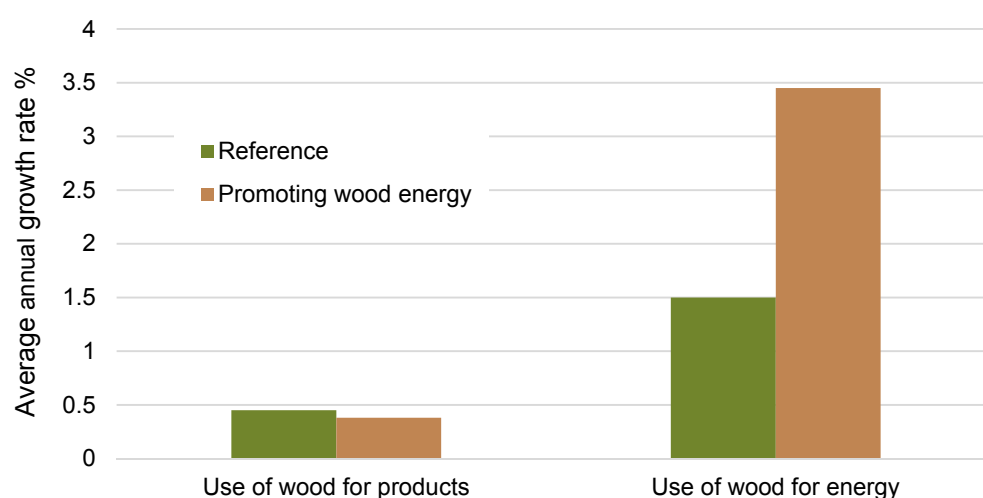
- CLT and timber structures, in general, can be built by using less natural resources and energy than other structures.
- CLT houses/construction act as carbon sinks: 1 m³ timber stores 0.9 t CO₂
- Formaldehyde-free and environmentally friendly glues used in gluing process

1.2.4 Bioenergy Demand Is Driving Wood Demand in Europe

Increasing demand for bioenergy is compensating for the declining pulpwood demand in Europe. Further, it grows on such a scale that it drives wood demand in Europe, and influences the wood fibre markets and pricing. According to the European Forest Sector Outlook Study II (UNECE/FAO 2011), the increase in consumption of forest products in Europe (excluding Russia) in roundwood equivalent (RWE) terms will be about 220 million m³ in 20 years (about 42% of the annual harvest in 2010). Most of the increase is predicted to come from wood energy equalling about 150 million m³ RWE, equalling 1.5% p.a. growth.

The use of wood for energy grows annually much faster than for wood products (Figure 13) under the Reference (base) Scenario and even more so under the so called “Wood Promotion Scenario”, which is based on the EC program and targets and intensification of wood biomass mobilisation from the European forests. It is possible that these projections overstate somewhat the impact of wood energy demand because of emerging, more stringent regulations concerning sustainability, but there is no question that the growth rate exceeds that of the use of wood for products.

Figure 13 Average Annual Rates of Growth in Wood Consumption by End-Use in 2010-2030



Source: UNECE/FAO 2011

1.2.5 Impact of China and India

Among the fast growing emerging markets, China is the definite “hot spot” of growing forest product markets. China influences strongly the international wood fibre flows and forest-related investments across all continents. The Chinese GDP growth has averaged 9% p.a. in last two decades, which combined with the world largest population base of some 1.425 billion in 2014 translates into a demand boom for all types of commodities and products, including forest products and especially import of wood fibre. The GDP growth rate has in recent years declined to 7.0-7.5% but it is still very high compared e.g. to Europe.

China has recently become the largest market for paper and sawnwood in the world. The demand for most forest products is expected to increase close to the GDP growth rates in the future, except in case of communication papers, which is predicted to grow slower. Notably, in ten years between 2003 and 2013:

- production of paper and paper board grew by 222%;
- production of wood pulp grew by 234%;
- production of sawnwood grew by 554%;
- production of wood-based panels grew by 370%; and
- production of sawlogs and veneer logs grew by 169%.

According to the FAO's latest global forest products (apparent) consumption data (FAOSTAT 2015), China is the

- second biggest consumer of industrial roundwood;
- biggest consumer of sawnwood;
- biggest consumer of wood-based panels;
- second biggest consumer of pulp for paper;
- biggest consumer of recovered paper; and
- biggest consumer of paper and paperboard.

China is the world's biggest producer of wood-based panels, including plywood, dissolving laminate flooring, and furniture (most of which is wooden) and the second biggest producer of sawnwood.

To meet the domestic demand for forest products and for sawlogs and fibre, China's imports have escalated in the last 15 years. China is the world's largest importer of industrial roundwood, sawnwood and fibre furnish (pulp and wastepaper). China's imports of industrial roundwood and sawnwood surged by 18% and reached record levels in 2013. About 20% of China's industrial roundwood consumption was satisfied by imports in 2013. China has become a key alternative market for sawnwood producers in Canada, the US and Europe, where the markets after the financial crisis stagnated (46 million m³ in 2013).

In 2003-2013, the imports (volume) of wood pulp increased by 255%, and of industrial roundwood by 172%. Most notably, the imports of wood chips increased during the same period by sevenfold. The expected construction of a series of new pulp mills over the next years will drive China's demand for hardwood chips even higher. In the coming years, China is projected to surpass Japan as the world's largest wood chip importer.

China's domestic fibre supply potential is limited due to land scarcity, uncertain tenure and environmental issues. In June 2015, China introduced a new policy that further limits harvesting of natural forests but also introduces restrictions to harvest plantation forests. To satisfy the growing need for wood, more plantation investments are needed in China and more importantly abroad to supply fibre to the Chinese wood-using industry and also increasingly energy producers (using e.g. pellets). European forest industry is increasingly investing in Asia to tap the opportunities both in wood and pulp and paper production in addition to investing in countries, such as Brazil and Uruguay, or in Eastern Africa (e.g. Mozambique).

India is in the process of becoming a "new China". This will also have implications for forest products and wood demand as well as investments and trade in the region especially since India has limited land resources available for large-scale plantation development. In fact, it can be that the current wood consumption figures for India underestimate consumption due to weak national statistics. India is the most populated country after China with 1.267 billion people in 2013, and population is still growing annually by 1.4%. India is projected to become world's most populous nation, surpassing China in 2031.

India is the 12th largest economy in the world, rapidly catching other countries with GDP growth averaging 7% p.a. A new Harvard study (Center for International Development 2015) predicts that the India's growth rate will surpass that of China in the coming years with an average annual growth rate of 7.9% against China's 4.6% in 2016-2023.

The combined GDP of China and India is predicted to be 1.5 times that of the G-7 countries by 2060. In addition, South East Asia's largest economy and most populous country Indonesia is anticipated to grow at 5.2 per cent annually to 2023, creating also a huge economy.

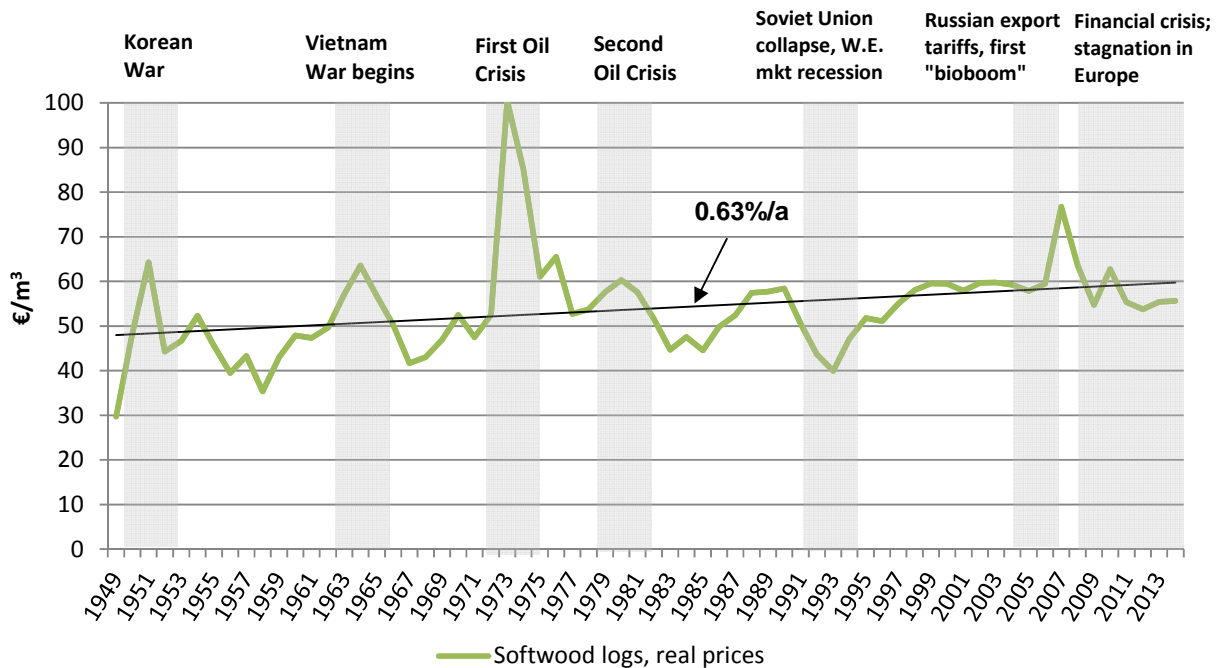
1.3 Wood Prices Are Predicted to Increase in Long Term

The various global and regional wood demand and supply estimates all predict increasing demand for roundwood, which will result in demand-supply gaps of varying sizes depending on the product, locality and time frame. Real wood prices can be expected to develop favourably due to shifts in demand and supply balances. Future wood price development will depend very much on the scale of investment in plantation forestry and increasing productivity of existing forests. It will also be influenced by the success in mobilising

existing wood biomass from forests, and on the speed of reduction of wood supply due to conservation and protection as well as forest degradation and deforestation.

Increasing demand for wood energy combined with industrial wood demand are putting pressure on wood prices. In Finland, the real price of wood has been increasing during the past decades annually by 0.63% p.a. according to an analysis of historical long-term real wood price trends for softwood logs in Finland since 1949 (Figure 14).

Figure 14 Softwood Log Real Price Trend in Finland, 1949-2013



Source: Dasos Capital 2015 (using Metla data)

The “European Forest Sector Outlook Study II” (UNECE/FAO 2011) price projection shows steady price increases throughout the forest sector, driven by increasing demand (especially for wood energy) and emerging scarcities. The study predicts that sawlog and pulp log prices may increase by 2.3% to 3.4% p.a. in the next twenty years, under a scenario where wood energy use is promoted. Under the base scenario, the price projections for roundwood varies from 1.8% to 2.7% p.a. in 2010-2030. However, if the demand projections are overestimated as Hetemäki (2014) suggests, the scarcity of wood and consequently the price pressure have been also overestimated. There are solid reasons to assume that the increases in long-term average prices will be lower than the UNECE/FAO base scenario projections, but still clearly positive likely exceeding 1% p.a.

A global econometric study by Rauniker et al. (2010) concludes that overall roundwood prices will increase in real terms due to increasing demand driven by bioenergy. Further, the study predicts that the demand for wood energy will not only set the floor for pulpwood prices but within 20 years the wood energy prices will start converging towards pulpwood prices.

The demand and supply mechanics and the relative importance of various demand and supply drivers vary a lot depending on the region and country. From the perspective of timberland investment, it is important to identify important existing or emerging “gap areas”, which may refer e.g. to emerging fibre scarcity or market inefficiencies as well as untapped market opportunities related to new products and services.

2. MEGA AND MACRO TRENDS INFLUENCING TIMBERLAND INVESTMENTS

2.1 Shift Towards a Bioeconomy and Changing Balance of Economic Power

Forestry and forest industry are being transformed by megatrends. They create both challenges and opportunities along the pathways to the long-term vision where future needs are met sustainably combining economic growth, and low ecological impact and carbon footprint. The three megatrends which influence the forestry and the timberland investment environment now and decades ahead the most are:

- the shift towards a biomass-based economy from the traditional fossil-based society, driven by climate change policies and reduced stocks of traditional energy sources;
- growing economic importance of emerging markets with China and India at the forefront followed by countries, such as Indonesia, Brazil and maybe Russia in the future; and
- continuing population growth with most of the growth in the developing and emerging countries.

By 2050, the world will look very different, offering both challenges and opportunities:

- The world population has reached some 9 billion people in 2050 meaning that two billion more people, including a much bigger middle class, will need more energy and all kinds of products, including forest products e.g. for housing.
- At the same time, land has become much scarcer (Figure 15), and competition for land is driven by converging demand for food, fuel and fibre.
- The world energy demand will increase by one third between 2010 and 2035 resulting in dwindling fossil fuel stocks and increased GHG emissions.
- Raw materials will become scarcer, prices will increase and become more volatile.
- Some 230 million ha of forests are likely to be lost by 2050 releasing large amounts of CO₂ into atmosphere, destroying biodiversity permanently and jeopardizing people's quality of life, based on the business-as-usual scenario.

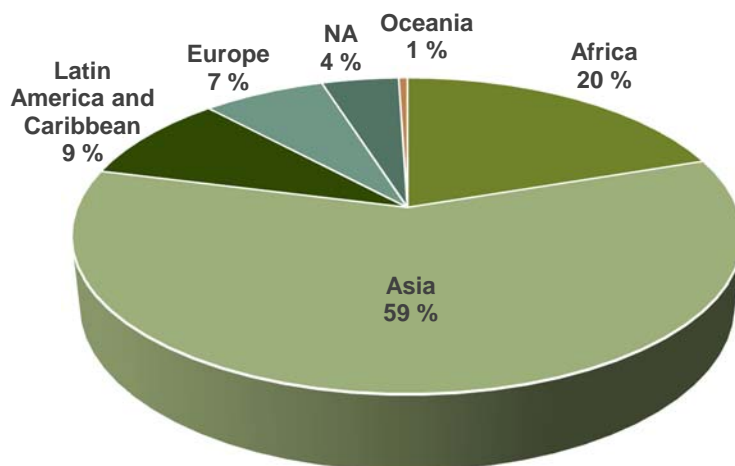
Figure 15 Estimated Hectares of Land per Capita, 1900-2050



Source: Adapted from Roberts 2010

In 2050, an estimated 90% of global population will live in emerging countries. Non-OECD countries account for 90% of total population growth and some 70% of the increase in economic output. Importantly, the share of the urban population and middle class will increase rapidly in Latin America and Caribbean, Africa, and Asia. Today about 48% of the Latin American and Caribbean population live in the cities; in 2050 the urban share is predicted to increase close to 70%. In 2050 China is the world's leading economy and India is at the same level as the US (Figure 16).

Figure 16 Estimated World Population by Region by 2050



Source: UN Population Information Network 2015

Increasing global population and economic growth mean more demand for energy and materials and consequently an increase in GHG emissions. Climate change and diminishing fossil energy resources are driving the need to change the ways of production and consumption. The age of fossil fuels is far from over, but it is widely accepted that the only alternative to meet people's needs sustainably and avoid the major economic, social and environmental costs associated with climate change is to shift towards a low-carbon bioeconomy. This will have many implications, including increasing demand for renewable energy, including wood-based bioenergy and bioproducts.

The ongoing structural shift in the global economic power in favour of China and many other emerging countries is a major force influencing also the forest sector and related future investment opportunities. The investment focus will continue shifting towards catering the needs of the biggest and fastest growing economies. The forest industry will become over time even more globalised.

2.2 Sustainable Bioeconomy and Forestry

Forestry plays an important role in the emergence of the bioeconomy, creating new and sustainable investment opportunities for forest and energy industry as well as wood producers. The importance of forests is based on their capacity to provide multiple products, such as timber and wood biomass for energy and a range of environmental services, which are increasingly valued and monetised. In fact, forestry is already an important part of the bioeconomy in EU and its role is predicted to increase over time:

- Wood and wood waste supply about 50% of the total renewable energy in the EU.
- The annual carbon sequestration in European forests is equivalent to around 9% of the EU's GHG emissions; since the forest area and growing stock are increasing, the value of carbon sequestration services is also increasing.
- Harvested and processed wood products are major storages of carbon, and substitute non-renewable and more carbon-intensive products.
- European forests are essential for the conservation of Europe's biodiversity; e.g. they represent around half of the designate Natura 2000 sites.
- About half of the EU paper production is based on recycled paper.
- Around 90% of Europe's wood requirements are met from sustainably managed forests within EU.

The share of the bioeconomy of the total EU-27 economy is about 17% out of which forest sector's share is estimated at 31%. In Finland, the total value of the bioeconomy is estimated at about EUR 60 billion, representing 16.1% of the national economy. Forest-based bioeconomy represents more than half of the Finnish bioeconomy (The Finnish Bioeconomy Strategy 2014).

The manufacture of processed wood products promotes sustainability in a number of ways starting from processing wood that comes from a sustainable source. Forest biomass and the by-products from sawmilling, pulp and paper processing as well as waste wood are major sources of renewable energy in forest-rich countries. E.g. in Finland, forest sector produces more than 70% of the consumed renewable energy whilst total renewable energy sources (RESs) account for 25% of total energy consumption. In Sweden, around 85% of the bioenergy comes from the forest (Swedish Forest Industries Federation 2012).

Wood, paper, paperboard and fibre packaging products can be recycled and reused many times over, substantially increasing the efficiency of raw material utilisation that in the first place has been based on renewable, biological resource. Products that have reached the end of their lifecycle and biomass that is not suitable for processing can be used in generation of renewable energy.

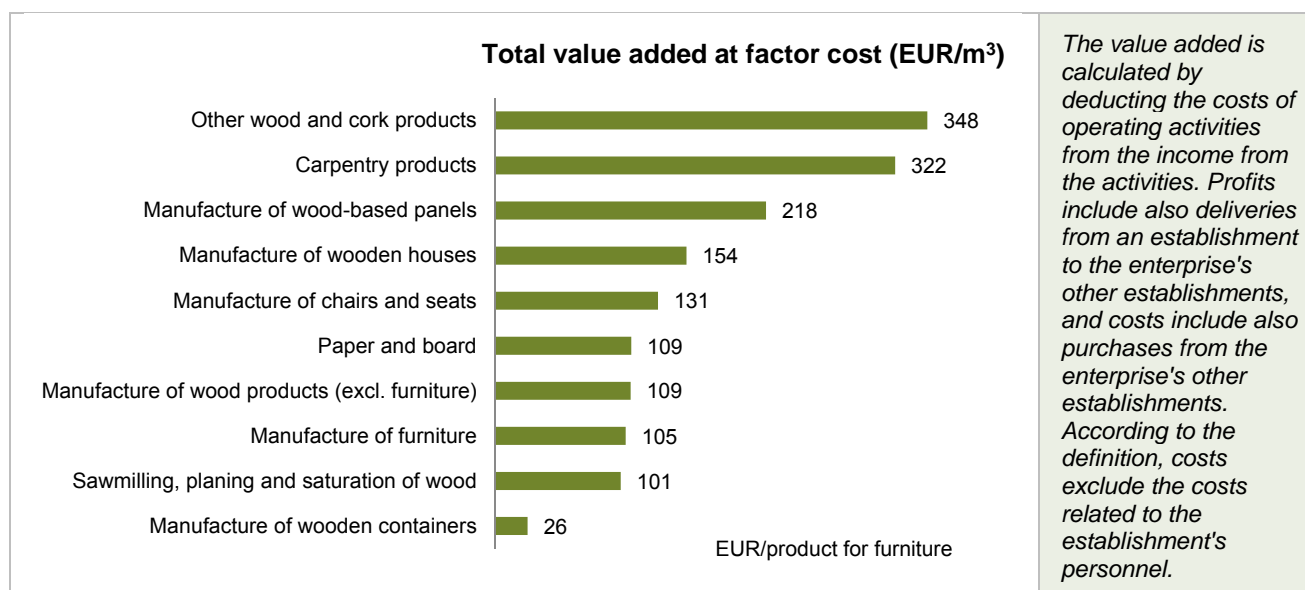
Wood materials used in construction have negative CO₂ emissions, i.e. they store carbon, whereas other materials are sources of CO₂ emissions over the life cycle. The energy used in construction, including manufacturing, transporting and erecting buildings is significantly lower for wood-based products. These features are likely to result in an increase in the demand for wood and other environmentally friendly materials used in construction when many countries adopt zero-carbon house construction targets. In many European countries wooden housing construction, including high-rise buildings, is booming. By using the full potential of wood in buildings, Europe could reduce CO₂ emissions by 15-20%.

2.3 Value-Added Development Contributes to Bioeconomy and Enhances Revenue

One of the key elements of a bioeconomy is improved resource efficiency and added value from the utilisation of forest and other natural resources. The development of forest-based bioproducts and services can make significant contributions to the value-added (GDP) and help making use of the entire resource base in a sustainable manner. This can be well demonstrated using already existing standard forest products.

The value added measures the total value added produced by the various factors of production in an establishment's actual operating activities. In the Finnish forest sector, the value added increases with the manufacturing of more advanced wood processing goods, as can be seen in Figure 17, which illustrates total value added in the forest as the forestry value added (mainly stumpage prices of the wood - logwood EUR 57 and pulpwood EUR 18) have added to the value added generated in each wood industrial end uses at factor cost.

Figure 17 Value Added of Wood Products in 2007



Source: Symbioosi Oy, adapted by Dasos Capital.

Note: According to Metla (2012) value added for paper and board is EUR 128/tonne. Making 1 tonne of paper needs around 1.4 m³ of pulpwood so total value added for 1 m³ of paper (0.71 tonne) is approx. EUR 91 plus the pulpwood stumpage price of EUR 18.

2.4 Policies and Regulations as Demand Drivers

The various regional and national policies and regulations, in particular within Europe, dealing with climate change, renewable energy, energy efficiency, and the bioeconomy, in general, have emerged as central drivers influencing the demand for wood (fibre). The key documents are:

- So called iLUC (Indirect land use change) Directive that revises some elements of the 2009 Renewable Energy Directive (EC 2015);
- EU Agreement on its 2030 climate and energy package (EUCO 2014);
- Green Paper. A 2030 framework for climate and energy policies (EC 2013a);
- Innovating for Sustainable Growth: A Bioeconomy for Europe in (EC 2012);
- A Roadmap for Moving to a Competitive Low Carbon Economy (EC 2011);
- So called EU 2020 strategy: A Strategy for Smart, Sustainable and Inclusive Growth; and
- EU Renewable Energy Directive: "Promotion of Use of Energy from Renewable Sources" (EC 2009), (which also forms the basis for the Finnish law from 2013 on the sustainability of biofuels).

The key 2020 targets are:

- 20% cut in GHG emissions compared with 1990;
- 20% of total energy consumption from renewable energy, and 10% share of re renewable energy in the transport sector; and
- 20% increase in energy efficiency.

The key 2030 targets are:

- At least 40% cut in GHG emissions compared with 1990;
- At least 27% of total energy consumption from renewable energy; and
- At least 27% increase in energy efficiency.

The long-term goal is that by 2050, the EU aims to cut its emissions substantially – by 80-95% compared to 1990 levels as part of the efforts required by developed countries as a group.

These climate and energy policies create new incentives for bioenergy and biofuel production. The EU Directive on the "Promotion of Use of Energy from Renewable Sources" (2009/28/EC) is the key driver of wood

energy demand in the EU countries. In 2011, the EC adopted a long-term roadmap for moving to a low carbon economy in 2050. This roadmap aims at 80% reduction of GHG emissions by 2050. To achieve the goal, Europe's energy production will have to be almost carbon-free, which gives a clear message about the crucial role of bioenergy, including wood-based biomass, for decarbonisation.

Based on the 2009 Renewable Energy Directive (EC 2009), there were initially nationally binding targets concerning the share of renewable energy in gross final energy consumption as well as the share of transportation fuels from renewable sources by 2020. Each member state has supplied a National Renewable Energy Action Plan (NREAP) outlining national approaches and roadmaps in terms of meeting the 2020 renewable energy targets. Solid biomass and wood biomass feature strongly in the majority of these plans (see Chapter 3.1.2).

In the United Kingdom (UK), political and regulatory interventions have incentivised renewable fuel and woody biomass, including wood pellets as a vehicle to "decarbonise" the economy. The UK's plan states that 15% of energy demand must be met by renewable sources by 2020. The UK has two different subsidy schemes: (i) the Renewables Obligation, and (ii) the Contracts for Difference Scheme that can enable coal-fired facilities to convert from coal to biomass. As a result, the UK has become world's largest importer of wood pellets.

The role of the forest sector is often mentioned in the EU Bioeconomy Strategy. Surprisingly, the related Action Plan does not explicitly deal with forestry sector at all. It recognises only vaguely the role and nature of the forest sector as a high-tech biomass utilising sector and omits entirely its current challenges to renew the product matrix from forest biomass (Ollikainen 2014).

Many countries have introduced national bioeconomy strategies or "white papers" (McCormick & Kautto 2013, Staffas et al. 2013). Some of these put considerable emphasis on biofuels and biorefineries and also the forest sector (e.g. Sweden, Finland and some Canadian provinces), and include concrete measures to enhance the sector's role in contributing the national bioeconomy objectives.

The Finnish Bioeconomy Strategy (2014) identifies the following elements directly linked to the forest-based sector:

- diversification through bio-based products;
- pioneering bioenergy production and use;
- increased use of bio-based raw materials in the chemical industry;
- timber construction to account for a significant share of urban construction;
- cost-effectiveness and environmental benefits from efficient biomass utilisation; and
- an increase in forest use on a sustainable basis.

It also identifies measures, such as providing incentives for the replacement of non-renewable natural resources by renewable ones in public procurement, promoting demand for bioeconomy products and services and generation of new bioeconomy businesses, and promotion of sustainable use of biomass.

Although, the policy and regulatory environment in the EU as a whole favours renewable energy, including biomass, the policy uncertainty may also affect the investments in the development of wood-based biofuels. EU renewable energy policies continue to be adjusted in response to changing political and economic conditions in the EU member countries, often leaving utilities and other renewable energy investors with uncertain prospects for what they can expect from government policy and support. For example, in 2014 the EU set new climate change related targets for 2030, which do not have binding targets for member states concerning renewable energy shares of total energy consumption (EURO 2014). Now, the target is binding only on the EU as a whole only.

Also, on 28 April 2015, the European Parliament approved a new legislation, the "iLUC Directive", that limits the way Member States can meet the target of 10% for renewables in transport fuels by 2020 (EC 2015). There will be a cap of 7% on the contribution of biofuels produced from 'food' crops, and a greater emphasis on the production of advanced biofuels from waste feedstock. This would, for example, limit the use of agricultural land to produce woody biomass. On the other hand, it may provide an incentive to make more efficient use of woody biomass sourced from existing forests and process waste.

Further, the poorly functioning EU Emission Trading System (ETS) brings a lot of volatility, and also indirectly supports fossil energy (coal) because of too low a CO₂ price that fails to account for external costs.

There are also various EU initiatives whose future impacts are unknown. A New EU Forest Strategy: Forests and the Forest-based Sector (EC 2013b) provides a framework for the development of the EU forest sector. It has introduced the cascade principle, under which wood would be used in the following order of priorities: wood-based products, extending their service life, re-use, recycling, bio-energy and disposal. EU strategies are not (legally) binding documents but if the cascade principle would be introduced as a legal principle like the European Parliament has suggested, it would likely constrain market-based, competitive and sustainable use of wood both for processing and energy uses. EC has commissioned a study on the cascade use of wood which will provide in 2016 guidance on the application of this principle.

At the national level, there is also “policy volatility”. Countries introduce or eliminate subsidies sometimes at quite a short notice, for example, after a new government is introduced, sometimes favouring wind or solar energy, and sometimes solid biomass. Sometimes these subsidies distort the wood market, and can provide unnecessary incentives to burn roundwood instead of processing it and using sidestreams to produce bioenergy and bioproducts.

From timberland investment perspective, it is likely less risky to avoid investments in *dedicated* woody biomass production at least in Europe – the situation in the South Eastern US and e.g. some parts of Latin America may be different. The profitability of this type of investments is likely to be too dependent on the policy and regulatory environment which can be unstable. Instead, waste wood, small wood from harvesting and wood waste from processing provide opportunities to increase and diversify revenue streams as part of integrated wood production, harvest/transport and processing of wood products and energy.

2.5 Impact of the Various Mega-trends on the Forest Sector Development and Investments

Economic growth, demographics, consumer trends and substitution, and environmental policies and regulation impact wood and forest product production patterns and market trends through various mechanisms. These global developments present both business opportunities and risks for the forest-based sectors. Sectors and businesses that can manage the risks and improve business efficiency while developing products and services to address sustainability problems and opportunities can grow, and improve their revenues and profitability.

The shift towards a low carbon-economy is already taking place and forestry plays an important role in this crucial transformation process. Whilst there are both positive and negative trends, the developments described in the earlier sections imply increasing aggregate demand for forest products and services. Over time forests are becoming an increasingly scarce resource, resulting in positive long-term price development and encouraging the expansion of timberland investment universe. Forest industries will become more diversified and links between wood processing, energy, chemistry, food and health will become stronger, also diversifying the revenue earning opportunities of the forest owners.

Dasos' long-term vision³ for the state of the sector by 2050 is summarised as follows:

- *Bioeconomy as a demand driver.* Bioeconomy has become an important driver of the global and European economy; forestry and forest industry are strongly integrated in producing more diversified bioproducts and services and making use of intelligent energy systems to produce, utilise and distribute energy more efficiently.
- *Bioproducts and services have diversified the forest sector.* The forest fibre industry has anticipated societal trends and consumer preferences to develop new bio-based products and business models which are as integral part of the forest industry as paper used to be. Highest possible value from forest resources, including wood and virgin and recycled fibre, is being produced improving the energy and raw material efficiency; value from a single tree is maximised. At the same time, delivery of forest ecosystem services, such as biodiversity conservation and carbon sequestration, is ensured and increasingly valued as well as “commoditised”, including e.g. nature-based tourism.

³ Based on Dasos's foresight, and adopting some elements of the WBCSD Vision 2050 and CEPI's 2050 “Roadmap to Low Carbon Bioeconomy”.

- *“Circular economy”*⁴. In the face of resource and energy scarcity, the production processes are based increasingly on a “circular economy” where more renewable resources are used, recycled, re-manufactured and re-used more efficiently producing even more value-added. New forest-based products and services improve resource efficiency and contribute to moving toward a competitive low carbon economy, while contributing more to the wellbeing of people in Europe and globally.
- *Wood-based bioenergy* has become a key part of the renewable energy sources (RES) package contributing to carbon reduction and sustainably produced low-carbon, energy efficient wood raw materials have increasingly substituted for carbon-intensive fossil fuel-based products.
- *Forests and carbon sequestration services*. Sustainably managed forests and processed wood products in use can further enhance their key role in carbon sequestration. The productivity of both natural forests and plantations has been increased sustainably, and woody biomass is mobilised efficiently to contribute to meeting renewable energy needs.
- *Sustainably managed, high-yield plantations and semi-natural planted forests* have become the most important source of industrial wood. The global plantation base has been expanded by 60-70 million hectares by 2050, and limited land resources are used more efficiently by consolidated forestland ownership and more efficient management, involving increasingly the private sector.
- *Sustainability as a driver for investments and new financial products and services*. Investors integrate systematically sustainability into investment decisions, and have decarbonised their portfolios and favour sustainably produced renewable resources and energy. Financial instruments, such as green forestry bonds and funds focusing on sustainable investments, including forestry, are part of the mainstream financial sector with a bigger market share.

⁴ The circular economy is a new economic model in which materials and value circulate and added value is generated by services and smart operations. In Finland, UPM as part of its Biofore Strategy and the Finnish Innovation Fund SITRA are actively researching the circular economy.

3. FOREST-BASED BIOENERGY AND BIOPRODUCTS

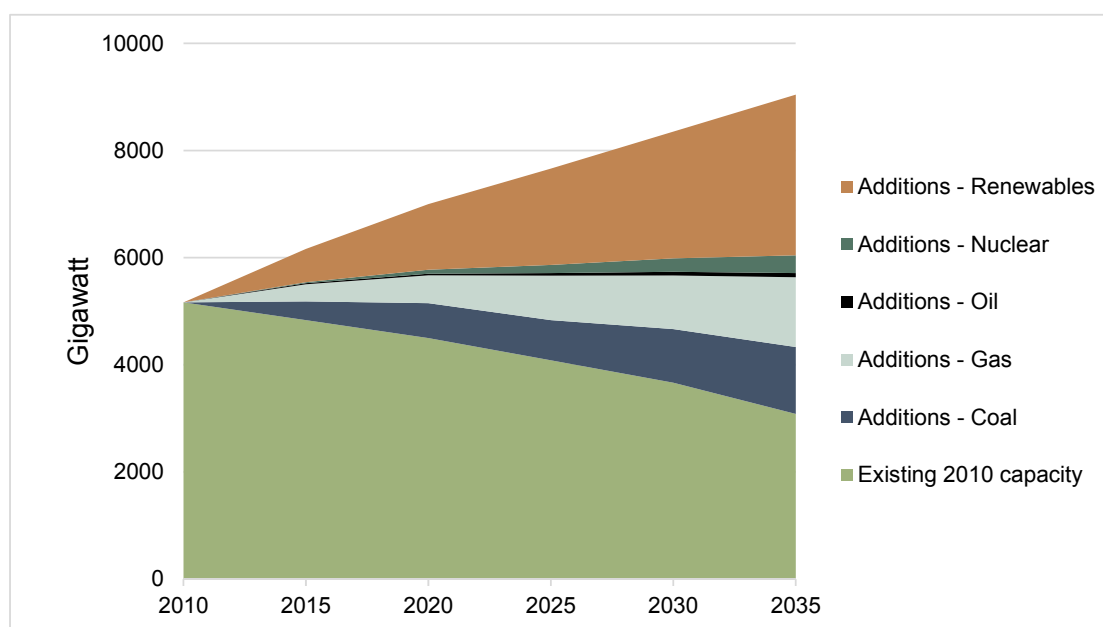
3.1 Global and Regional Energy Trends Favour Woody Biomass and Other Renewable Energy

3.1.1 Global Renewable Energy Trends

The evolution of wood biomass in energy production depends on the overall energy demand trends and the dynamics of energy markets, which are increasingly determined by environmental policies, scarcity of fossil fuels as well as economic and population growth in non-OECD countries.

The most notable trend is the increased importance of RES in meeting the future energy needs while substituting for coal and oil (Figure 18). The accelerated interest in biomass is explained by the maturity of the available technology, cost competitiveness and the fact that most biomass energy applications reduce carbon dioxide emissions up to 55-96% compared to fossil fuels (Biomass for Heat and Power 2010).

Figure 18 World Energy Outlook by Source



Source: IEA 2011

The share of non-hydro renewables in total power generation is estimated to increase from around 3% in 2010 to 15% in 2035. According to the International Renewable Energy Agency (IRENA) study (IRENA 2014), it could theoretically reach 36% of the global energy mix, with biomass accounting for up to 60% of the total final renewable energy use.

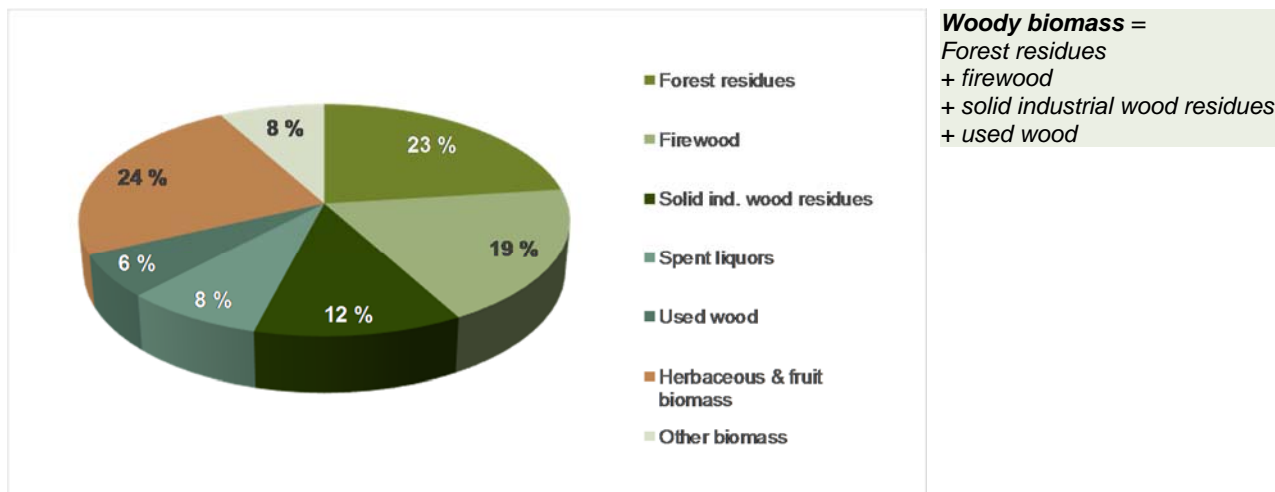
3.1.2 EU Policies Drive the Demand for Wood Biomass

EU's renewable energy and climate change policies (see Chapter 2.4) and the relative competitiveness of various energy sources are accelerating the demand for renewable energy in Europe. Solid biomass and forestry biomass in particular are foreseen to play an important role in future in many European countries where potential alternative sources for renewable energy are limited.

In many countries wood biomass already plays an important role in renewable energy production because of the large availability of forest resources combined with limited alternative (fossil) energy sources. In countries

such as Sweden, Finland, Latvia and Austria, the share of renewables of total energy use already exceeds 20%. In these countries, along with some other European countries, wood energy (including wood biomass and processing waste) is the dominant type of renewable energy exceeding 50% of the total RES (EUwood 2010). Total existing biomass potential (excluding biowaste) in Europe is estimated at 157 Mtoe out of which two thirds is from woody biomass (Figure 19). Currently, only 48% of the annual biomass potential is used.

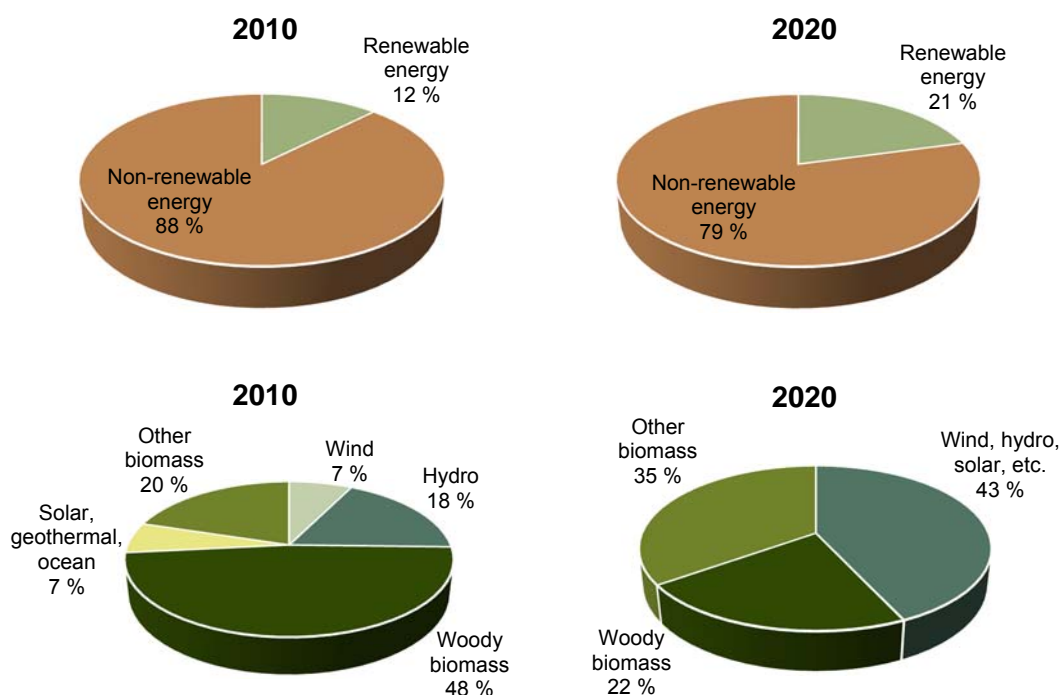
Figure 19 European Biomass Energy Potential



Source: EUBIONET Project 2011

Figure 20 summarises the role of wood biomass in meeting the EU renewable energy target as part of the broader renewable energy mix. There is significant potential to increase the supply wood biomass in Europe to meet the increasing demand. Less than 70% of the annual forest increment from production forests is harvested, i.e. that each EU forest stock grows by about 300 million m³. However, there are also constraints in mobilising the wood due to logistical challenges, environmental reasons and economics. Further, a lot of the wood energy production is closely linked to forest industry production, which will indirectly also affect the supply.

Figure 20 Evolution of Share of Renewable Energy of Total Energy Use (Above) and Wood Energy of Total Renewable Energy Use (Below) in Europe, 2010-2020



Source: European Environment Agency 2011.

All recent projections indicate steady growth for wood energy, and related wood use in Europe. For example, EUwood estimates that wood volumes for energy use can grow to 573 million m³ by 2020 and could reach 752 million m³ in 2030, representing 73% growth between 2010 and 2030. RISI projects that wood biomass demand for energy use could reach 540 million m³ by 2020, indicating a growth of 2.1% p.a. (RISI 2011). Finally, UNECE/FAO 2011 in the EFSOS II study predicted that energy use of wood in Europe (excluding Russia) would amount to 435-857 million m³ by 2030.

The demand projections of the influential study (EUwood 2010) may overestimate the wood energy demand and scarcity of wood biomass for energy use in the future, e.g. because they ignore structural changes taking place in forest industry and international trade in forest biomass (Hetemäki 2014; Hetemäki 2015). Further, all bioenergy has suffered recently from low-prices carbon imports (a side effect of the rise of shale gas in the United's States and recently also in Europe) as well as a low carbon dioxide price in the emission trading system.

However, it is still clear that the growth prospects for wood energy are growing, and even more so if the bioenergy production costs are cut (potential is 30-50%) by just mainstreaming the use of already available technology, and carbon dioxide prices increase as projected. Over time, it is reasonable to assume that the demand-supply balance will tighten. In 2030, the total demand for wood in Europe, including industrial and energy use, is projected at 1.4 billion m³ while "domestic" supply is below that level, irrespective of the mobilisation scenario (EUwood 2010).

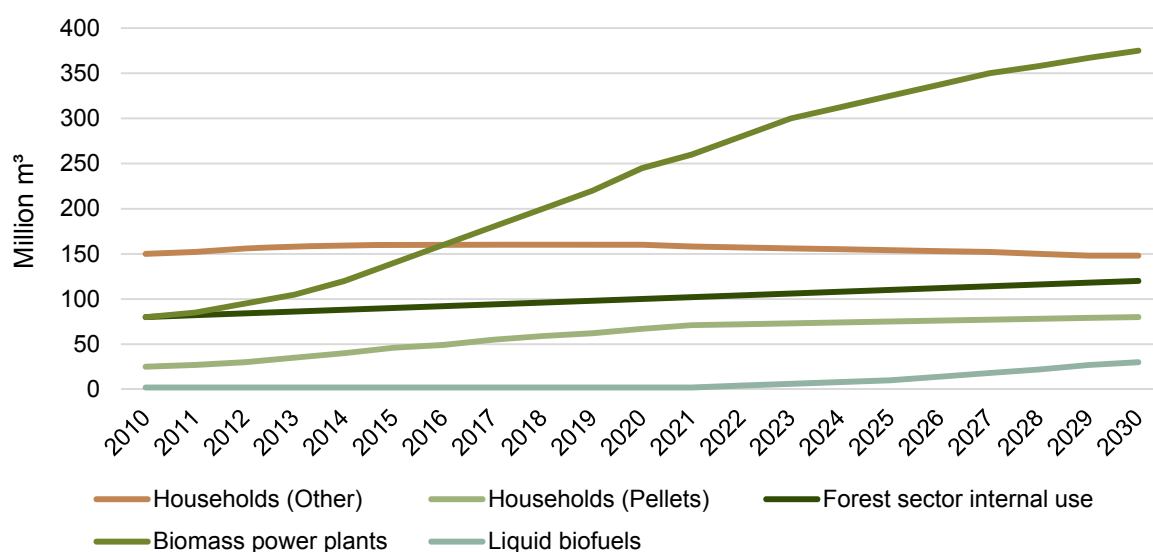
The increasing import of woody biomass into Europe demonstrates the tight market situation in some countries in Europe, which has also been reflected in steadily increasing prices. North America has made use of Europe's quest to reduce its dependence on fossil fuels and to reduce CO₂ emissions, and had increased its wood-biomass exports to Europe from an estimated USD 40 million in 2004 to almost USD 530 million in 2014 (Wilson 2015).

3.1.3 Biofuel Development and Use of Wood

EU's Renewable Energies Directive has set a target of a 10% share of renewable energies in transport fuels by 2020. Further, European Council confirmed in 2011 an objective of reducing GHG emissions from transportation by 67% by 2050 compared to 1990. A switch from conventional transport fuel to biofuels could in theory reduce GHG emissions by up to 93% in the transport sector.

Demand for wood biomass for biofuel production is expected to pick up very slowly with no significant impacts in the forthcoming ten years but reaching possibly already 29 million m³ within EU27 by 2030. In terms of volume, this would represent some 4% of total wood consumption but would play a much more significant role in contributing to the 10% target of RES in transport fuels (Figure 21). However, the concerns regarding the sustainability of biofuels especially in Europe, and the resulting introduction of the iLUC Directive (EC 2015) may slow down the demand.

Figure 21 Development of Total Amounts of Wood Energy Use by Consumer in Europe (EU27) in 2010-2030



Source: EUwood 2010

Production of biodiesel from wood biomass is already possible on a commercial scale, and first commercial projects for forest biomass based second-generation biofuel plants have already been announced in Finland, and similar technology has been piloted elsewhere in Europe and in the US. Box 2 provides a good example of a commercial, industrial scale operation.

Increasing demand for biofuels will mean increasing demand for wood. To put this potential increase in scale, two 200 Kt p.a. biofuel plants should in principle be able to produce enough biodiesel to account for about 9% of road traffic fuel consumption in Finland, closely matching the EU's 10% biofuel target. In terms of wood consumption, this would correspond to about 7% of the average annual industrial wood use in Finland.

Box 2 World's First Wood-based Second Generation Biodiesel Started Its Operation

World's first commercial second generation biodiesel fuel mill using wood-based feedstock commenced its production in early 2015 in Lappeenranta, Finland. The UPM BioVerno biorefinery will be producing 120 million litres (100 million tonnes), of biodiesel. This mill is integrated with the existing pulp and paper mill and a sawmill. The mill uses crude tall oil which is a side product of pulp production originating from wood resin.

UPM's advanced biodiesel is an innovation which will decrease GHG emissions of transport up to 80% in comparison to fossil fuels. The UPM Verno diesel oil won the World Biomarket Bio Business Award for best commercial product in 2015.

This biofuel has specific advantages compared to other renewable energy sources; it utilises side products, benefits from an already existing distribution network and is fully compatible with the requirements of the transport sector; it substitutes hundred percent for normal diesel oil used in transport. It can hence be used unmixed, or mixed with standard diesel fuel. It does not compete with food production, and it is made from a residue based on sustainably (certified) produced wood.

Finland's goal is to increase the share of renewable fuels to one fifth of total fuels used by road transport by 2020; this mill has the capacity to meet 25% of this target. Hence, there is room for additional similar type of investments.

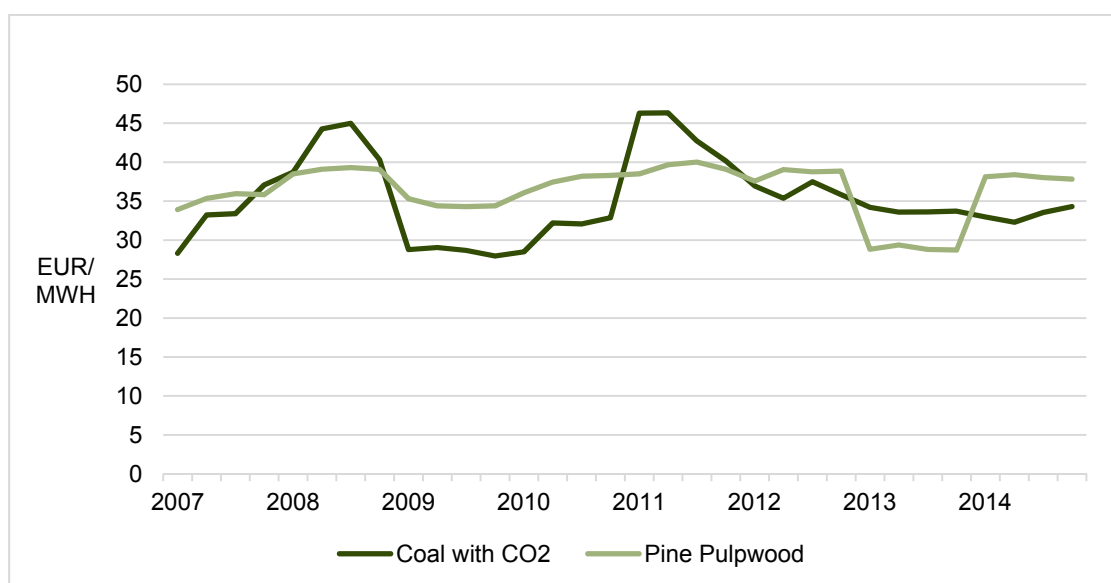
However, it must also be noted that crude tall oil is a scarce by-product of chemical (conifer) pulp manufacturing with several alternative uses.

3.1.4 Competitiveness of Wood Energy

The competitiveness of biomass against fossil fuels strengthens as CO₂ prices increase. At current CO₂ emission price levels, when prices of emission allowances in the ETS market have tumbled below EUR 7-10 per tonne of carbon dioxide, and even less than EUR 5, biomass-based energy production has tended to be more expensive than coal or other fossil fuel alternatives.

According to the recent Dasos analysis comparing wood energy costs to coal prices (including CO₂ cost), during some years small roundwood has been able compete against coal in Finland, but most of the time, and currently, it is not the case. Low price of coal, combined with drastically dropped CO₂ price, makes coal a more attractive source of energy just on economic grounds. However, if the CO₂ price would increase to more EUR 20 as many analysts predict now when the ETS reform decisions have been decided, the use of wood for energy will become more profitable, enabling also the utilisation of currently unused residues. At present, the use of harvested and collected residues and small wood for energy is not competitive without subsidies (Figure 22).

Figure 22 Wood Energy Cost vs. Coal EUR/MWh (mill gate), Including CO₂ Cost in Finland, 2007-2014



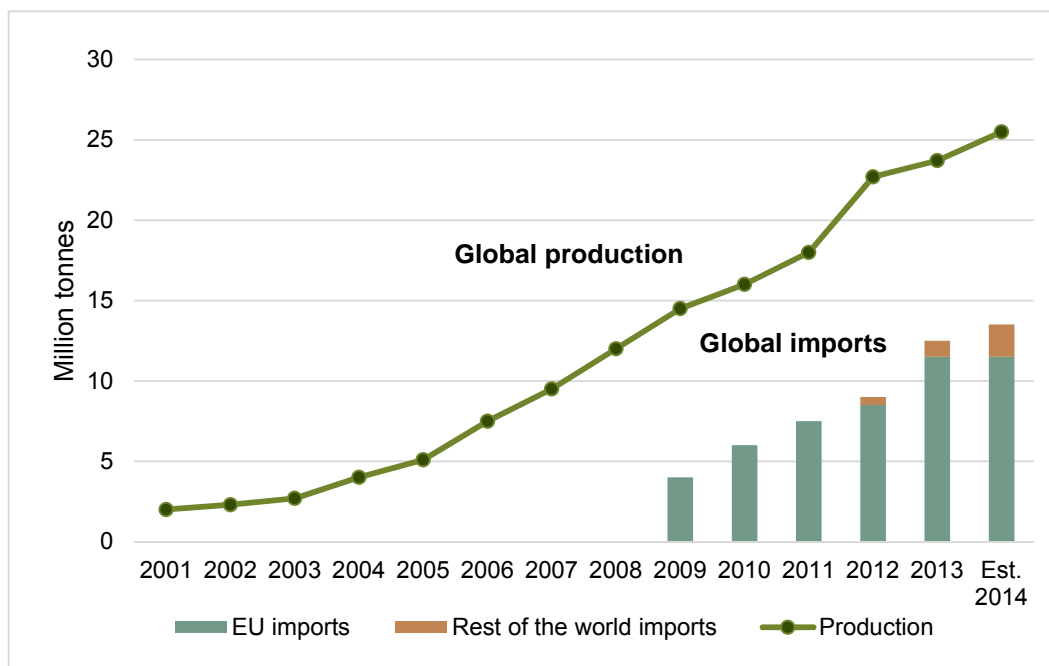
Source: Dasos Capital 2015

3.1.5 Wood Pellet Markets Are Growing Rapidly in Europe

The demand for wood chips and wood pellets for energy use has been rising globally rapidly, driven especially by Europe followed by North America and Asia (China, South Korea, and Japan). The global production reached an estimated 25.5 million tonnes in 2014; growing 76% in just five years (Goetzl 2015, Huang 2015). In Europe, Germany, Sweden, France Latvia, Austria and Portugal are leading producers. Production capacity has increased in the US in the last two years particularly to feed the growing European market. Some of the mills that have been established in the Southeast US are in fact owned and operated by European electricity utilities, such as Drax, to meet EU-mandated emissions targets (Figure 23).

EU's share of global consumption of wood pellets in 2014 is estimated at 81%. The top five consuming countries on the other hand are the UK, Italy, Denmark, Germany and Sweden. In the UK, pellets are predominantly used for power generation as well as in Belgium and the Netherlands. In Italy, the UK and Germany, however, they are currently used almost exclusively for heat production. Overall, about two-thirds of the wood pellets produced worldwide are used to generate electricity and about one-third are used for heat production.

Figure 23 Global Wood Pellet Production and Import Trends 2001-2014



Source: Goetzl 2015; Dasos Capital 2015

Global demand for wood pellets is heavily driven by policies to increase the use of renewable energy. This applies particularly to Europe but to some extent also to North America and some Asian countries. The basic policy driver in the EU is the Renewable Energy Directive from 2009. The consumption of pellets in Europe has grown on average by 16% p.a. since 2009 reaching about 20 million tonnes in 2014 (Huang 2014).

The expansion of combined heat and power (CHP) plants is driving the demand for industrial wood pellets in Europe. The UK in particular is relying on the use of wood pellets in co-firing or dedicated biomass power plants as part of its compliance plan. Consequently, it has become the world's largest importer of wood pellets, importing most of its feedstock from the US because of difficulties in securing access to a large enough quantities from European producers. Few years ago there were numerous plans to establish woody biomass based bioenergy plants in the UK and some other European countries. Most of these plans were never realised because of the problems in securing financing which was often linked to the difficulties in demonstrating secure access to feedstock. This gap is creating now major opportunities to the US producers and exporters but opportunities exist also for European producers of wood pellets, and of course to all forest owners growing and selling wood.

Global demand for wood pellets is predicted to grow despite some policy uncertainties, and will shape a significant segment of the renewable energy market over the next decade and perhaps beyond. The reality is that use of wood pellets in CHP and heating in domestic use results in 88% reduction in CO₂ emissions compared to coal and 81% compared to heating oil (domestic use) (Rakos 2014).

The wood pellet demand for households in Europe has been projected to increase on average at least by 7%-8% p.a. until 2030; annual growth is likely to be close to 15% p.a. in the coming years. The EU is likely to remain the world's largest consumer of wood pellets in the world, but East Asia is going to show a very strong growth and maybe even become the second biggest consumer by 2020 (Goetzl 2015).

The development of pellet technology is also expected to support pellet demand globally. Current co-firing technologies allow mixing only 5-10% of wood pellets with coal. The newly developed torrefied wood pellets are similar to coal and can be mixed with coal without any limits. Further, torrefied wood pellets double the density from 9 GJ up to 18 GJ per cubic meter, which in effect cuts transportation costs by one half. Recently issued technical standards for industrial pellets, called ENPlus and emerging European Standards Institute (CEN), and International Organisation for Standardisation (ISO) standards for biomass energy applications and sustainable bioenergy production will help addressing sustainability concerns and making wood pellets a global product.

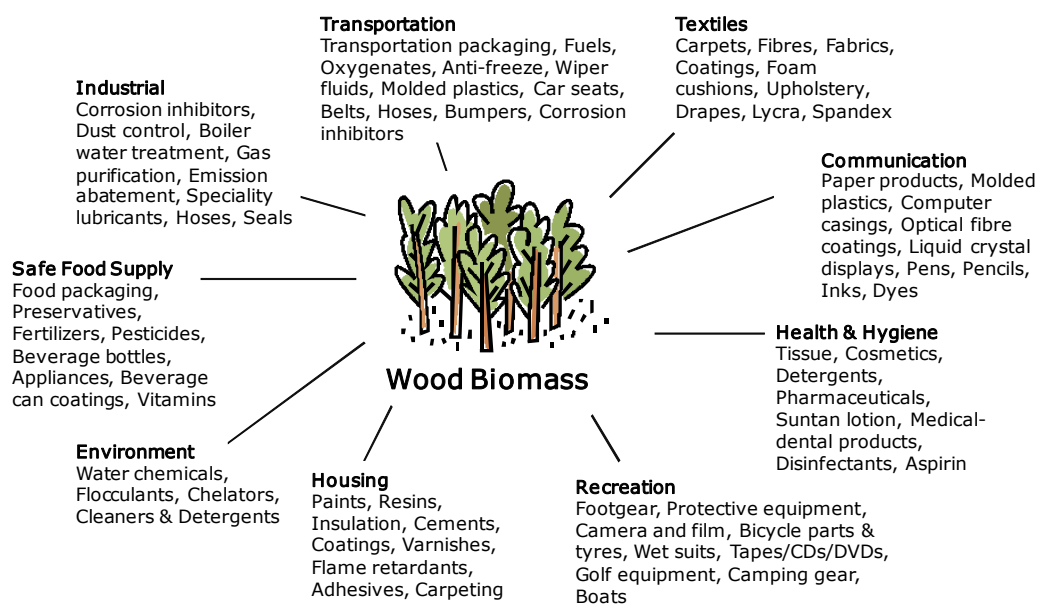
3.2 Biorefineries and New Products Based on Wood

The demand for bioproducts is growing rapidly worldwide. This represents a major economic opportunity for the forest sector due to the abundance of forest biomass and waste products. To date, most of the forest biomass used to make bioenergy and bioproducts has come from the by-products of forest industry manufacturing processes. In this way, value has been added to what would otherwise be waste residues improving resource-efficiency and profitability. Another major benefit of biomass-derived energy and bioproducts is a reduced dependence on fossil fuels.

In Europe and North America forest industry has been wakening up to new opportunities provided through maximising the benefits from wood fibre to produce new high value added products. Many of these products help with meeting the demands of the “Green Economy”, and as a package would improve the efficiency of wood biomass utilisation throughout the value chain in a carbon neutral manner. These products have high energy efficiency and low dependency on fossil fuels, and they can be used to substitute for non-renewable resources, supporting the EU strategic vision of a Bioeconomy for Europe.

Forest industries are turning into biorefineries which use wood fibre and process waste to make a wide range of products, including energy, recycled to produce more value, before being converted to energy at the end of the life-cycle. This is also the long-term strategy of the European forest industry (CEPI 2011). Many such biorefineries already exist; most of them still pilot or demonstration plants. One can even argue that modern pulp and napper industry producing energy and e.g. tall oil in addition to pulp and paper, are some kind of biorefineries, although they are not producing new bioproducts (yet) (Figure 24).

Figure 24 New Bioeconomy Oriented Forest Industry



Source: CEPI 2011, adapted by Dasos Capital

In addition to bio-fuels (and naturally heat and power), wood fibre can be used to develop new bio-materials, such as bio-composites and composites, wood-fibre based textiles (e.g. viscose), bio-chemicals for food and chemical industry, nano-cellulose, nano-fibres, wood-based food additives (e.g. vanillin) represent new technology and products with commercial potential, 3-D printing pulp, mouldable hemi-cellulose. For example, cellulose fibres can be separated into nano-fibres, which have potential applications in various fields, such as bio-nanocomposites, tissue engineering scaffolds, filtration media, packaging, etc. (Paperi ja puu 2015; Harlin 2014; CEPI 2011).

Recent examples of important commercial bioproduct developments are provided below:

- VTT Technical Research Centre of Finland Ltd has developed a method of converting lignocellulosic biomass into manufacturing chemicals such as benzene, toluene and xylene – known as BTX chemicals. VTT is in the process of improving the technical and economic feasibility of the process as a step towards commercial viability.
- New and innovative paper-based packaging is continuously developed to increase functional use – including optimal food preservation – and to better serve consumers. E.g., Lappeenranta University of Technology has developed jointly with StoraEnso a new type of extremely tight packaging board (and related new process) which could over time replace plastic packages.
- Cellulose nanocrystals (CNC), a cutting-edge emerging technology being developed e.g. in Canada and Finland. CNC is light, strong and bio-degradable, with a wide array of possible uses, from bone replacement and tooth repair, to airplane and car parts to chemicals, composites and coatings. CNC has potential to revolutionize many applications including sunscreens, cosmetics, pigments in paint, and optical films for use in specialty packaging. World's first commercial demonstration plant is already producing CNC, integrated with the Domtar pulp and paper mill in Windsor, Québec.
- UPM and Renmatix Inc. are cooperating in the further development of Renmatix's water-based Plantrose™ process to convert woody biomass into low-cost sugar intermediates for subsequent downstream processing into biochemical with a target of offering cost-competitive bio-alternatives for select petrochemicals on an industrial scale. Renmatix is the leading manufacturer of cellulosic sugar, an enabling feedstock for petroleum alternatives used in the global biochemical and biofuels markets. In 2015, Renmatix invested in a new feedstock processing facility dedicated to the conversion of woody biomass into cellulosic sugar.
- Stora Enso is developing xylose-based products using new technology developed by a start-up company Virdia to separate sugar from wood biomass.
- In 2015, a Swedish technological university Chalmers announced a new technology enabling 3-D printing using wood pulp as a raw material. Wood fibre has the potential to play a major role in the largest manufacturing revolution this century — providing substrate for 3D printers from lignin, an affordable and renewable by-product of pulp mills.
- Cellulose products can be used as a substitute for glass fibres in reinforced plastics. In Canada, progress has been made in making carbon fibre from lignin that could be used in high-end sporting equipment such as bicycles, golf clubs and tennis racquets. Sugar streams generated from wood can be used in a range of bio-plastics for example medical applications such as bone implants.

One rapidly growing bioproduct is wood-derived textile(s) which are close substitutes for cotton. Because land and water restrictions restrict the continued expansion of cotton, it is expected that wood-based textile fibres will be increasingly used to meet the demand for raw material. Wood-derived viscose, in its various forms, already accounts for 6% of the world fabric market. Its market share is third largest after synthetics and cotton but ahead of wool. The market prospects are good because modern viscose is environmentally friendly and technological innovations are resulting in attractive new products. For example, Tencel® produced in Austria (by the Lenzing Group) is a strong, machine-washable, sustainably produced fibre. Its worldwide demand is predicted to increase for use in both woven products and “non-wovens”, with an increased production base in Europe (UNECE/FAO 2014). Spinnova Ltd, one of the biggest spin-offs of the VTT Technical Research Centre (Finland), is cooperating e.g. with the Lenzing Group to develop new technology to spin yarn from pulp fibre to replace cotton without complex chemical processes.

Box 3 First “Next-Generation” Wood-Based Biorefinery in the World Will Start Its Operation in 2017

In 2015, the Finnish Metsä Group announced the biggest ever investment in the Finnish forest sector, a 1.3 million tonne Metsä Fibre pulp mill in Äänekoski, Finland, amounting to an estimated EUR 1.1 billion. The mill will also produce electricity, biofuels and various bioproducts.

The mill concept is based on an integrated production of pulp, bioenergy and bioproducts. High-quality pulp, followed by bioenergy (primarily electricity but also processes steam and heat), tall oil and turpentine are the planned core products. The mill does not use any fossil energy, but all needed energy is produced from wood. The electricity self-sufficiency rate is 240%; the new bioproduct mill is expected to increase the share of renewable energy in Finland by about 2%.

Potential new products include bio-material (custom-made pulp, lignin upgrades and new fibre products); bio-chemical (raw materials for bio-plastics, fertilizers and process chemicals, and bio-energy: (bio-diesel, methanol, bio-gas, product gas and ethanol).

The plan is to utilise raw materials and side streams 100 percent as products and bioenergy. The mill concept includes also a central idea of creating a partner network linking Metsä Fibre, small and medium-sized enterprises and research community to create new products with high added value.

The mill increases the use of roundwood by 6.5 million m³, i.e. by more than 10% of the current annual industrial roundwood removals in Finland. It is the biggest investment in primary wood processing and utilisation of domestic wood resources in the entire Europe since the start of the new millennium. From that perspective this investment represents a shift; in the last two decades investments have started shifting towards emerging countries in Asia and South America.

The mill is expected to start operating in 2017.

Source: von Weymarn 2014; Paperi ja Puu 2015

All these technological developments and new products help to diversify the revenue sources in the forest sector and also improve the profitability of the forest industry. At the same time, forest resources are used more efficiently and sustainably. There is still quite a long way to go but already in the medium term, and definitely in the long term, various bioproducts and also bioenergy will form an important part of the value-added generated in the forest-based bioeconomy, and also of export revenue for more advanced forestry countries. New service business opportunities will also be created in the bioproduct value chains; they can turn out to be quite significant (Hetemäki 2014).

4. TRENDS IN WOOD-BASED HOUSING AND CONSTRUCTION

4.1 Wood, Construction and Wood-Based Architecture

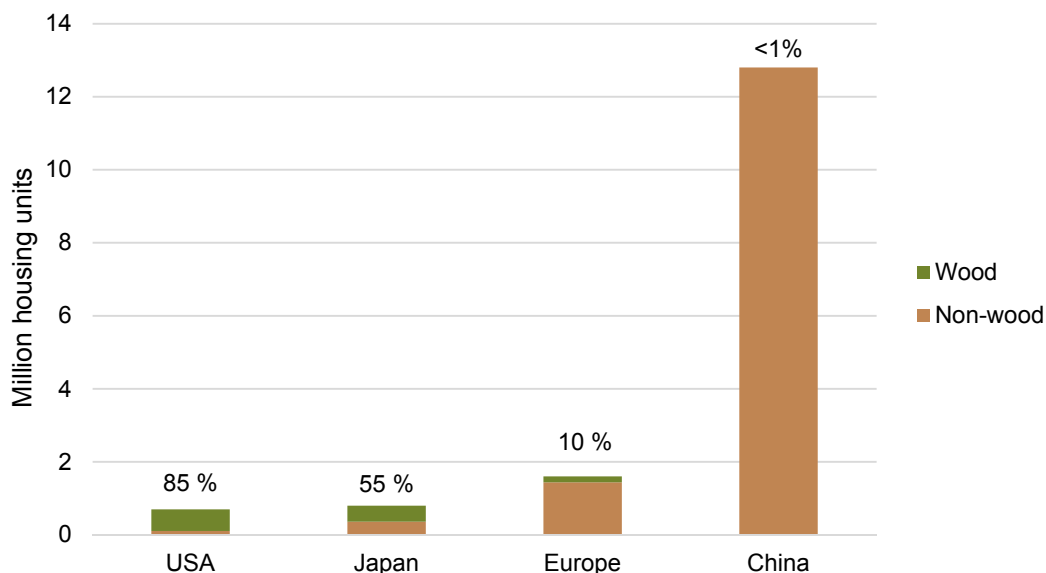
4.1.1 Use of Wood in Construction

Up to 70% of timberland revenue comes from wood-based construction and furniture industries which consume some 30-40% of the roundwood production volume. Globally, some 65% of sawnwood production is used in the construction sector; in Finland the share is about 80%. These end uses typically demand for high-quality and large-sized sawlogs with unit value (EUR/m³) up to three-four times the value of wood e.g. in the wood pulping. Sawnwood, wood-based panels, CLT, glulam and wood-based composite products used in construction and design are mainstream forest products that represent major value added in the forest industry.

The use of wood in the construction sector and in interior design tends to grow universally when GDP per capita increases. The correlation is transmitted through housing starts, which is closely aligned with GDP developments. This could imply relatively low growth rates for wood used in construction, since in the countries where wood is a common raw material, GDP growth rates are currently relatively low. However, “greens trends”, people’s preferences concerning architecture, technological development and regional (EU) and national policies are directly or indirectly favouring the use of wood not only in residential building but also for offices, public buildings and infrastructure, such as bridges.

The accelerated construction of wooden buildings in Europe will increase the demand for wood, but the biggest impact is not due to the increased volume but increased demand for value-added products and higher quality wood (Figure 25).

Figure 25 Share of Wood-Frame Houses of Housing Starts in Key Regions/Countries in 2010



Source: Euroconstruct Statistics 2013

Buildings, their construction and raw materials used in construction are a significant source of carbon dioxide emissions globally and consume a lot of energy. Buildings account for 40% of total energy consumption and 30% carbon dioxide emissions in EU. Globally, construction as a whole, including manufacture of construction materials, construction and use of buildings, accounts up to 40% of the GHG emissions, and 40% of the energy consumption. Construction activity is increasing due to population growth, urbanisation, migration and rising living standards, and hence the use of energy and materials from renewable sources in the building sector has emerged as an important approach to reduce GHG emissions and improve energy efficiency.

4.1.2 Environmental Policies, Regulations and Green Architectural Trends Favour Use of Wood

Policy (regulatory), technological, economic and social drivers influence the demand for wood materials in construction, including renovation of old buildings.

In 2010, the EU introduced a Roadmap for Moving to a Competitive Low Carbon Economy in 2050 which sets very ambitious targets for reducing GHG emissions from residential buildings by about 50% by 2030 and 90% by 2050 (EC 2011). In 2010, EU issued a Directive (EC 2010) which requires that all new buildings within EU are to be “nearly zero-energy buildings” by 2020, and public buildings by 2018. These objectives are to be met through a number of measures aimed at improving energy efficiency, including promotion of energy-efficient and low carbon footprint materials; these developments are expected to increase the use of wood.

In 2006, the Government of the UK declared that all new residential buildings are to be zero carbon by 2016. In Canada, the Province of British Columbia introduced in 2009 an act that requires wood to be considered as the primary building material in public buildings. Many other provinces have introduced similar requirements thereafter.

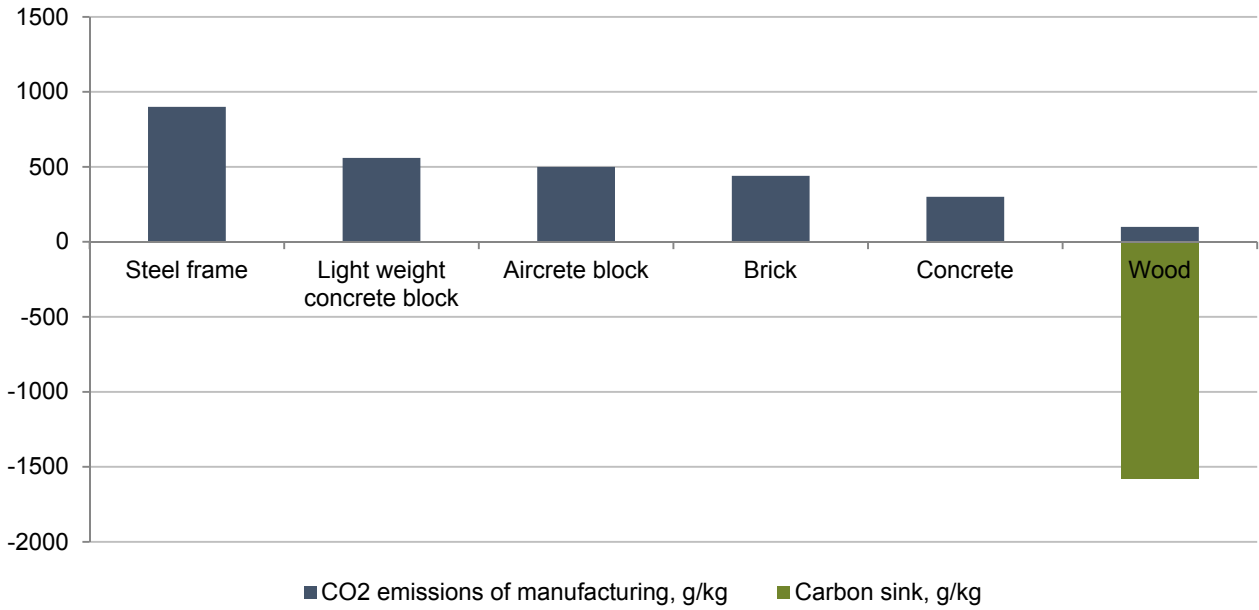
The changes in national building and safety standards and fire codes, development of new technology and industrialised production systems, requirements to use life-cycle assessment (LCA) to assess environmental impacts, and implementing EU directives related to nearly zero-energy housing are accelerating the construction of wooden buildings in Europe. In many countries standards have in the past favoured less energy efficient materials, such as concrete but the situation is changing quickly. The International Green Construction Code issued in 2012 favours sustainably produced wood as construction material. Building codes in many European countries increasingly incorporate engineered wood products and their structural design values enable them to compete successfully with concrete and steel in the construction of tall and large buildings (UNECE/FAO 2014).

In Finland, the fire code was modified in 2011 to enable the construction of multi-storey wooden buildings up to eight storeys. In 2012, a new industrial standard called “RunkoPES” was introduced to facilitate the construction of prefabricated wooden commercial and multi-storey wood buildings. Further, it is planned that the revised construction code will look at life cycle environmental impacts and resource efficiency of construction materials from 2017 onwards, which will favour the use of wood.

National programs promoting the use of wood are improving the competitiveness of wood construction industry and accelerating the development of new industrial applications based on increased use of wood in Finland and elsewhere in Europe. In Sweden, a national wood construction strategy for multi-storey and public buildings and constructions was developed in 2004. In 11 years the share of wood multi-storey buildings increased from about 5% to about 20%. In the long term, the share of 30% is seen as feasible (Jonsson 2009). The Finnish National Wood Construction Program aims at reaching a 10% share in less than four years. In 2013, about 150 wooden multi-storey buildings were constructed in Finland; in 2014 the figure was more than close to 700, accounting for a 5% market share of residential multi-storey building construction. About 6 800 multi-storey buildings are currently planned in Finland; already in 2015 the share of wooden multi-storey buildings will be getting close to 10% of the market. Public procurement policies can also influence the demand for wood used in construction (Hietala et al. 2015; Hurmekoski et al. 2015). According to Hietala et al (2015), the increased use of wood in public contracts would have positive economic impacts on the national economy in addition to the environmental benefits.

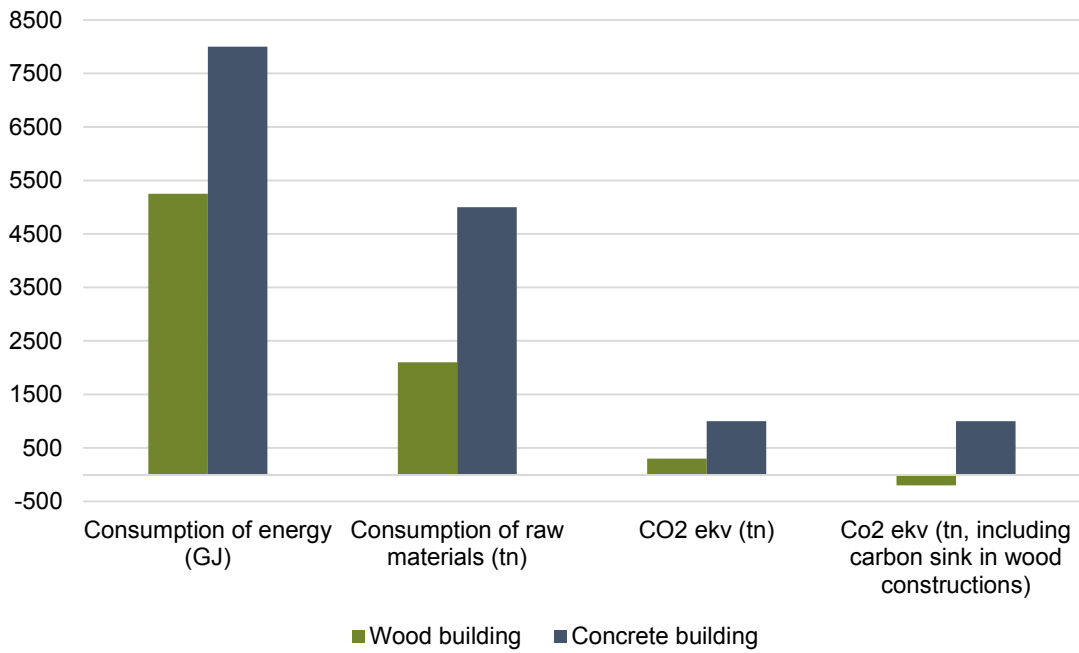
Scientific findings indicate that a wooden building can reduce significantly its carbon load compared to an equivalent building made from concrete reinforced with steel, and reduce the use of natural resources and energy per constructed housing unit over the lifecycle (Figure 26, Figure 27 and Figure 28). Wooden buildings act also as carbon sinks (Bribian et al. 2011; Koskela et al. 2011; Sathre and O’Connor 2010). Timber came on the top in the study ‘Environmental Profiles of Building Materials, Components and Buildings’ - one of the first substantive exercises undertaken by a major independent research body into the of LCA of building materials (Building Research Establishment 2015). Timber scored highly in the 13 environmental impacts studied — from climate change, pollution to air and water, waste disposal, and transport pollution and congestion. According to the study, timber is the only building material to have a positive impact on the environment, with trees’ ability to absorb carbon dioxide and emit oxygen.

Figure 26 Carbon Footprint of Various Construction Materials



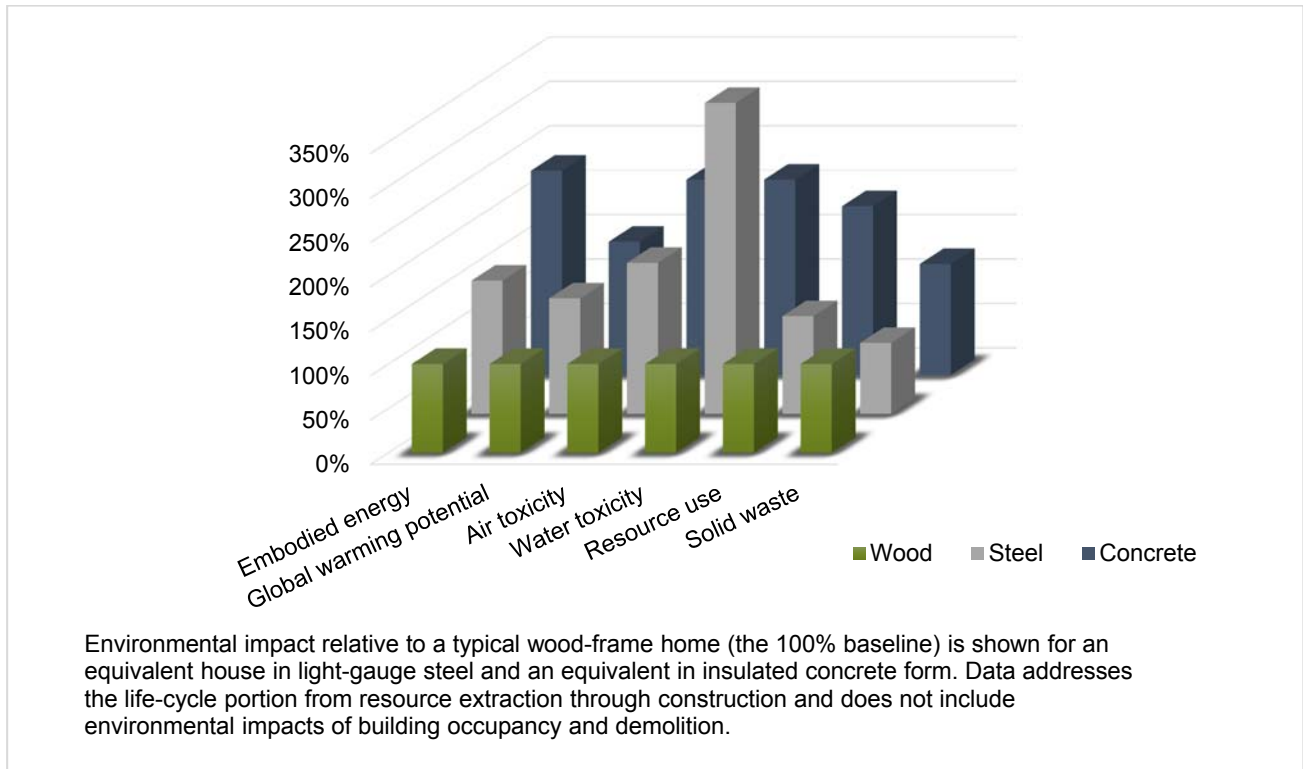
Source: Based on Viljakainen 2009

Figure 27 Natural Resource Consumption of Concrete vs. Wooden Office Building



Source: CEI-Bois 2009

Figure 28 Environmental Impacts of Housing Types Based on Life Cycle Assessment



Source: Canadian Wood Council

Construction of a wooden building results on average about 30% time saving compared to traditional construction practices; and time savings even up to 50% are possible. All in all, the assembling process is easier, safer and more effective (Tolppanen et al. 2013). As a whole, wooden multi-storey construction appears to be cost-competitive despite somewhat more expensive raw material. Further, there is significant potential to reduce the total costs through the adoption of a more industrialised approach to construction based on the use of prefabricated components (Hurmekoski et al. 2015).

The energy used in buildings, including manufacturing, transporting and erecting buildings, is significantly lower for wood-based products than for other materials over the life-cycle. When you include the carbon stored in wood products, sawn wood actually has negative net emissions (Figure 27). The combined effect of carbon storage and substitution means that 1 m³ of wood stores 0.9 tonnes of CO₂ and substitutes 1.1 tonne of CO₂, resulting in a total saving of 2 tonne of CO₂.

Multiple health – both physiological and psychological - benefits have been associated with wooden interiors in homes, businesses and public buildings in independent scientific research according to two comprehensive reviews (Planer Ark 2014; Muilu-Mäkelä et al. 2014).

Box 4 provides examples of modern wood-frame buildings and their basic features.

Box 4 Examples of Use of Wood in Architecture and Different Uses



PuuMera in Kivistö, Vantaa, Finland

- Europe's largest residential multi-storey building made of wood; completed in July 2015 (will be however surpassed in 2016 by a 24-storey wooden building in Vienna)
- The use of prefabricated modules made the construction process fast, reaching the speed of one floor a week
- The carbon footprint is less than a half of the average building; 30% energy savings
- Designed by Vuorelma Architects

Source: Dasos Capital 2015; photo by Nora Anttonen



Kamppi Chapel of Silence, and Viikki Church, Helsinki, Finland

- The Chapel designed by K2S Architects, represents a flexible use of wood raw material; the material does not limit the architecture
- Viikki Church designed by JKMM Architects

Source: Dasos Capital 2015; photo by Nora Anttonen



Planned Guggenheim Museum, Helsinki, Finland

- A Paris-based architect studio Moreau Kusunoki Architects won in June 2015 the architecture competition of Guggenheim Helsinki
- The main material of the façade is charred timber, which also improves fire safety



Haltia Nature Center in Nuukio, Finland

- First public building in Finland built entirely of wood; designed by Lahdelma & Mahlamäki
- Exterior made out of ecologically friendly impregnated pine
- Walls, roofs and floors are all made of CLT from Austria (supplied by StoraEnso)
- Durable and high fire resistance
- Prefabricated CLT made possible the short construction time of 18 months

Source: Dasos Capital 2013



Library at the Melbourne Victoria Harbour, Australia

- The library designed by Clare Design and Hayball, was opened in 2014
- The first public building in Australia that has been made with CLT (supplied by StoraEnso)

Source: storaenso.fi



Wood City, Helsinki, Finland

- The construction work of a wooden quarter, designed by Anttinen Oiva Architects, offering offices, hotel and homes in Jätkäsaari, Helsinki will begin in late 2015
- The Wood City will be built using CLT modules, which will makes the construction process fast

Source: woodcity.fi

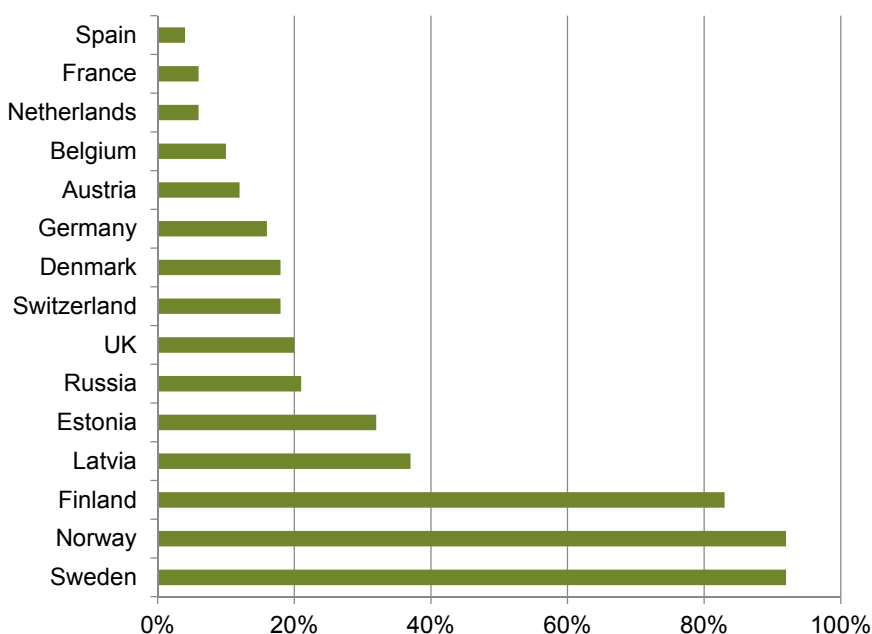
4.1.3 Future Trends in Wooden Building Construction

In most European countries, there is a significant potential to increase the use of wood in the construction of all types of buildings as is indicated in Figure 29. Many of these countries have also adopted policies and programs to systemically increase the use of wood in construction. According to the Architectural Barometer (2013) in countries, such as the UK, Germany, France and Italy, the use wood is in the European construction market expected to increase. Strong growth is taking place also in Switzerland and Austria. The annual sawnwood consumption per capita is 0.5-0.6 m³ in countries, such as Finland and Sweden, but only about 0.1 m³ on average in Europe and less than 0.1 m³ per capita in Russia and Spain, and only about 0.2 m³ in Germany and France.

The share of wood-frame residential houses is already very high in Scandinavia. In Finland, Norway and Sweden the biggest potential in increasing the use of wood in construction lies in multi-storey residential buildings and office since wood already dominates the construction of single houses and vacation homes. All these countries have national programs to promote wood house construction, or use of wood, in general, in construction. Significant growth potential is seen in multi-storey houses, offices and public buildings and in

remodelling and improving energy-efficiency of existing buildings. In some countries, established practices in the construction sector value-chain, traditions and culture are slowing-down the expansion of wooden multi-storey construction in some European countries (Hurmekoski et al. 2015).

Figure 29 Share of Wooden Houses in Residential Construction in Europe in 2010



Source: Euroconstruct Statistics 2013

The CLT is expected to gain an increasing market share in the construction of multi-storey buildings. The use of prefabricated wooden facade elements in the renovation of old concrete apartment blocks has also proved to be a cost-effective and technically feasible method, which is likely to increase the demand for CLT and sawnwood in construction throughout Europe over time. Prefabricated modules and design-build systems based on engineered wood products can be competitive in answering the demand for packaged assemblies by mass timber solutions. They are quicker to assembly and require fewer tasks to be performed on site compared to some of the competing materials, such as concrete (Manninen 2014). To meet the increasing demand for CLT in Finland, Stora Enso built in 2014 the first CLT factory in Finland.

4.2 Investing in Green Buildings

Given the role of the building sector as a major global source of GHG emissions and consumer of energy, real estate investment is emerging as an effective avenue for addressing climate change and sustainable energy use. Investors at the forefront of these changes are likely to be in a strong position to enhance their portfolio performance. They are also likely to be better positioned to deal with impending regulatory risks concerning e.g. energy efficiency of buildings or their carbon footprint.

The fresh PriceWaterhouseCoopers (PWC) studies - Emerging Trends in Real Estate Sector (PWC 2015) and Real Estate 2020: Building the Future (PWC 2014) - and the recent UBS study Real Estate and Sustainability: Investing for Returns and the Future (2014), all identify green or sustainable buildings as a major emerging investment trend in the real estate sector. There are already funds (e.g. by the Deutsche Bank and Credit Suisse) that focus solely on sustainable/green buildings. Wooden buildings are likely to be a just small part of these portfolios. However, these trends indicate that the “green building” trend is not a hype, or just expressions of policy aspirations but something that is already happening, and is also being mainstreamed into the capital markets.

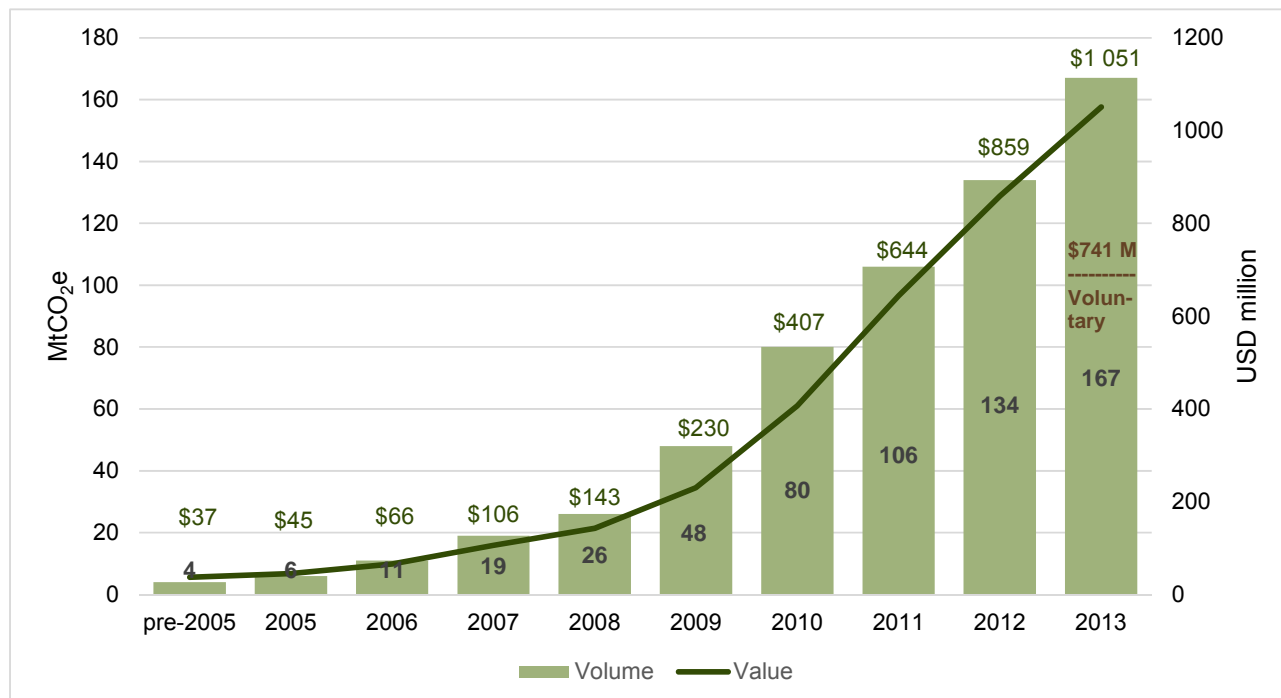
5. CLIMATE CHANGE, FOREST CARBON, GREEN BONDS AND FORESTRY INVESTMENTS

5.1 Climate Change and Forest Carbon Market Prospects

Forestry plays an important role in climate change mitigation due to forest's cost-effective potential to (i) increase carbon sequestration and act as carbon sinks, and (ii) reduce GHG emissions through avoided deforestation and forest degradation (reducing emissions from deforestation and forest degradation, REDD). Deforestation and forest degradation contribute currently about 14% of the global GHG emissions, which explains the interest in investing into avoiding deforestation. In fact, forestry transactions were the first-ever carbon offsets. The Commission on Climate and Tropical Forests (2010) suggested that the scale of financing required to halve deforestation will increase over the current decade, reaching USD 30 billion annually by 2020. There are other estimates of similar scale all strongly concluding that forest finance must increase dramatically to achieve the goals of the UN Framework Convention on Climate Change (UNFCCC) and related international and national commitments.

In 2013, forest carbon project developers reported the highest overall volume attributed to the global marketplace for forestry offsets - totalling 32.7 MtCO₂, a 17% increase from 2012, and just slightly exceeding the previous all-time high of 32 million tonnes in 2010. However, the value dropped 11% from 2012 due to a decline in average offset prices down to USD 5.2/tCO₂ from USD 7.8/tCO₂ (Ecosystem Marketplace 2014). In fact, the low price of carbon is an issue not only for the forest carbon market but globally for carbon credits in general, including the European emissions trading scheme (ETS). In 2013 the cumulative market exceeded for the first time one billion (Figure 30).

Figure 30 Cumulative Forestry Offset Transaction Volume and Value, All Markets



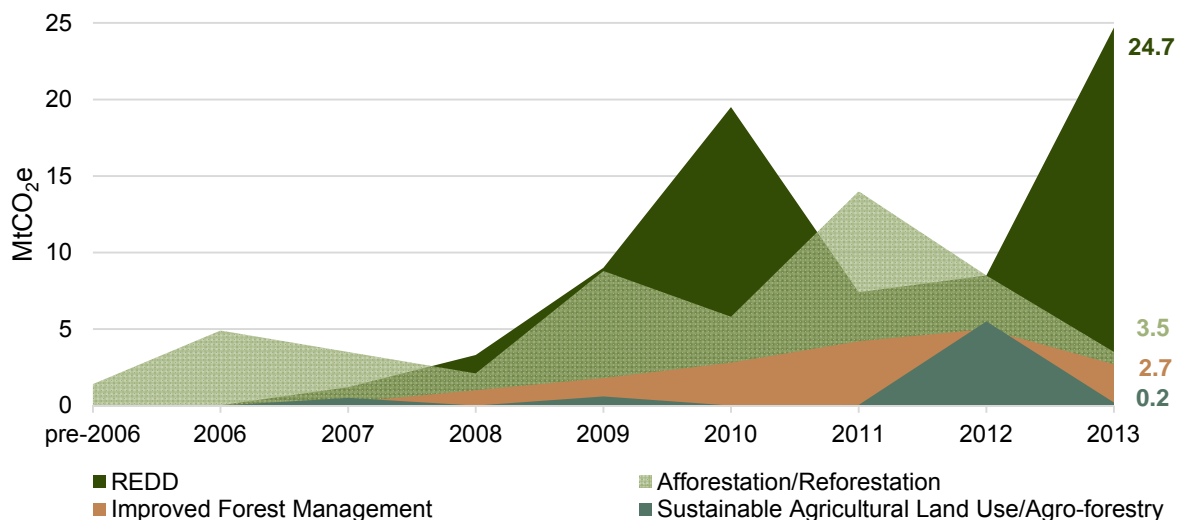
Source: Ecosystem Marketplace 2014

Most demand for forest offsets to date has occurred in the voluntary carbon markets. Out of the total global traded forest carbon volume in 2013, 89% was purchased in voluntary market. REDD credits can be purchased in the voluntary market. The demand for REDD offsets nearly tripled in 2013, accounting for more than half of the market value. Looking at the accumulated volume of forests carbon credits (Figure 31), the dominating role

of REDD projects stands out. Improved forest management and plantation-type of projects (afforestation and reforestation) play a small role (Ecosystem Marketplace 2014).

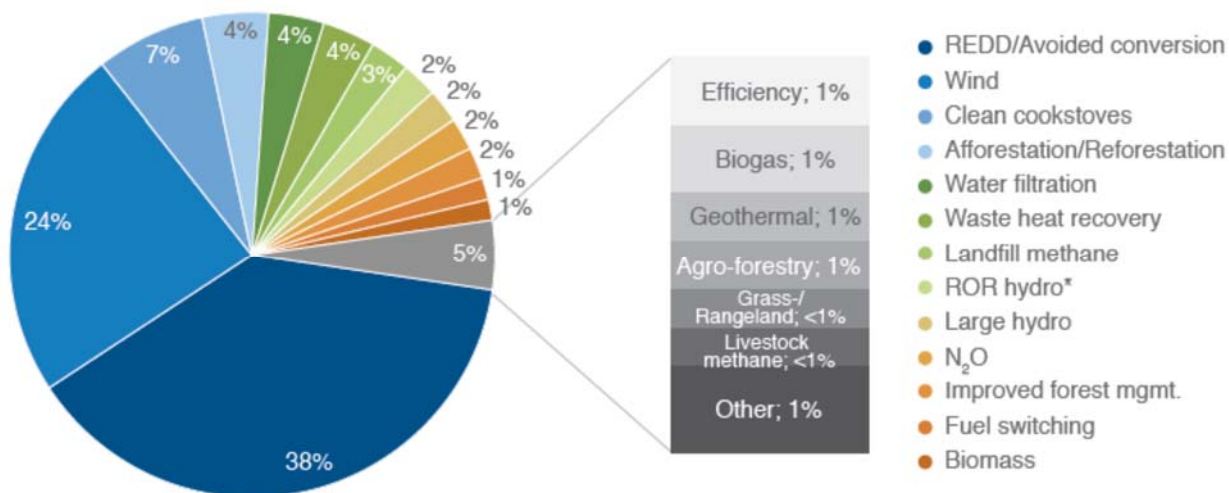
In 2013, offsets generated by forestry and land-use projects represented a 45% of the voluntary marketplace compared to 32% in 2012. However, this is only about 1% of the world's total carbon credit market (Figure 32).

Figure 31 Accumulated Volume (MtCO₂) of Forest Carbon Credit Trade by Type of Project (All Markets) in 2013



Source: Ecosystem Marketplace 2014

Figure 32 Global Market (OTC) Share by Project Type in 2014



Source: State of Voluntary Carbon Markets 2015

However, there are a number of issues and developments which are likely to increase the interests of project developers and investors in forestry-related carbon projects, as long as the political uncertainty concerning the global climate change policies is lifted off (possibly partly in Paris climate change negotiations).

First, all the political uncertainty concerning a new global climate change agreement does not change the facts – confirmed by the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) - that climate change is a serious global issue and forestry plays a major role in it, and that investors simply cannot ignore climate change. Despite some decline in the relative role of forests as a source of direct GHG emissions,

the IPCC has estimated that the Agriculture, Forestry and Other Land Uses (AFOLU) sectors contribute about 24% of direct GHG emissions, forestry being responsible for 14% of the emissions (IPCC 2014).

The AFOLU sector as whole offers relatively low-cost mitigation potential, and most importantly, the IPCC Fifth Assessment Report (2014) identifies afforestation, sustainable forest management, and reducing deforestation amongst the most cost-effective GHG mitigation strategies within the AFOLU. This offers interesting investment opportunities for institutional investors and impact investors many of whom already have forestry and/or climate as an asset class. Investment opportunities include e.g. improved forest management, afforestation and reforestation, and naturally avoided deforestation and forest degradation.

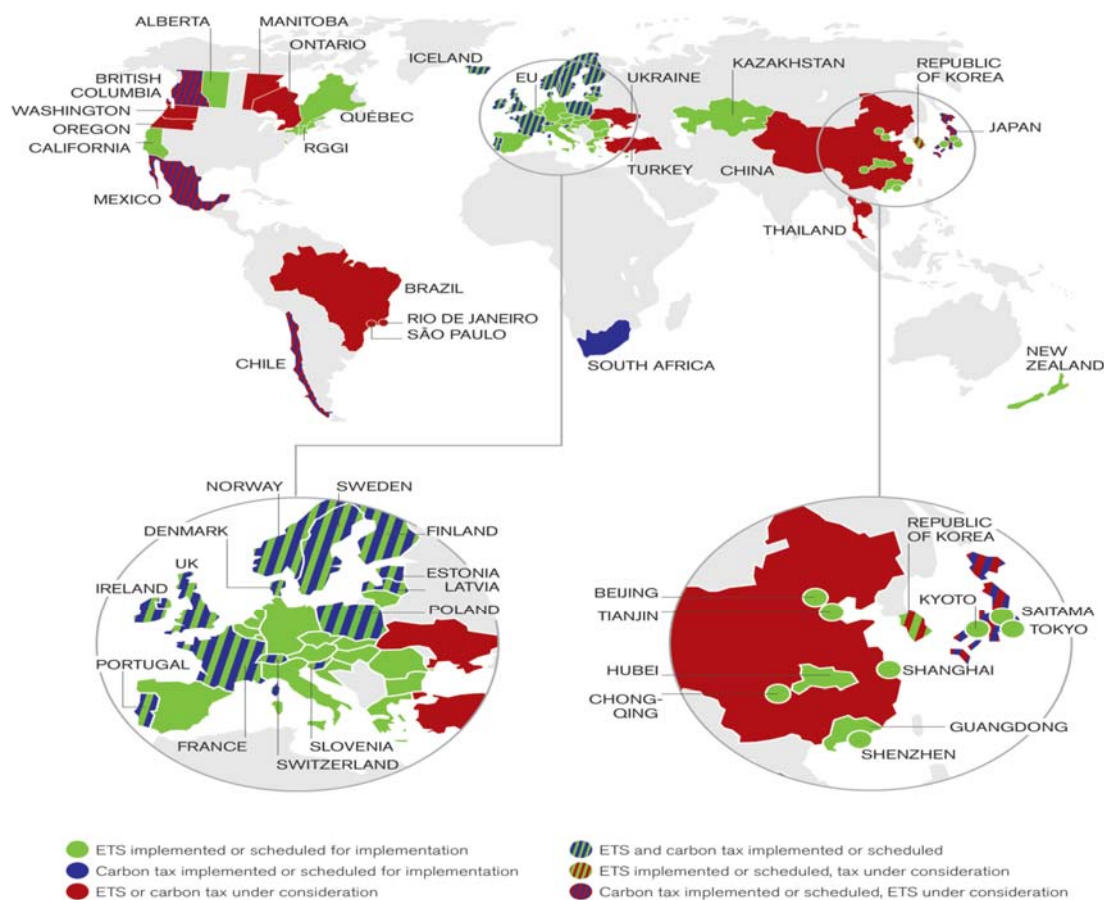
Second, it is increasingly recognised that forests' role in climate change mitigation is not only limited to acting as a storage for carbon. Carbon sequestration services will remain also in the future at the core of the international dialogue on forests and climate change and climate-related forest financing. Dieterle & Larson (2014) and Galbert et al. (2013) argue, however, that the most significant potential contribution forests can make to climate change mitigation take in fact place outside of forests themselves. What is not widely understood, is the role that harvested and processed forest products and wood-based energy play in the carbon balance - a role that is omitted by current forms of carbon accounting (Dieterle & Larson 2014). Wood can increasingly be used to substitute for concrete, steel, and aluminium in construction (which would increase both the carbon and energy balance). Significant amounts of carbon are stored in durable, long-lived wood products, such as furniture, construction material (houses, bridges, etc.) forming an immense forest products carbon pool. Together, these three effects can contribute more to climate change mitigation than carbon sequestration through forest conservation (REDD+).

Third, global carbon markets and carbon pricing are becoming a reality. In 2015, about 40 national and over 20 sub-national jurisdictions, representing almost a quarter of global GHG emissions, are putting a price on carbon. Carbon pricing has been expanding rapidly in the recent years, initiatives valued at the end of 2014 at nearly USD 50 billion, out of which ETSS amounted to USD 32 billion (Carbon Pricing Watch 2015). There are 12 national and sub-national ETSS, and importantly, the California "cap and trade" scheme, which is playing an important role for forestry credits. The global carbon markets will increase significantly in 2016, if China introduces the national trading system as planned (Figure 33).

Fourth, there are also great expectations concerning new financing instruments that could attract significant incremental financing and generate opportunities for new forestry projects and investment. Green bonds, and specifically green climate bonds, or AFOLU/REDD climate bonds, can help to leverage significant amounts of private capital from institutional investors to help overcome the upfront investment costs and financing requirements of protecting and managing forests sustainably.

However, in 2015 the situation for forest carbon projects is quite challenging, because credit prices are so low that they at present do not cover the credit delivery and transaction costs. Carbon markets continue to be very volatile posing risk to project developers and investors; in the recent years prices have been declining due to perceived overs-supply of off-sets and inefficiently functioning EU ETS. In effect, the EU carbon price has collapsed.

Figure 33 Summary Map of Existing, Emerging, and Potential Regional, National and Sub-national Carbon Pricing Instruments



Source: *Carbon Watch 2015*

The lack of binding targets and signals in sight which would help boosting the demand with some kind of certainty, combined with increasing supply of credits, is making investments in forestry carbon project unattractive. After 19th UN Conference of the Parties (COP-20) in Lima in 2014, still no immediate agreement on the post-Kyoto agreement was reached. The lack of a new international agreement continues to create considerable market uncertainty. A lot will depend on the forth coming Paris negotiations in December 2015. Forest carbon markets will attract mainstream financing and significant private sector financing after the risks associated with forest credits are reduced and the following things are in place:

- post-Kyoto agreement with clear caps and simplified procedures for all types of forest carbon projects (including REDD+) is approved;
- there is more long-term policy certainty in general concerning regional and national policies: private investment decisions depend on public policies (and stability) of incentives provided by governments;
- efficient caps are introduced within EU so that ETS market can become more efficient;
- worldwide, the mechanisms must be set so that carbon prices reflect the urgency with which one needs to respond to climate change and the related increasing costs;
- ETS qualifies afforestation and reforestation projects in its market and REDD-based credits are integrated into a global trading scheme improving liquidity through a secondary market;
- REDD policies and rules at global and national level must be instituted and made transparent and clear;
- risk mitigation instruments such as standards, insurances, guarantees covering forest carbon credits are introduced; and
- “REDD companies” with a track record and demonstrated management capacity and enough “quality” projects on a large-enough scale to justify high upfront and transaction costs and enable benchmarking.

Ahead of the “make-or-break” Paris international climate summit later in 2015, some signs of progress are visible, addressing also some of the key concerns expressed above:

- The EU has reached an agreement on its 2030 climate and energy package in preparation for the Paris summit, including the target of reducing GHG emissions by at least 40% by 2030 compared to the 1990s levels. (However, there is no more national binding renewable energy target a before.)
- The EU plans to revitalise its emissions trading system, the world’s first and largest ETS, to meet its 2030 target of reducing GHG emissions by 40 percent compared to 1990 levels. In May 2015, the European Council and Parliament agreed to introduce a Market Stability Reserve by 2019.
- According to experts, the price of EU emission allowances (EUAs) could rise to more than EUR 20 by 2020 from their current level of about EUR 7.5 because of the curbing the excess supply of allowances (Environmental Finance electronic newsletter May 6, 2015). (However, this would leave the European ETS relatively ineffective for four more years.)
- In August 2015, US President Obama announced the aim to cut the US carbon emissions by one third by 2030 compared to the level of 2005.

5.2 Green Bonds and Timberland Investment

Investors with USD 45 trillion of assets under management have made public commitments to climate and responsible investment - green bonds can help them achieve their pledges in fixed income. The interest in green bonds is generated through a combination of factors, including institutional investors becoming more concerned about sustainable development, new investors focused on environmental, social and governance (ESG) performance, and improved fit with the long-term liabilities and risk profiles of institutional investors.

Climate bonds, many of which have forestry elements, are seen as a promising financial instrument to bridge the estimated huge financing gap to mitigate climate change and help the world shift to a low-carbon economy. The Commission on Climate and Tropical Forests (2010) has estimated that around USD 30 billion would be needed annually to halve the deforestation and sustainably manage and enhance forest carbon stocks. The UNFCCC (2007) has estimated that the incremental annual financing needs are about USD 21 billion in 2030. New financing sources are needed; the compliance and voluntary market for carbon offset credits will not generate sufficient funding to meet forestry and other land use mitigation and adaptation financing needs.

The recent emergence of interest in green forest bonds is strongly linked to the broader climate-change related evolution of green bonds. Forest bonds are seen as a key to accelerate private investment in mitigating climate change through forest conservation and sustainable forest management. In 2014, the Swedish forest industry company SCA issued the first labelled bond linked to certified forests, the bond also included a commitment to increase forest cover by 1% each year. Green Investment Solutions is planning to launch a GBP 150 million regulated bond on-going investment in forestry, green energy projects and biomass. The asset is backed by sustainably managed, certified plantation teak (<http://www.greenforestrybond.co.uk>).

Green forest bonds are yet to become an established fixed income asset space but they hold significant promise. Green bonds are already a reality and the market is expected to continue to grow rapidly which will create more interest also for green climate and forest bonds because of the major role forests can play in providing carbon sequestration services and because these services have already been commoditised (carbon credits). Second, there are arguments that mitigation of climate change through forest conservation will not suffice; there is a need also to promote sustainable commercial production-oriented forestry, including establishment of sustainably managed plantations (Dieterle & Larson 2014; Oliver et al. 2014; Garlbert et al. 2013). Third, the investor universe concerned about sustainable, responsible and impact investing/ environmental, social and governance (SRI/ESG) and impact investments is growing; green forest bonds can provide an attractive return/risk profile to the investors while also offering green credentials through advancing social, economic and environmental goals.

This development will have a positive impact on traditional timberland investment in several ways. Over time, green bonds are likely to make forest investments a more established asset class and, in general, improve the credentials of forest investments. In fact, the revised Green Bond Principles (International Capital Market Association 2015; www.icmagroup.org/greenbonds) explicitly refer to sustainable land use, including

sustainable forestry, as an eligible green project category. The revised principles also identify four areas of overarching concern: (i) climate change, (ii) natural-resources depletion, (iii) biodiversity conservation, and (iv) pollution, of which the three first ones are relevant from forestry investment perspective.

Green bonds are also likely to contribute to deepening the timberland market bringing new investors and assets managers, and consequently enhancing the liquidity of forest assets. Finally, forest bonds can be issued to finance commercial sustainable forestry projects similar to what Green Investment Solutions is planning to do.

5.3 Future of Green Forest Bonds

The future for forest bonds looks promising but a number of issues must be sorted out before the forest bond market will start growing. Institutional and impact investors will be increasingly attracted to green bonds, including green forest bonds, provided that they are somehow standardised, transparent, comparable and credible in terms of delivering profit and promised environmental and social benefits.

One of the major challenges is that while returns from sustainable wood production can be predicted quite reliably and sustainably (verified through forest certification), the cash flows to be generated from the markets for forest environmental services, including also carbon, are not yet reliable; in fact they are extremely volatile and depend on changes in political guidance and regulation. The lack of regulatory certainty and the absence of mainstream demand for forestry carbon credits mean that it will be difficult to generate stable revenues that the bond investors demand and prefer. Paradoxically, the cases that would benefit the most from forest bonds are the cases that entail high levels of risk - which is anathema to the bond investors. Further, other ecosystem services, while attractive in theory, are difficult to monetize and do not provide an adequate basis for a quality credit rating that such bonds need (Fu 2012).

Maybe the biggest challenge is related to the actual rationale for green bonds; the prospective issuers of green bonds need to convince investors that the investments are truly “green”. There are major reputational risks; the vast majority of green bonds are self-labelled as “green” by the issuer. However, there is no universally accepted definition of what makes a green bond. Investors and environmental NGOs are increasingly seeking evidence of environmental credentials of investments labelled as green. Green bonds are projected to become an increasingly significant proportion of overall climate finance, meaning increasing concern and scrutiny for the integrity of this market to avoid claims of “green washing”. On April 30, 2015 an alliance of 17 NGOs, including Friends of the Earth and Rainforest Action Network, published an open letter criticizing the new Green Bond Principles for the lack of transparency and avoiding addressing the issue of “what is green” head-on.

It is likely that in future, green bonds must refer to clear and science-based definitions and criteria of what constitutes “green” and commit to third-party, independent verification of sustainability. This type of systems are already well-established for sustainable forestry projects (e.g. FSC or Programme for the Endorsement of Forest Certification-PEFC) or forest carbon project (e.g. Verified Carbon Standard, Gold Standard), which should make it more attractive to use bond proceeds for forestry projects, or issue green forest bonds. KPMG (2015) report “Gearing up for Green Bonds” also argues for independent third-party verification of sustainability in addition to the current main practice of second opinions.

Climate Bonds Initiative (CBI) has been at the forefront in addressing the challenge of verifying that green bond proceeds are really being used to deliver environmental and social benefits, and in particular climate change solutions. CBI has developed the Climate Bond Standard – a screening tool for investors and governments to support investments contributing to low-carbon economy. Bonds complying with the Standard will be certified as ‘Climate Bonds’, a mark that assures their contribution to the delivery of a low-carbon economy. The objective is to credibly verify environmental and social outcomes of activities supported by bond issuances (CBI 2015).

CBI has set up in 2014 the Agriculture & Forestry Technical AFOLU Working Group, to develop eligibility criteria for AFOLU related assets and projects that can be used to back climate bonds. These developments are likely to spur the growth of forest-related green bond market in the future (2014a).⁵

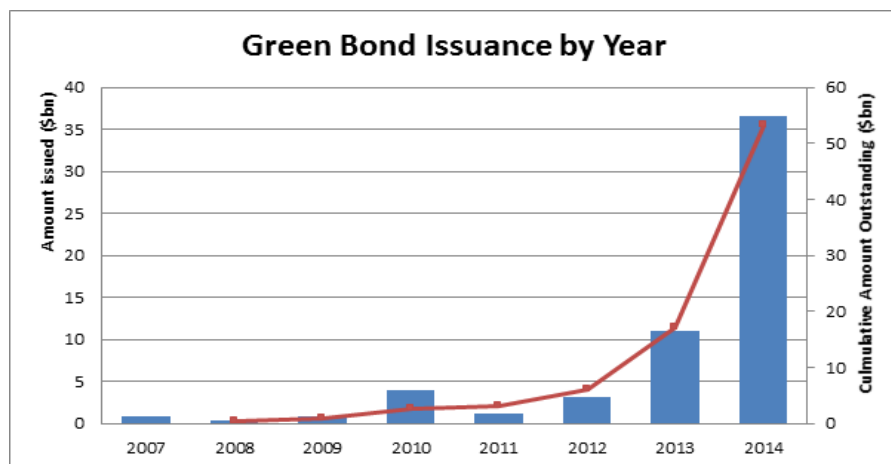
Box 5 Green Bonds, Climate Bonds and Green Forest Bonds

A *green bond* is functionally like any other bond issued by governments, financial institutions or companies but financing is raised from the debt capital market for “green causes”, such as clean energy, improved energy efficiency, climate-mitigation and adaptation, renewable energy, green buildings, sustainable forestry, and other environment-friendly projects, assets or business activities. Green (labelled) forest bonds and *climate bonds* are a sub-set of green bonds which again represent just a tiny share of total global bond market. Green forestry bonds can sometimes be also a sub-set of green climate bonds, when forestry is used to address climate change problems.

The green bond market has grown rapidly since the introduction of the first “labelled” green bond in 2007 by the World Bank. The market has practically “exploded” in the last three years recording a ten-fold increase in 2011-2014 from about USD 3 billion in 2011 to 36.6 billion in 2014, bringing the outstanding green bond issues to about USD 52 billion. KPMG in its report “Gearing up for Green Bonds” (KPMG 2015) is predicting that the market for green bonds could reach USD 100 billion in 2015. The CBI (2014b) has estimated the climate-themed bond universe at about USD 500 billion and uses this as a theoretical estimate of the maximum investable universe for the future labelled Green Bonds market.

Initially, the market was dominated by development finance institutions but since 2013 corporate and commercial bank issues have risen sharply reaching a 30% share of the total green bond markets. Despite this striking trend the green market bond share is still only about 0.5% of the estimated global bond market of USD 100 trillion, and forestry’s share is naturally even less. Largest market sectors are “low carbon” transport, energy and climate finance. The research conducted by CBI and HSBC has identified up to USD 4.2 billion in bonds outstanding clearly aligned with AFOLU sector, representing 1% of the total universe of climate-themed bonds (CBI 2014b). Paper and pulp manufacturers were responsible for the majority of these bonds.

Figure 34 Green Bond Issuance by Year



⁵ Dasos Capital is involved in this work as a member of the Industry Working Group together with representatives from Credit Suisse, Rabobank, World Bank, Hancock Natural Resources Group, and some other organisations associated with investments on forest land.

6. TIMBERLAND INVESTMENT PRIMER AND MARKET UPDATE

6.1 Background on Timberland Investment

Business opportunities for timberland investment have traditionally been driven by

- favourable market prospects for forest industry and wood;
- need for forest ownership restructuring; and
- introduction of efficient investment platforms.

The important drivers for changes in timberland ownership are the companies' need to concentrate on their core business, bolster balance sheets, enhance shareholder value, taxation issues (both for the company divesting and the institutional investor), and improve liquidity. In many cases, the company maintains access to the fibre resource through long-term timber sales agreements with the investors buying the timberland assets. For their part, institutional investors drive the change by seeking investment opportunities in alternative asset classes in order to diversify their investment portfolios. The attractiveness of timberland asset class for institutional investors is largely based on its low correlation with other asset classes. More recently, sustainability credentials and contribution to the "green economy", including the delivery climate change services, have made forestry investments attractive to so called impact investors.

Institutional timberland investment has its origin in the US that still dominates the global timberland investment business. In late 1970s and early 1980s, forest products companies began increasingly to evaluate the strategic role of their timberland holdings and saw potential in selling their timberland, with the proceeds being invested in expanding wood-processing to meet the increasing demand for industrial forest products. Pension funds and other institutions with vast amounts of capital, and a legal mandate to diversify their investments, became logical buyers of this timberland while timberland investment management organisations (TIMOs) emerged to manage the forest assets in the 1980s.

In the US, forest products industries accelerated the divestment of their timberland assets until 2010 when there was only one major forest product company owning timberland in the US. Most of the high-quality forestry assets in New Zealand and Australia are also in the hands of institutional investors. Similar process is taking place also in other countries bringing investors, timberland funds and industry together for mutual benefits to be derived from timberland investing (Haltia, Katila & Anttila 2010).

In 2012-2013, institutional timberland investments were estimated to total about USD 70-85 billion (e.g. according IWC 2013). In 2015, institutional timberland investments, including also other vehicles than funds, have likely already exceeded USD 100 billion. According to RISI about 75% of these investments are in North America.

6.2 Timberland Investment Universe Is Expanding

The global timberland investment universe expansion is driven by several forces. The majority of (institutional) timberland investments are in the US where most of the forests owned by the industry have already been acquired into institutional ownership. Hence, the market will grow much slower in the future based increasingly on the secondary market. The market is characterised by wide - if not perfect - information regarding timberland returns and risks. Unless structural changes, such as environmental policies similar to those of the 1990s will be repeated, the expected reward of timberland investing is likely to set at the level determined by the rate biological growth (see e.g. Rinehart 2010). Investors and timberland fund managers are looking for new markets with more attractive return expectations and growth opportunities.

In Europe, Australia and also in Latin America it is becoming more common for forest industry companies to separate forest ownership and management from the core business of producing forest products, or more recently, energy. In Europe, many industrial forest owners are following the American model and divesting their assets. Tornator in Finland and Bergvik Skog in Sweden are examples of successful large-scale industrial

forest asset divesting in Europe. In 2015, Finsilva Plc, one of the largest Nordic independent forest owners divested its forest assets.

The introduction of International Financial Reporting Standards (IFRS) accounting standards has also been driving the ownership change. Since in many cases current balance sheet values for timberland assets have been lower than their fair values, the accounting reform has generally resulted in larger balance sheet values for timberland assets, which as a result, translates into an incentive for timberland asset spin-offs.

It is important to understand that there are also significant differences between the US and Europe although when it comes to the rationale for changes in forest ownership. In the former communist countries in Eastern and Central Europe a lot of forest assets of varying sizes have been privatised and are looking for active managers after the restitution processes. In many countries forests have ended up with owners whose livelihoods do not depend on forestry and who are often so called “absentee” forest owners. The number of smallholdings has also increased as a result of restitution and privatisation.

At the overall European level, the number of smallholdings is vast. In number, almost three-quarters of all private holdings are less than 3 ha. In major study on private forest ownership within EU, twelve countries reported that the fragmentation of private holdings represents a hindrance to sustainable forest management. Small-scale owners often find it more difficult to draw profits than larger entities, and transfer of knowledge and access to infrastructure is more complicated when owners are many (UNECE/FAO 2010). Therefore, there is a great need to consolidate smaller holdings into bigger assets to create more viable management units, including clusters of properties that enjoy economies of scale and make better use of high-technology.

Reducing the passive forest ownership and forest ownership fragmentation has become a major forest policy issue across Europe. Timberland investment funds are increasingly entering these markets and offer a useful vehicle to improve the efficiency of forest management. The general target is to re-establish and increase the number of actively operating forestry entities with sufficient scale for sustainable timber market contribution. New forms of private forest ownership can improve performance through pooling investment, management and marketing capacity.

Despite various privatisation schemes and involvement of the non-state sector at broad in the management of forests, private sector as a whole owns only some 14% of the world’s total forest area. This suggests a significant role for private timberland investing when various state organisations are increasingly allocating production forests or forest land to the private sector for management through various mechanisms. The investable and leasable forestland could be theoretically worth maximum EUR 500 billion globally, with the total value of immediately investable *core* investable timberland representing possibly 30-35% of this total value.

6.3 Global and Regional Timberland Investment Trends

The emergence of global timberland investment is taking place alongside of a major structural change in global forest industry. Rapid population and economic growth in emerging countries are driving the global demand for forest products as discussed in this report. At the same time, the globalisation of the forestry and forest industry combined with the shifting point of gravity for various forest industry products as well as bioenergy have moved the focus of new forestry investments to new areas, including Europe and the emerging countries.

The private sector initiative is driving the establishment of new forest assets, especially in the capital scarce emerging markets. In many cases new investment/financing models are being actively sought for where independent timberland investment and management organisations are linked to industrial investments, including also investments into biomass feedstock for energy production.

The above mentioned trends together explain why during the last ten years the share of non-USA timberland investment has increased and will continue to increase. At first stage, the US-based funds expanded their business primarily to Australia and Latin America; Europe and Africa have also entered the radar of some US investors.

The regional investment trends are also influenced by the market efficiency and information. The US timberland markets have become very efficient, the first round benefits from divesting the assets, including

returns from higher and better uses (HBUs) and rationalising the assets, have been largely tapped. Moreover, the environmental policies applied recently have no more contributed to the increased scarcity of timberland in the fashion of the 1990s, and the “spotted owl” effect which reduced wood supply in the North West US and improved the returns from timberland investment in the 1990s has not been repeated (unless the mountain beetle problem affects the US lumber and sawlog markets in the coming years). Consequently the expected returns have dropped.

Similar type of development is taking place also e.g. in Brazil; land owners have very good access to information and good foresight, and consequently land prices reflect also well increasing competition for land. It appears that future expectations are already well capitalised into the value of bare land which makes it difficult to make acceptable returns in these markets. Investors looking for higher returns start moving to frontier markets, or in general to new markets where one can enjoy “early bird” benefits before e.g. regulations concerning ownership may start reducing the benefits.

In the recent five years, funds specialised in timberland investment in emerging markets have been established both in the US and Europe. Currently there are around 25 TIMOs in the US and possibly more than 100 timberland managers worldwide (IWC 2013). Timberland is gradually becoming an established asset in Europe and beyond, following the general historical timberland investment trends of the US but with new variations and new opportunities. NewForests (2013) estimates that the current incremental investible universe of timberland could be around USD 150-200 billion. The Pension Consulting Alliance has estimated the value of global investable core timberland standing at USD 125 billion at the end of 2014 (2015).

In the recent years, institutional timberland investment has been increasing in Europe. First examples were the spin-offs of the forests assets of StoraEnso in Sweden and Finland (Bergvik Skog and Tornator respectively). However, real TIMO type of investments in the Baltic countries, Romania and Finland started only in late 2000s. There have been institutional timberland investments also in Ireland, Poland Spain and the UK. Most recently, in April 2015, Dasos acquired the majority of Finsilva Plc. Finsilva Plc was one of the largest independent forest owners in the Northern Europe holding 130 000 hectares of forests mainly in the Central and Southern Finland. International Woodland Company (IWC) estimates that currently about USD 7 billion of timberland investments are currently under institutional ownership in Europe (Pagh 2015).

6.4 Timberland Asset Characteristics

Timberland investment has evolved substantially during the last 25 years. However, the basic fundamentals, which explain the attractiveness of this asset class especially to the institutional investors, have remained the same. Institutional investment managers have been attracted to timberland because of:

- attractive risk-return profile supported by historical trend;
- portfolio diversification benefits due to low correlation with other asset classes; and
- inflation hedging characteristics.

Institutional investors are commonly placing timberland investments in their alternative investment of the real estate portfolios. Some may also place timberland in a natural resource allocation while for example CalPERS has placed timberland in a category of “inflation hedge” products. With its long investment horizon (up to 10 years), timberland is attractive asset to match the long-term perspective of pension funds, and endowment and foundation spending requirements.

6.4.1 Timberland Provides Favourable Risk-adjusted Returns

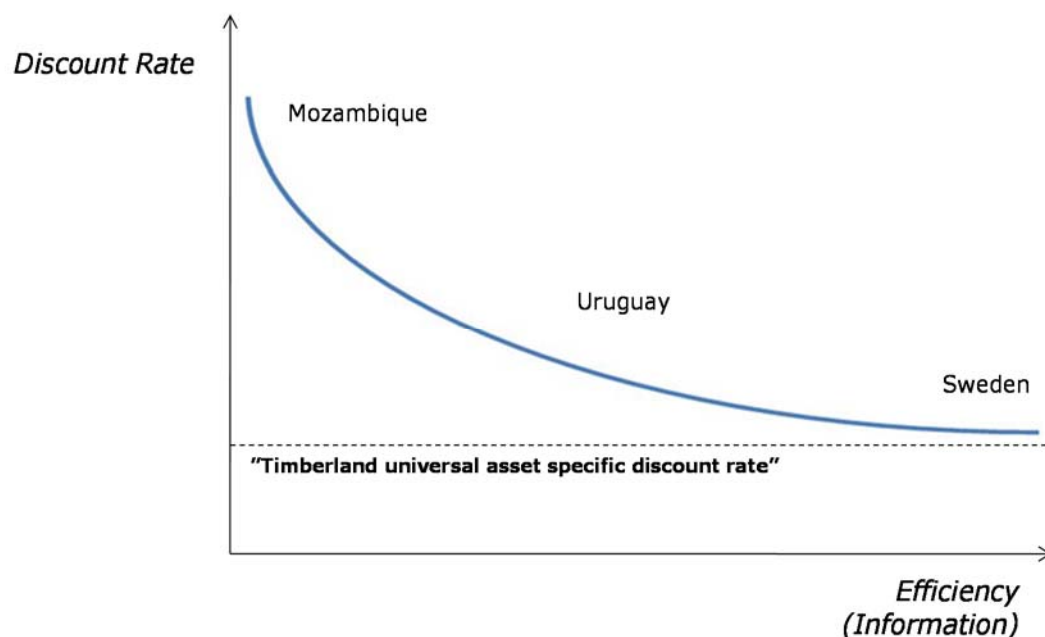
Timberland, as represented by the National Council of Real Estate Investment Fiduciaries (NCREIF) Timberland Index, has performed well against other assets, yielding an annualized return of 12.3% in 1987-2014. However, it should be noted that the returns in the US have been over the last ten years levelling closer to the rate of biological growth. The average annual nominal return in the last five years has been about 6%, with rates around 10% during the last two years, though.

When considering timberland investment returns and risks at a more micro level, it is important to understand that risk adjusted returns vary greatly by region. As in case of any (financial) security, the return and scope for arbitrage of timberland investments are related to the “perfectness” of information and “efficiency” of the market:

- Perfect information (*efficient market*). For example, the US timberland market and some parts of European market are characterised by nearly perfect information regarding timberland productivity, and the demand for wood and land. The foresight is as good as it can be, and as a consequence the expected timberland return is largely determined by the rate of biological growth (in addition to possible efficiency gap in the management of each specific asset).
- Accumulating information (*converging efficiency*) - Ex-frontier timberland markets. Regions, such as e.g. Uruguay, Southern Brazil and Chile, are characterised by fast-growing species, including Eucalyptus and various pine trees. However, the rapid biological growth rate does not automatically translate into high economic returns. Given the increasingly well-established market for wood in these regions, the recently developed foresight for wood use and the information on the limited availability of land, the biological growth potential has gradually become capitalized in the land value. In consequence, the expected timberland return in the reached equilibrium typically exceeds the return in the US market only by an amount associated with the country risk premium. In addition, there may be premium available depending on the uncertainty related to the possible additional profit from improved (future) tree genetics and forest management efficiency.
- Lacking information (*inefficient market*) - Frontier timberland market. Especially in Africa and Asia – but also in some parts of Europe – the tree grower often remains uncertain what the market for the just planted trees will be. At the point of establishing a plantation or acquiring a timberland asset, there is no information on the existence of future local market or on prices of mature timber. At the extreme, the forest plantation has to be established as a non-profit (or indeed negative profit) venture unless the market will not develop while the trees are growing. The forest owner will carry the risk whether she will be compensated at all by biological growth – as well as possibly by increasing land and wood prices with the evolution of the market. In case of success, the forest owner will benefit of arbitrage and be fully compensated for the risk taken. The reward clearly exceeds the rate of biological growth due to increased wood and land prices, plus naturally due to the premium corresponding to the country risk.

It should be taken into account that timberland *per se* is not a homogeneous asset. There is no real (direct) link, e.g. between the markets for teak (*Tectona grandis*) sawlogs and Norway Spruce (*Picea abies*) pulpwood. Hence, the efficiency argument with its implications, including asset specific return and discount rate characteristics, should be taken to apply to each sub-market of timberland separately (Figure 35).

Figure 35 Timberland Investment Discount Rate as Function of Efficiency



Source: Dasos Capital 2015

6.4.2 Sources of Timberland Investment Returns

Timberland returns are driven by three major factors, which are:

- capital appreciation consisting mainly of biological growth (volume growth and value growth) but also changes in timber and land prices;
- mitigation of asset inefficiencies; and
- mitigation of market inefficiencies.

The effect of biological growth on timberland return comes from two sources; (i) *volume growth*, and (ii) *value growth*. *Volume growth* of the forest varies considerably depending on the region, growing conditions (soils, water availability, temperature patterns), and quality of forest management. The latter is very important since a capable manager can greatly enhance returns by enhancing growth; e.g. in case of fast growing plantations up to 50% growth improvements possible with right genetic material.

Value growth refers to a change in the composition of the tree/growing stock; when the tree grows in volume it also turns into higher unit-value (EUR/m³) products (in-growth), i.e. from low-value small-sized trees to high-value, large-sized logs. Some European timberland markets may appear very competitive due to reached high unit value of trees (compensating longer rotation/slower volume growth) compared with frontier return perspectives as discussed above.

Above all, the biological growth is independent from macroeconomic conditions or financial market performance. Low correlation of timberland with financial securities is largely due to the independence of biological growth. In case of low cycle with decreasing wood prices, the forest owner may temporarily postpone timber sales and sell later during rising cycle a larger volume given the nature of the growing - and bio-storageable - biological asset. In general, the increasing wood prices accelerate the value increasing effect of the biological growth.

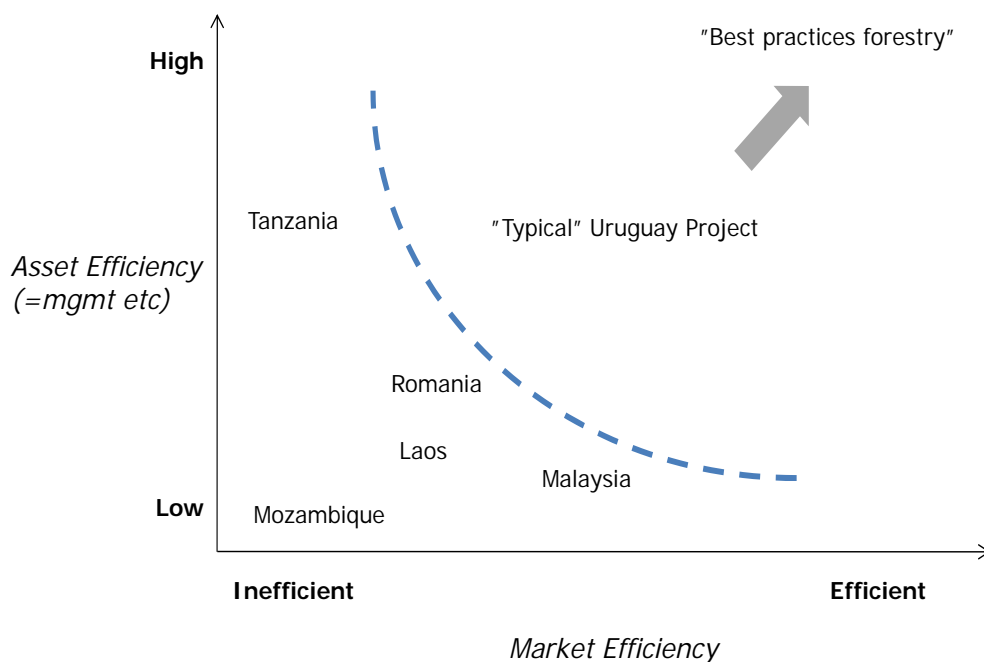
Capital appreciation may also be enhanced by land prices. Increasing competition for land to be used for agriculture and bioenergy production, and recreational or even real estate use, as well as forestry, can provide major upside potential based on land appreciation.

As discussed above, timberland manager can add substantial value based on inefficiencies. *Value is created* through mitigating inefficiencies and achieving higher levels of efficiency. In principle, the following two sources of efficiency are relevant when considering timberland investment from a private equity perspective:

- *asset efficiency*: under-managed and sub-efficiently maintained forest assets/companies
- *market efficiency*: forest assets/companies in inefficient market (new market, developing market, frontier market etc.)

Figure 36 illustrates the efficiency trade-off. Overall efficiency increases towards north-east in Figure 36. The dashed curve is a contour line or isoquant representing a given level of efficiency with changing the efficiency components. At very low levels of market efficiency an increasing asset efficiency is required in order to maintain the overall level of efficiency, and *vice versa*.

Figure 36 Scope for Efficiency Trade-off

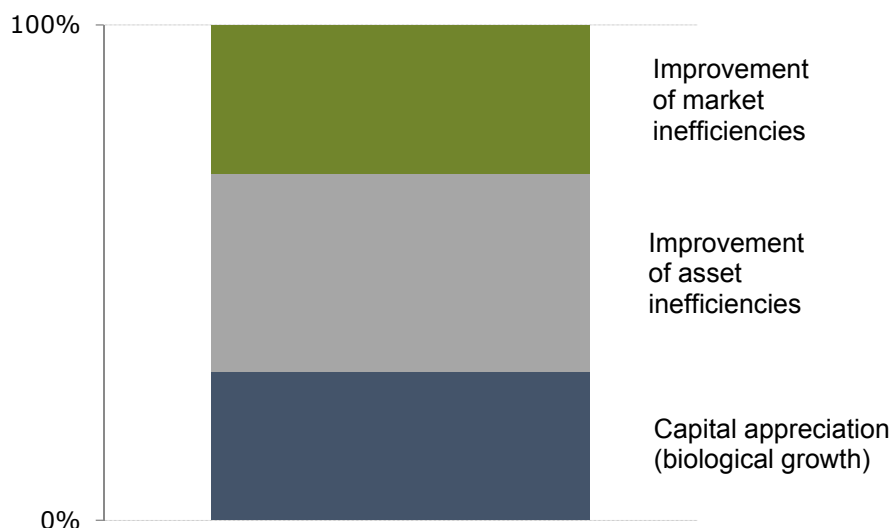


Source: Dasos Capital 2015

Asset efficiency can be increased by improving e.g. silviculture, harvesting and forest management means. The degree of market efficiency is usually benchmarked by the distance of the timberland asset from the market, i.e. the point where the wood is saleable, at stump, at road side, Free on Board (FOB) or Cost, Insurance and Freight (CIF).

It should be noted that efficiency is a relative concept. The benchmark for “good” efficiency is shifting with the development of technology as well as market evolution. The asset efficiency benchmark is affected e.g. by the evolution of tree genetics, harvesting machinery productivity and IT systems available for forest management. But also the market for forest products tends to change over time. In particular, the benchmark for market efficiency has been re-designed by the emergency of the *market for energy wood*, including small dimensions and stumps which did not have any end-use until recently (Figure 37).

Figure 37 Dasos Value Creation Pattern, Case Illustration



Source: Dasos Capital 2015

In addition, the following factors play a role in setting efficiency target from the market viewpoint:

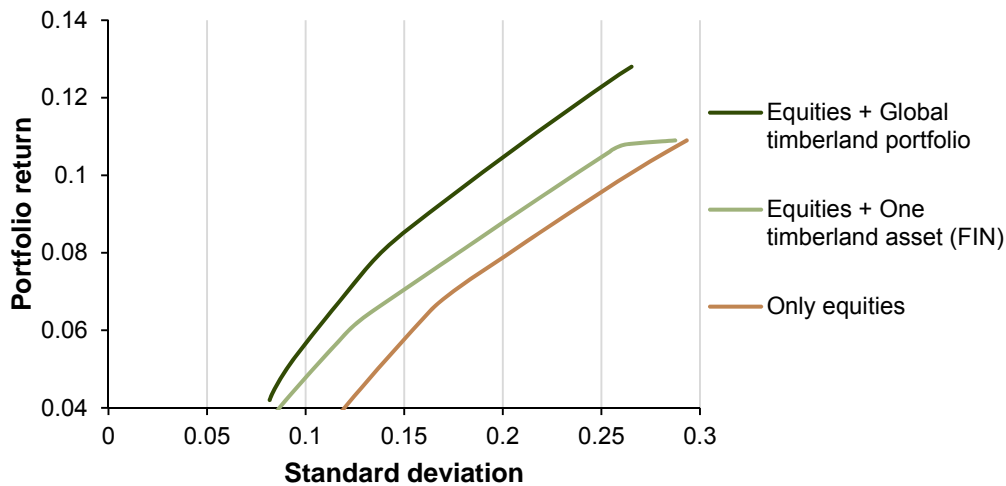
- *HBU* of acquired forests can often provide complementary revenue to timberland investors in a form of selling or leasing land for conservation use or parcelling out land for real estate purposes.
- Over a longer horizon, *carbon forestry* can play a role in timberland investment as return enhancer. Forest carbon credits have the potential to provide significant upside to traditional timberland harvesting revenue model, though associated with some volatility due to great fluctuations of carbon credit prices. It needs to be recognised that the underlying demand drivers related to forest carbon credits are very much different from traditional timberland investment; in principle it is a different product.
- *Payments for other environmental/ecosystem services (PES)*, such as conservation of biodiversity or landscape, are also providing investment opportunities and complementary revenue streams. In the US, conservation easements have provided considerable upside for TIMOs already for years. In Europe, nature values trading and biodiversity conservation programs are under rapid evolution. Private forests owners can at present be compensated e.g. in Austria, Sweden and Finland for forest conservation.

Hence, the hunt for timberland efficiency is characterised by forever continuing rivalry towards continuously shifting efficiency benchmarks, both for asset as well as the market.

6.4.3 Portfolio Diversification Benefits

There is plenty of evidence of timberland investments having low correlation with other asset classes (Lundgren 2005, Lutz 2004, Carroll 2003, and Binkley et al. 2001). This special feature is mainly derived from biological growth factor (trees grow and create value irrespective of business cycles) and forest owner's ability to postpone timber sales during the cyclically low wood prices or other market disturbances without losing the value of standing, harvestable timber. Therefore, diversifying a portfolio with timberland investments is likely to increase returns and decrease risks, or in other words likely to help in achieving a more efficient frontier compared to an investment portfolio or real estate portfolio excluding timberland investments (Dasos Capital 2010, Rauniker et al. 2010, Hancock 2003). Moreover, diversification of the portfolio through various timberland assets with different characteristics (brown/greenfield, tree species, geographic regions, etc.) vs. investing in one timberland asset will generate further benefits in risk-return context (Figure 38).

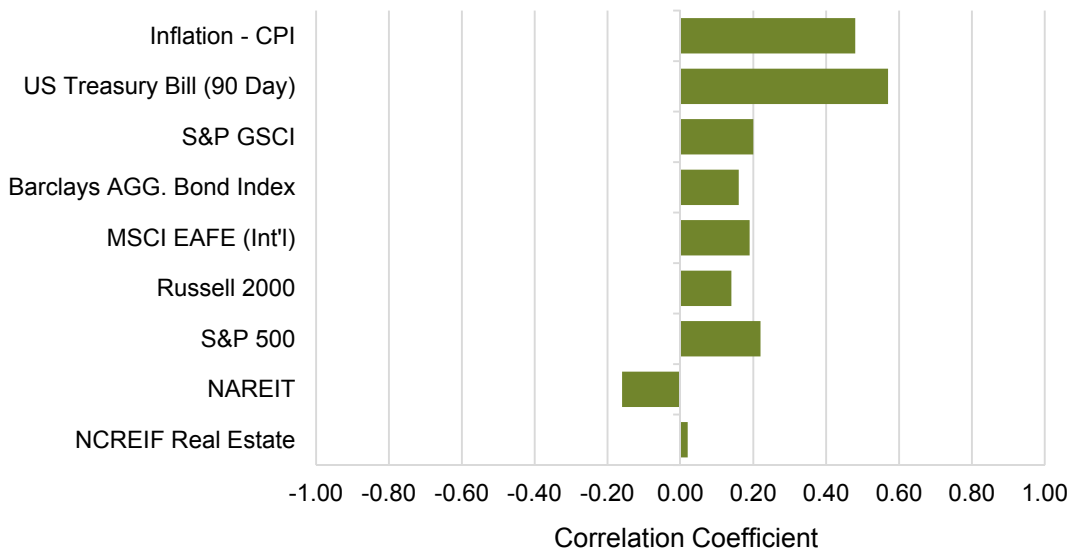
Figure 38 Risk Efficient Frontiers in a Hypothetical Investment Portfolio, 15 % Maximum Forest Asset Weight Limitation



Source: Dasos Capital 2013

Timberland assets have a low correlation to the various asset classes (e.g. only 0.15% with bonds in case of NCREIF). Large economic events, such as the current economic crisis, may cause earlier uncorrelated assets to behave similarly in a short term. It appears that during the recent 3-4 years correlation with other asset classes has increased (Figure 39).

Figure 39 Correlations of Selected Asset Class Indices to the NCREIF Timberland Index 1987 to 2013



Source: Campbell Group 2015 (based on NCREIF, NAREIT, Morningstar, S&P, Federal Reserve)

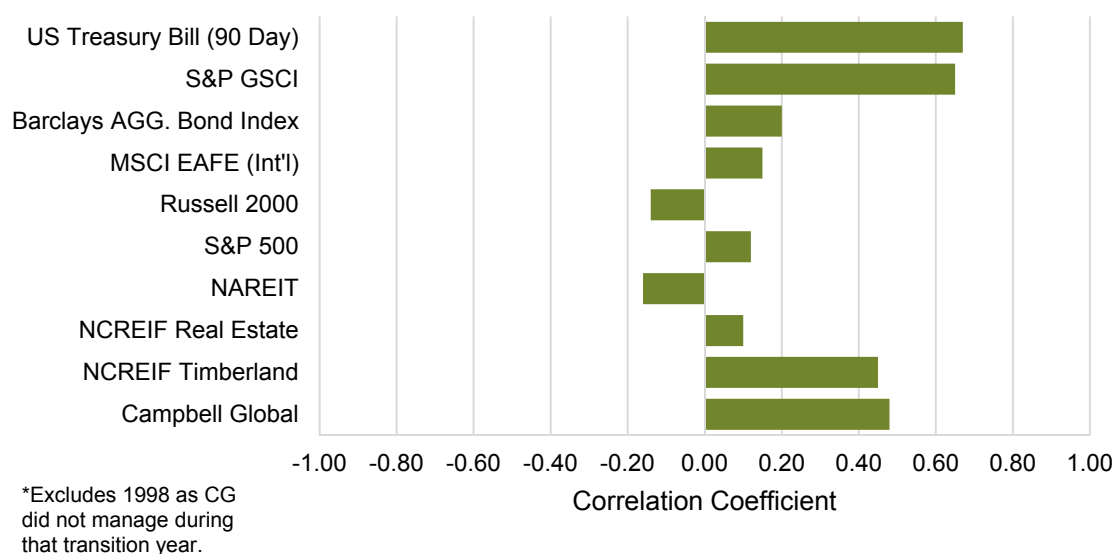
It is important to note that portfolio diversification benefits due to low or no correlation with other asset classes applies to private equity type timberland investment and not to listed vehicles. Private equity timberland assets outperform the market but have low systemic risk, whereas public timberland assets perform similarly to the market. Inclusion of private equity structured timberland investments can improve the efficient frontier, albeit such potential is limited for public-equity timberland properties (Mei and Clutter 2010).

6.4.4 Timberland Investments as an Inflation Hedge

According to research, timberland is correlated positively with inflation especially over longer periods (Hancock 2009, Lundgren 2005, Lausti 2004, Binkley et al. 1993). Therefore, timberland investments can be used as a hedge against inflation. This is also supported by a study made by Lutz (2007), concluding that a geographically diversified timberland investment portfolio acts as an inflation hedge. It needs to be noted that inflation hedge applies specifically to unanticipated inflation.

As Figure 40 suggests, timber appears to hedge inflation over long run. It is important to recognise, however, that growing stock values do not, in short run, hedge inflation. It is the growth component and land value development which hedge inflation in the long run (Binkley et al. 1993).

Figure 40 Correlation of Selected Asset Class Indices to Inflation in 1987-2013



Source: Campbell 2015 (based on NCREIF, NAREIT, Morningstar, S&P, Federal Reserve)

6.4.5 Decomposing the Timberland Capital Productivity

Timberland capital productivity (TCP) or profitability is usually expressed as an aggregate figure that is fundamentally a ratio between value of given timberland asset or portfolio of assets plus the net proceeds in the *observation period (1)* and the *base period (0)* value of the asset. Timberland capital productivity can be written in its general form as follows:

$$TCP_{General} = \frac{Timberland\ value_1 + Revenues_1 - Costs_1}{Timberland\ value_0}$$

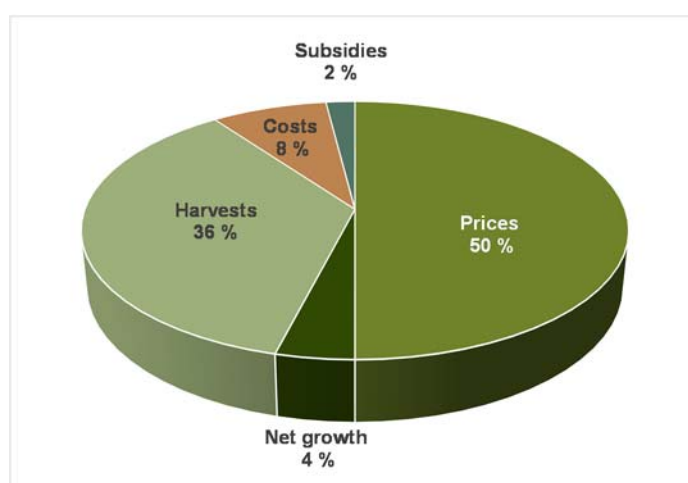
The above formulation allows one to allocate the aggregate return into an appreciation component and a cash flow-based revenue component, which is the practice followed by the original NCREIF Timberland. In fund performance indices, such as in the NCREIF Timberland Fund and Separate Account Index, the property values and revenues are captured into the net asset values or aggregate returns reported by the funds which makes the separation impossible. However, even this two-way split is only a partial decomposition since it just divides the different monetary contributions under two new labels instead of one. To make the split more profound it is essential to separate the capital productivity into separated contributions of prices, costs, harvests and growth. The profound decomposition enables the users of the index to evaluate and observe the prospects of timberlands in greater detail.

For example, Metla (2012) calculates annual returns for Finnish private forest based on their inventoried liquidation value. Mathematically we arrive at the following formulation for timberland return:

$$TCP_{Metla} = \ln \left(\frac{\sum_{i=1}^n p_{1,i} (q_{0,i} + \gamma_{1,i} + h_{1,i}) - C_1}{\sum_{i=1}^n p_{0,i} q_{0,i}} \right)$$

where i represents timber assortment, q growing stock volume, γ net growth volume, h harvest volume and C costs. It is possible to decompose the different return components in the equation into their own sub-indices. This decomposition process is a delicate stage in timberland productivity measurement and it can be done by following different principles, and therefore different sub-indices for same phenomena will result. For a detailed discussion of timberland capital productivity measurement and index decomposition one should see Äärilä and Haltia (2013). Thanks to the full decomposition practiced by Metla it is possible, for example, to calculate the relative contributions of different return components as presented in Figure 41.

Figure 41 Average Relative Contributions of Different Timberland Return Components of Finnish Private Forests in 2001-2011



Source: Metla 2012

6.5 Timberland Investment and Sustainability

In the case of more common asset classes, such as stocks or private equity, there are often challenges in measuring and demonstrating sustainability performance. This creates challenges for investors who are interested in combining attractive returns with socially and environmentally responsible investment.

Sustainable forestry investments create opportunities to internalise environmental benefits and allow, e.g. in demonstrating how the investment contributes to addressing climate change concerns. In case of forestry investments, investors interested in promoting sustainability may rely on annual internationally accredited third-party assessments of individual project's compliance with social and environmental performance standards. There are two international (global) certification schemes - FSC and PEFC - with such standards and verification of compliance through independent accredited third party audits.

In April 2015, the total certified area, in accordance with either PEFC or FSC standards, reached 447 million hectares; or about 11 % of the total global forest area (4.03 billion hectares). Two-thirds of all certified forests globally are certified to PEFC. Most of the certified forests are in Europe and North America. Although the area under certification has been increasing steadily, in Asia and Latin America most of the world's forests are still uncertified.

There is an overlap in the two schemes, estimated at 7.5 million ha, i.e. these are forests that are certified under both the FSC and PEFC. In Finland, 20 million hectares is PEFC-certified and 1 million hectares FSC-certified bringing the total share of certified forests to about 91%, whereas the average in Western Europe in mid-2014 was 63.4%. In contrast, in two major forestry countries, i.e. Brazil and Indonesia, the role

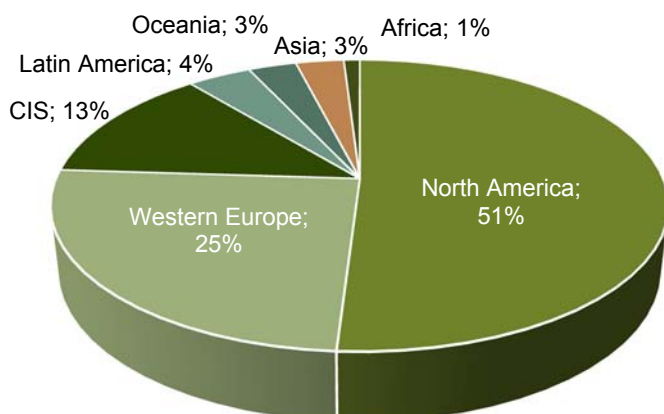
certification is still marginal: in Brazil 1.3% of the total forest area is under internationally accredited certification and in Indonesia 2% (Table 1 and Figure 42).

Table 1 Certified Areas of Total Forest Area in mid-2014

Region	Relative Forest Area Certified (%)
North America	36
Western Europe	63.4
CIS	6.6
Oceania	6.6
Africa	1
Latin America	1.7
Asia	2.4
Total	10.7

Source: PEFC 2014, FSC 2014

Figure 42 Approximate Regional Shares of Total (PEFC, FSC) Certified Forests in 2014



Source: PEFC 2014; FSC 2014

Forest certification helps with monitoring sustainability performance and provides useful information for asset managers to improve the quality of management and find out ways to create value through improved sustainability. For external investors certification is an important independent tool for ensuring compliance, e.g. with various international agreements and national legislation. In a way, it can serve as a management tool for investors to mitigate image risks.

The above statistics must be interpreted with caution. Naturally, they provide an indication of the overall quality of forest management and governance worldwide and in individual countries and forest management units. On the other hand, in many countries not all sustainably managed have been certified because there has been no market benefits in sight, particularly when wood and wood products are sold to domestic markets. But e.g. in Latin America and Asia, a capable forest investors and manager can have the forests certified as sustainably managed, allowing differentiation in the markets and value-creation. Socially and environmentally responsible timberland funds have investment policies which require certification of all their forest assets under management.

In addition to sustainability certification, it is also possible to certify that the wood used in processing comes from legal and sustainable sources. This type of “chain of custody” third-party certification is commonly used e.g. by the forest industry and trade intermediaries as part of their quality assurance process and demonstration of legal origin of their products.

Box 6 Sustainability of Wood-based Bioenergy Production

Sustainability of bioenergy production, including the use of solid biomass, has emerged as a major issue particularly in Europe. The EC Renewable Energy Directive (EC 2009) has binding sustainability criteria for biofuels. However, no such binding criteria exist for solid biomass including woody biomass. The EC’s energy department attempted to bring forward sustainability criteria for biomass in 2013-2014 but the plan was abandoned due to strong opposition from other departments, as well countries with large forestry sectors and forest industry. The argument was that there are already several well-established instruments in place, which support and guarantee sustainable land use and forest management and regulate timber markets at the EU level, and further, voluntary forest certification schemes, such as FSC and PEFC address also address sustainability woody biomass production.

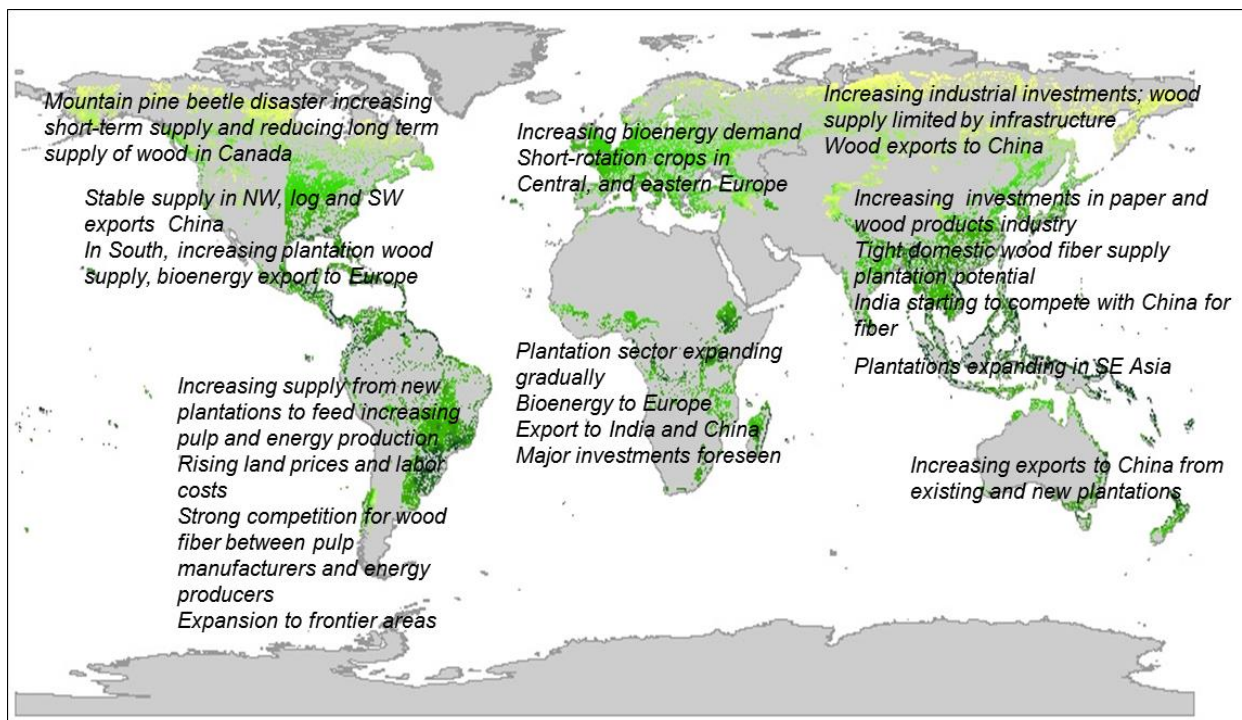
In 2013, a voluntary market-driven scheme called the Sustainable Biomass Partnership (SBP) was established. SBP is an industry-led initiative formed in 2013 by major European utilities that use biomass, mostly in the form of wood pellets, in large thermal power plants. SBP introduced in 2015 a standard under which the pellet mills and other biomass producers can demonstrate the sustainable origin of woody biomass, and also provide data that can be used to assess carbon impacts. The standard recognises the credibility of existing and well-proven forest certification schemes, the FSC and the PEFC schemes.

7. OPPORTUNITIES FOR FOREST INDUSTRY AND TIMBERLAND INVESTMENT

7.1 Global Trends and Environment for Timberland Investment

How forestry can help with meeting the increasing demand for forest products and wood sustainably, and addressing climate change and energy security challenges and opportunities, will shape the investment opportunities for timberland. The ongoing shift from a fossil-fuel based economy to a low-carbon “Green Economy” will enhance the role of forest sector cutting across many sectors from “green” construction to sustainable energy production. It is apparent that forestry will play an increasingly important role in contributing to the climate change mitigation through sustainable forest management and conservation, and enhancing sustainable delivery of wood-based bioenergy. At the same time, the growing population and GDP, driven especially by the emerging countries, will create regional imbalances influencing forest production and trade flows. Figure 43 summarises the key development trends and their impacts on forestry and forest industry investments and flow of forest products in different regions and key countries.

Figure 43 Overview of Key Global Forest Trends and Their Impacts on Investment and Trade Flows



7.2 Long-term Markets Fundamentals for Timberland Investment Are Sound

The global demand prospects for all industrial forest products and wood biomass are good, naturally with regional variations. Pulp and paper demand is driven very much by China, and in future India and also some other emerging countries. Use of wood and wood-based panel products will increase throughout the world. Demand for sawlogs will maintain its dominant position in terms of value although the largest increase in wood volume in Europe is largely linked to bioenergy demand.

Wood biomass demand for energy use will grow significantly in Europe during the next 30 years, helping simultaneously to meet energy demand and contribute to the greening of the economy through reduced carbon footprint. Replacing only 1% of the total primary energy consumption in EU27 would require over 90 million m³ of wood corresponding to about 20% of the current industrial wood use in Europe.

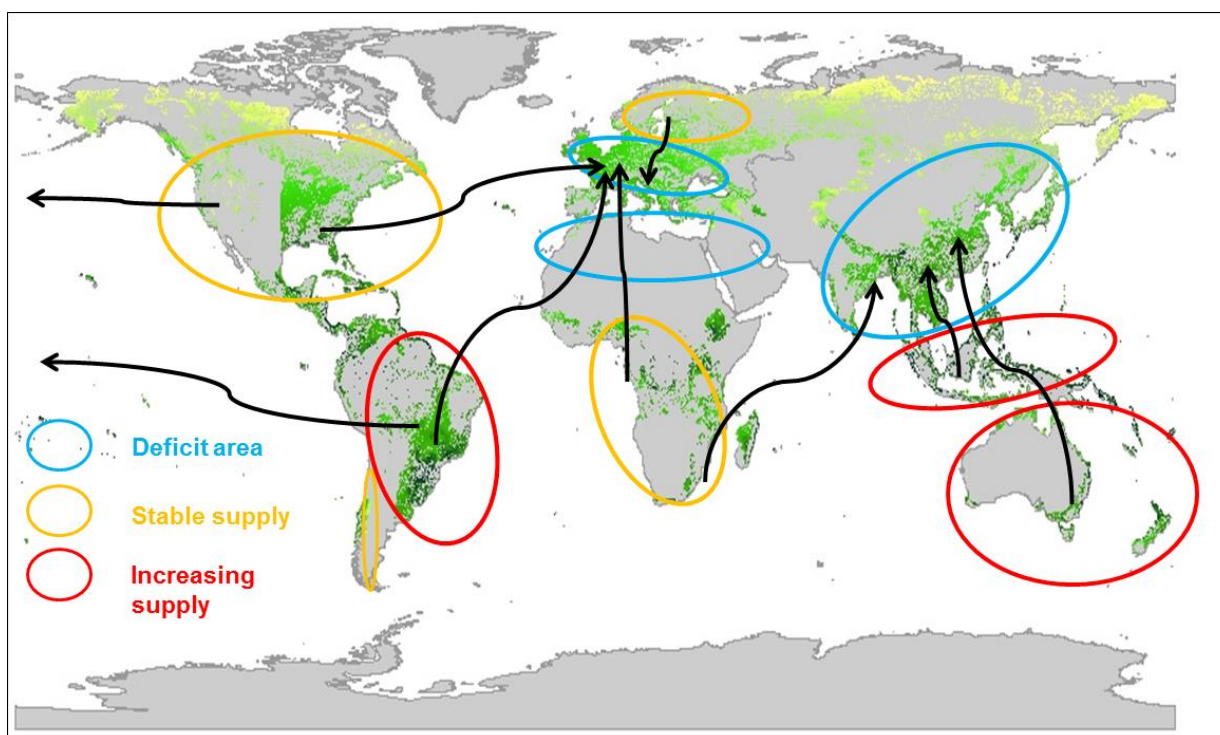
Green building is expected to grow rapidly particularly in some European countries, such as the UK, France, and Finland. Sawlogs will remain a key revenue earner for most forest owners due to increasing demand for construction wood and high price in relation to pulpwood. Further, sawlog production in most cases can be combined with production of pulpwood and waste wood for pulping, and energy production and use.

Wood industry is quickly transforming into high-tech bio-combine industry that integrates forest products with heat, fuel, electricity, bio-chemical product and even food stuff production. These developments combined with rapid demand growth for forest products and bioenergy in the emerging markets, and carbon sequestration services worldwide imply increasing demand for forest assets.

7.3 Major Forest Investments Are Needed To Meet the Future Needs

The gap between sustainable supply of wood and demand for wood is increasing in the coming decades. Over time forests are becoming an increasingly scarce resource, resulting in positive long-term price development and incentives to expand the forest resource base through new, more productive plantations and more efficient management of existing plantations and natural forests. Figure 44 identifies three biggest regional wood fibre gap areas: Asia with China and India at the forefront, Europe, and Middle East and North Africa region.

Figure 44 Regional Wood Fibre Gaps and Wood Fibre Flows



Dasos has estimated that about 45-55 million hectares of new industrial planted forests (both fast growing plantations and semi-managed planted forests) would be needed worldwide to fill the projected roundwood gap of some 700 million m³ in 2030. This would require investments in the range of EUR 80-100 billion in the coming two decades. If major investments are not realised, the remaining natural forests will be put under increasing pressure since the wood must simply come from somewhere. Most of the investments in fast-growing plantations will take place in Latin America, South East Asia and also in Australia/New Zealand which will increase their supply especially to China and India.

There are also opportunities to increase sustainable production of wood from the managed natural forests in Europe, and make better use of the current growth potential. The area of forest available for wood supply has increased by more than 4 million hectares since 2000. At the same time the growing stock has grown by over 12%, to almost 22 billion cubic meters, while only around 60% of the annual growth is being harvested. Further,

there is potential to mobilise wood biomass from various sources, including improved utilisation of existing forests and waste.

Forest industry and energy companies will look for ways of ensuring adequate wood fibre supplies both through better mobilisation of existing resources but also through investing in new assets. This is where timberland investment sector can play an important role through mobilising and investing funds for forestry development either alone or through partnerships with industrial players and energy companies.

In case of many European countries, the investment in more productive forestry – be it for forest industry or energy use – will also require rationalisation of forest assets. Especially in the former communist countries in Eastern and Central Europe countries, forest ownership is very fragmented and there are many absentee forest owners who are not really managing their assets. Timberland investing using various platforms can be very useful vehicle for rationalising forest ownership in Europe and improving the efficiency and profitability of forest management. It is also envisaged that restructuring of both industrial and state forest ownership and investments into new assets outside the US will provide investors in Scandinavia and rest of Europe with excellent opportunities to diversify their investments.

This report makes a strong point that the market fundamentals underlying timberland investment are sound and the emerging trends create new investment opportunities. At the same time, it is apparent that there are so many factors at play - sometimes working towards the same direction and sometimes towards opposite direction – that it is crucial to understand the sector and underlying dynamic demand drivers well. Finally, the recent and expected developments will not affect the inherent attractive features of this asset class. On the contrary, increasingly efficient, sustainable forest management aimed at meeting the industry's needs profitably through investments into existing natural forest and expanding the plantation base is more important than ever.

In the long term, the basic characteristics of timberland assets related to relatively stable and non-correlated concept of biological tree growth will prevail and result in stability when compared to other investments. In the evolving quite complex environment, timberland will continue as a steady asset with increasing recognition in Europe, Asia and Latin America as an asset playing an important role in institutional portfolios.

7.4 Is the Pendulum Swinging Back in Long-fibered Pulpwood?

Paper is increasingly produced where the market prospects are the best, whereas pulp is produced close to the fibre source. This is mainly due to transport economics: some 5 tonnes of wood is required for 1 tonne of pulp whereas wood pulp is only one of the inputs required in paper manufacturing. As emerging countries offer the best long-term market prospects for paper and wood products and good growing conditions for fast-growing plantations, both production and fibre production have been shifting increasingly to Latin America and Asia.

In the US and Scandinavia, newsprint and pulping capacity has been reduced because of declining demand for newsprint and other communication paper grades. At the same time, substantial increase in the paper production is taking place particularly in China that is being fed wood chips and pulp by South East Asian and South American countries. Recently, some of the biggest pulp and paper complexes - including both processing facilities and fast-growing plantations - have been built in Asia and South America.

However, the cost advantage of these emerging countries appears to be eroding, especially considering new greenfield projects. Growing - even escalating - land prices in Latin America, e.g. in many parts of Brazil and Uruguay combined with rapidly growing labour costs, have made investments in new plantations less attractive. For example, in Brazil minimum salaries increased six fold (in real terms) in two decades. In the 1970s labour costs were marginal but in 2013 they accounted for 42% of eucalyptus wood costs at mill gate. In the late 1990s/early 2000s average land costs (for forest plantation development) in Brazil ranged between USD 500-1 000 per hectare; today prices in the same areas can average USD 2 500-3 000 per hectare, while at the same time share of acquired land that can be used for commercial plantations has declined to 50% due to new government policies. In Mata Grosso, land suitable for eucalyptus can cost USD 3 500 per hectare. In Uruguay, forest-related transaction prices increased from USD 800-900 per hectare to USD 3 000 per hectare in 2004-2014 (Flynn 2015).

The total cost of establishing a plantation has reached USD 6 500-7 000 per hectare (Dasos Capital 2015). According to Pihlajamäki & Pastila (2015) wood cost development is eroding the cost competitiveness of

Brazilian fibre production. The marginal cost of pulp wood in many parts of Brazil and Uruguay is already at parity with the Scandinavian marginal cost when the price of bare land is also considered.

There is increasing competition for land because of expansion of agriculture, livestock, and bioenergy production, infrastructure development and also expansion of conservation areas. In many Latin American countries, there is land available at a competitive price but they are often located in more remote areas with weak infrastructure and too far from the local industry or export market. In Asia, it is difficult to find large enough homogenous areas due to very high population density and there is also increasing competition for land from various sources, which results not only in higher prices but increasing social risks. In Africa, political uncertainty, unclear land tenure issues, weak information basis and research knowledge, as well as governance problems (including corruption) act as major constraints to significant plantation and pulp and paper investments (Castren et al 2014).

Boreal zone forest areas with unused harvesting potential and high quality of management in stable and efficient countries with good access to best practice technology and qualified labour force have become interesting (again) for industrial and timberland investors. The market prospect for softwood pulp are promising; even in Asia the demand is predicted to increase. In 2015, Metsä Group announced officially the biggest ever investment in the Finnish forest sector, a 1.3 million tonne pulp mill in Äänekoski amounting to an estimated EUR 1.1 billion. The mill will also produce biofuel and new bioproducts. The new bioproduct mill is expected to increase the share of renewable energy in Finland by about 2%.

The Äänekoski mill will use about 6.5 million m³ of wood annually. Another similar size pulp mill is being planned in Kuopio, Finland by a new company called Finnpulp. Several de-bottlenecking investments in the established capacity are currently taking place. These developments will mean a significant increase in demand for roundwood in Finland.

It is unavoidable that in Europe and the US as well as in Japan the consumption of paper will stagnate, and in case of printing and writing even drop. However, countries such as Finland and Sweden, can increase the exports of other paper products and also softwood pulp as long as they remain competitive. The Metsä Group investment is an example of this type of new investment, and on a large scale. Also, some of the existing plants can be transformed to produce biomaterials and bioenergy; in Finland and Sweden some plants are producing dissolving pulp for the textile industry (Hetemäki 2014).

More of this type of investments can take place in Finland and other Nordic countries, and why not elsewhere in the boreal zone. More value-added processing, new products and services are needed to diversify and create new revenue streams from forests and wood. More research and development and investments are needed to support this development. At the same time, it is crucial for the EU and the “forestry countries” within EU to ensure that the policy and regulatory environment affecting the competitiveness of the pulp and paper, and mechanical forest industry will be maintained or rather improved. This would also contribute to moving towards a greener economy: pulp and paper, sawnwood, renewable bioenergy, bioproducts, and related woody biomass production, and supply and land uses are all integrated with each other.

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