European Commission

Business Innovation Observatory

Sustainable supply of raw materials

A more cost-efficient and sustainable forest sector

Case study 61

Internal Market, Industry, Entrepreneurship and SMEs

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Business Innovation Observatory
Contract No 190/PP/ENT/CIP/12/C/N03C01

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European Union, February 2016.

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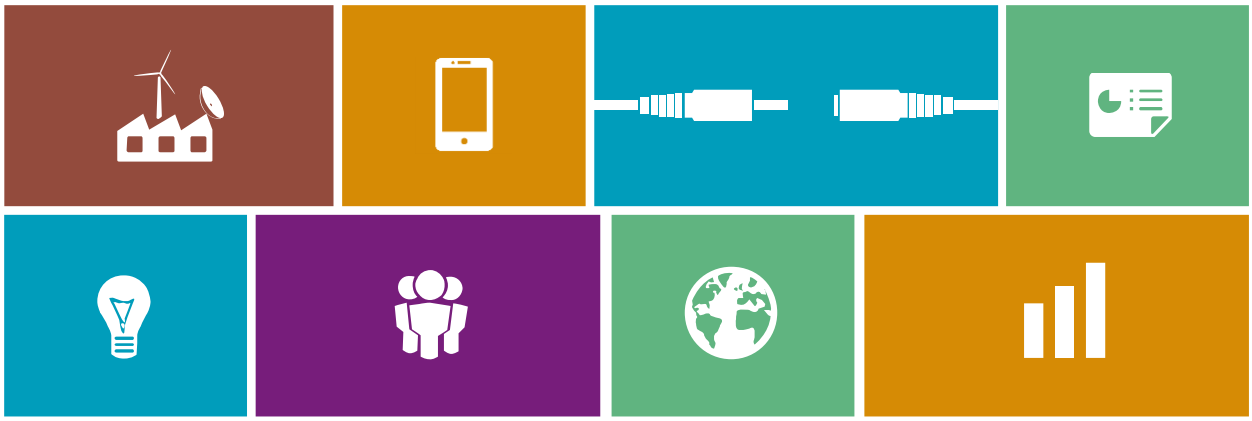


1. Executive summary

Innovative solutions for the sourcing of raw materials are an important objective to help generate economic growth and reduce European dependence on foreign imports, especially in the context of growing demand. This case study presents the latest innovations in the wood-harvesting sector.

The forest-based industry value chain encompasses the management of existing forests or the planting and subsequent management of new ones, known as forestry. Forests are harvested for the wood, after which the wood is processed in order to produce wood products sold on the market. This study presents companies which became successful through business innovations across that value chain. Their innovativeness results from the introduction of virtuous wood harvesting practices, as well as from achieving greater cost-efficiencies and producing higher-value products.

The EU forest-based industries constitute one of Europe's largest industrial sectors, accounting for around 10 per cent of European manufacturing industry's total value of production, value-added and employment. The forest products market grew by 1.3 per cent in 2013 to reach a value of EUR 110 billion, a volume of around 695.5 million m^3. By 2018, it will reach a value of around EUR 129 billion. There are approximately 456,000 companies operating in the sector today. Along with wood harvesting companies, this number includes companies further downstream *i.a.* woodworking industries, the furniture industry, pulp and paper manufacturing and converting industries, and the printing industry.

The forest-based sector is highly globalised, and has close links with markets further downstream, which in recent times have negatively impacted it. This is particularly the case with the construction, as well as the paper and pulp markets. In addition, it suffers from a lack of unifying regulation at the level of the Single Market and is at times perceived as somewhat protectionist.

The forest-based sector is heavily influenced by a number of drivers and barriers, both market- and policy-driven. Given the important influence of forests for mitigating climate change and environmental preservation, the sector is heavily impacted by environmental policy as well as the carbon market. In this context innovations in the use of wood and new wood products are also helping diversify its potential and drive growth in the market.

What can be the role of the policy makers? In order to support the forest-based industry and drive business innovation, environmental policy driving virtuous wood harvesting and good forest management should be continued. Second, given its high labour intensity, Member States should put more focus on the wood-harvesting sector jobs in their general labour policies. Third, investment into research and development for the wood-harvesting sector should continue, as it helps to develop new wood products. Fourth, an alignment amongst Member States on wood standards and regulations could be encouraged across the Single Market. Finally, support systems to help European companies operate on new markets could be envisaged.

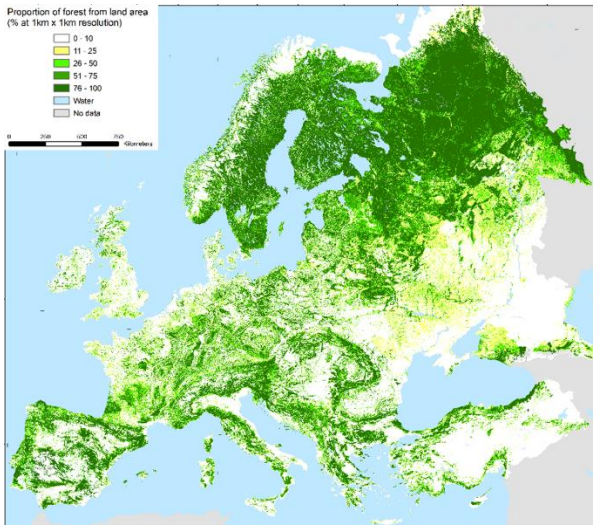
2. A more cost-efficient and sustainable forest-based industry

2.1. Trend presentation

Innovative solutions for the sourcing of raw materials help generate economic growth and reduce European dependence on foreign imports. Doing so requires both an efficient and sustainable supply of metals, minerals and wood products if growing demand for these products is to be met. Meeting this demand is key, given the 30 million jobs in the EU that are impacted by raw material sourcing, in many key economic sectors such as automotive, aerospace, and renewable energy.[1] As part of a series on the latest trend in the sustainable supply of raw materials, this case study will present the latest innovations in the forest-based sector with regards to the harvesting and processing of wood.

Forests and other wooded land represent around 44 per cent of the EU's surface. This area has seen continual growth over the last 50 years and the four regions of European woodland (the majority are boreal; along with central; alpine; and Mediterranean types of forest) represent 5 per cent of the world's forests. Over the last 50 years, both their area and the standing timber volume has seen growth.[2]

Figure 1: The coverage of forest land across Europe



Source: Kempeneers et al. 2011[3]

While forest land can be found across all of Europe, the greatest concentrations of woodland are boreal forests, (found in Northern European countries). The ownership of European forests varies between countries but on average 40 per cent are publically owned by the state or local authorities and 60 per cent are privately owned by individuals, companies, or churches.

The forest-based industry, particularly harvesting and sawmilling (processing) of wood, is a mature industry. The EU forest-based industries constitute one of Europe's largest industrial sectors, accounting for around 10% of European manufacturing industry's total value of production, value-added and employment. They provide employment and income for some 2.6 million people directly all over the EU, in particular in remote areas, and help the EU's 12 million private forest owners generate economic growth.[2]

Wood is a renewable resource (albeit one that needs to be managed sustainably) that binds carbon-dioxide from the atmosphere as plants photosynthesise in order to generate energy necessary to grow. The typical products of wood harvesting consist of: industrial roundwood, sawnwood, wood panels and sheets, and wood fuels.[4] Wood products can be recycled and reused as renewable energy at the end of their lifecycle like other forest biomass that is unsuitable for processing. Once harvested, wood is then sawmilled or otherwise processed to produce staple products of the forest industry such as pulp, paper, board products, paper goods and packaging. These goods serve to meet the demands of industries such as construction, furniture and carpentry industry and biomass and biofuel refining.[5]

While the harvesting of wood, and the forest-based sector in general, is far from a new industry, there have been innovations in the sector across the different steps of its value chain, which Figure 2 provides a general overview of.

Figure 2: An overview of the forest-based industry value chain

Source: PwC Analysis

New innovations have come from the novel application of technologies into harvesting practices to help improve the planting, management and conservation of forests and how their harvesting is planned. The most prominent innovations on which companies have capitalised over the last three decades has been through the introduction of new mechanisations, tools and techniques used for the harvesting of wood to maximise economic efficiency,[6] or help harvesters (which cut the wood) and forwarders (which move it once cut) move around in previously difficult to

reach places which might have previously made harvesting uneconomical.[7]

In addition, there have been innovations in the processing of wood once harvested to help improve the efficiency of processing. In addition, new innovations have come about in the processing of wood to help create new higher-value products to be sold on the market to meet growing demand for wood products, particularly in new markets.

2.2. Overview of the companies

The following companies have been identified as having become successful companies in part, if not largely, because of their innovations in the wood-harvesting sector. They demonstrate the different means companies have brought innovations to the different parts of the value chain of the market, through the introduction of new technologies or from new or improved processes.

Table 1: Overview of the company cases referred to in this case study

Company	Location	Business innovation	Signals of success
Arbonaut	Finland	Arbonaut, is a world leader in developing information gathering and GIS solutions for forest inventory and natural resource management. The company provides its proprietary ArboLiDAR forest inventory technology which produces estimates such as timber volume and height to serve for forest operational planning and decision-making in boreal zone, as well as in tropical and subtropical plantation environments.	- Recipient of the 2011 North Karelian Chamber of Commerce for Excellence in Education. - Involved in several large public projects including REDD projects. - Recipient of multiple research grants - Globally distributed clients.
Green Resources	Norway/UK	Green Resources is a Norwegian company with its main offices located in London (UK). The company has 45,000 ha of standing forest in East Africa, established through its own planting activities. It is also one of the first companies globally to receive carbon revenue from its plantation forests.	- The company is Africa's largest forestation company and a leader in East African wood manufacturing. - It operates East Africa's largest sawmill in Tanzania. - The company has allegedly planted more new forest than any other organization in Africa since 2000. - Company CEO was the keynote speaker at the World Forestry Congress in 2015. - The EU awarded the company in 2010 a renewable energy grant of EUR 2.4 million for a project on farmer's woodlots and bio-carbon production in Mozambique and Tanzania.
Microtec	Italy	Microtec, founded in 1980, is an Italian company that provides tailor-made wood scanning solutions to client companies involved in the processing of wood such as sawmills.	- Over more than 30 years, the company has acquired clients across the globe for a variety of different types of wood processing. - The CEO, Federico Giudiceandrea was awarded with the 2013 Schweighofer price, an award given to the most innovative companies in the forest-based industry. - Received the ADI Design award for its latest product: the Goldeneye Multi-sensor Quality Scanner.

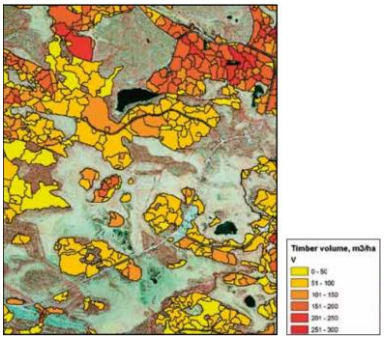
Company	Location	Business innovation	Signals of success
Ponsse	Finland	Ponsse Plc is a sales, maintenance and technology company and a global leader in the field of environmentally friendly cut-to-length forest machines.	- The company's shares are quoted on the NASDAQ OMX Nordic List. - Operates in approximately 40 countries. - Their latest release, the Ponsse Scorpion harvester won the Red Dot Award: for Product Design in 2015.
Triton Resources	Canada	Triton is a privately-held company founded in 2000 and based in British Columbia, Canada, who specialises in the harvesting of wood from underwater forests. Within the underwater logging business, the company is involved in technology design, harvest concession development, inventory assessments, logging services, and eco-wood sales	- In the top 10 for the 2007 Green Product award for Green Building Products. - 2007 Environmental Hall of Fame award. - Cleantech Next 10 Leaders of Tomorrow. - Popular Science Magazine's Best of What's New: GreenTech. - In Top 10 for the Canadian Research Council's Green Building Products. - Finalist for Viatec's Environmental Excellence Award Newsmaker of the Year Finalist. - Listed as one of the 10 Brilliant Companies by Entrepreneur magazine.

Problem 1 – It is important for wood-harvesting to develop and update an inventory of forest land in order to manage and harvest it in a sustainable manner. This task is generally done through manual measurements which is labour-intensive.

arbonaut

Innovative solution 1 – Arbonaut is a Finnish company spun out of the University of Eastern Finland and the Lappeenranta University of Technology. It has developed a solution to measure more accurately and more cost effectively forest inventories using LiDAR technology. The company's proprietary algorithm helps develop an accurate forest inventory of the forest land, and only requires a flyover of the forest land. Not only does this technology allow a more cost effective means of updating forest inventories, but it also facilitates management and planning of harvesting and can help identify and mitigate fire risks.

Arbonaut's LiDAR technology provides an accurate means to update forest inventories.



Source: Arbonaut[8]

Problem 2 – An important problem in the wood-harvesting industry is that of unsustainable harvesting and illegal logging. This impacts the local environment through a destruction of the local flora and fauna, reduces the potential for future woodland, negatively impacts the local community, and has legal implications for companies that engage in illegal logging or purchase wood procured this way.

green RESOURCES

Innovative solution 2 – Green Resources is a company that over more than 20 years has grown and established an African global presence in order to benefit from an economy of scale. Its strategy is based on the sustainable development of the areas in which it operates. The company harvests wood from plantations in Mozambique, Tanzania and Uganda, where the climate and species of trees allow for greater productivity, giving them a competitive advantage over wood sourced in colder climes such as Northern Europe.

Deforestation and illegal logging is increasingly viewed as unacceptable, increasing the demand for wood grown in plantations. The company converts low-yielding grassland and degraded forest to grow the highest-yielding crops suitable for the land areas under the company's management. The focus is on forestry, including growing exotic and indigenous species, but also other crops that make appropriate and profitable use of the available land. Their operations adhere to sustainability principles, minimising the environmental impact.

In addition to this, the company has improved its economic efficiency by collecting wood waste that would otherwise be discarded and converting these into pellets to be used as

biomass fuel. Finally, carbon finance plays a key part of the funding of the company's plantations, which are located in areas where there are no commercial-scale forestry operations. At the same time, investments into the local area provides major benefits to the local populations.

A Green Resources plantation of Eucalyptus (10 months old)

Source: Green Resources[9]

Problem 3 – In order to improve the efficiency of wood processing, companies need to register the species of wood, dimensions and any defects it might have. Automation can help achieve much needed cost-efficiencies.

MiCROTEC

Innovative solution 3 – Microtec has provided personalized solutions for customers since 35 years. As the consolidated global leader in optoelectronic wood grading applications, the company specialises in Multi-Sensor Quality Scanning technologies that include proprietary cameras, lasers and X-ray sensors to optimize, automate and streamline all kind of production processes.

CT Log 360° X-ray CT-Sawing Optimization for logs

Source: Microtec promotional material

Problem 4 – In response to drop in the price of wood as well as economic pressures it is becoming increasingly important for companies engaged in the harvesting of wood to do so in as cost-effective a manner as possible.

PONSSE

Innovative solution 4 – Ponsse has recently released its latest harvester, the Ponsse Scorpion which it says offers the best possible setting for efficient and productive work. The harvester is innovative in that it has eight wheels and an active stabilisation system which detects the direction and position of the crane, and then presses the rear frame in the direction of work. Pressing the rear wheels against the ground and the weight of the rear frame improves the machine's stability significantly when working on one side – including when the machine is moving.

This new award-winning harvester allows harvesting to take place further away from roads (which are both costly to build and have negative environmental impacts) and vitally, allows accessing more difficult-to-reach environments. The unique new crane solution offers excellent visibility in all directions, enabling smooth, flexible working whatever the conditions. Good visibility on both sides of the cabin allows for efficient and non-restricted crane movements for tree felling, and the selection of felling direction and position of piles. Allowing for greater efficiency and minimising any damage caused to the environment.

As the cabin is located in the middle of the machine, the driver can easily see to the extremes of even dense thinning routes. Moreover, the driver is positioned in the middle of the cabin's turning circle, providing an ergonomic work environment for the operator.

The Ponsse Scorpion harvester

Source: Ponsse[10]

Problem 5 – Given the need for sustainable wood supply, alternative sources of wood can help reduce the pressure on living forests and provide alternatives to illegal logging.

TRITON 'underwater harvesting specialists'

Innovative solution 5 – More than 40 million hectares of land have been flooded in the construction of hydroelectric dams and a sizeable amount of trees lie preserved at the bottom of these flooded areas. In addition to being a source of wood, underwater forests pose a safety risk that requires clearing.

Triton has been at the forefront of the underwater logging industry through technology design, harvest concession development, inventory assessments, logging services, and eco-wood sales.

Using its patented SHARC™ and Sawfish™ (pictured below) underwater harvesting systems, Triton recovers standing, submerged timber in a safe, efficient and environmentally-friendly manner.

Triton's Sawfish (left) is a submersible with a saw that harvests wood and attaches floatation devices to bring the logs to the surface for harvesting. The SHARC (right) is their latest harvesting technology which is deployed in tropical reservoirs

Source: (left) Treehugger.com[11] (right) Triton Resources[12]

3. Impact of the trend

The harvesting of wood within the forest-based industry is a staple industry in Europe. With some 180 million hectares of forest land and other wooded land, wood is the most important product sourced from forests.[13] The EU currently harvests less than its annual wood growth, meaning that stocks are both growing as well as ageing. As such the EU has the potential to harvest more wood from its forest land while still being sustainable.[1]

Demand for wood is set to increase as the demand of wood-based products grows for uses in established industries such as furniture and construction, as well as in less traditional markets such as in biomass energy and bio-chemicals. Businesses that offer a means to provide added value to players in this growing market stand to benefit from this, helping generate economic growth and employment in Europe. Additionally, given its nature as a carbon-neutral renewable product, smarter means to harvest and process wood will help achieve European environmental targets and promote sustainability practices in the forest-based sector.

3.1. The market potential of the trend

While the forest-based sector has been important to the European economy for millennia, for construction and for fuel, there is potential through greater innovations to further develop the forest-based industry within the European context, both in terms of sustainable resources and for business creation.

According to the latest Eurostat statistics[14] there are around 180 million hectares of forest and other wooded land, which equates to approximately 42 per cent of all EU landmass. Sweden and Finland have particularly large potential wood resources, with roughly 77 per cent of their respective landmasses being covered by forests. Other countries with extensive relative forest or wooded land include Slovenia where this number stands at 63 per cent, while in Estonia, Spain and Latvia it is around 55 per cent.

As demonstrated by many of the showcased companies, the wood industry has become a globalised market, and has increased in complexity as a result of this. Green Resources for example is a Norwegian company, with offices in London and its operations in Africa. All of the other companies had a globally distributed client list.

New products and technologies have also helped make this an even more competitive market and environmental protection also plays a major role both in terms of processed materials and nature preservation. European, Australian and North American manufacturers are competing with cheaper wood products sourced from the Asian, African and South American markets. The European market of wood-based products has had to respond by enhancing productivity and improving quality, as well as better designing and marketing products.[15]

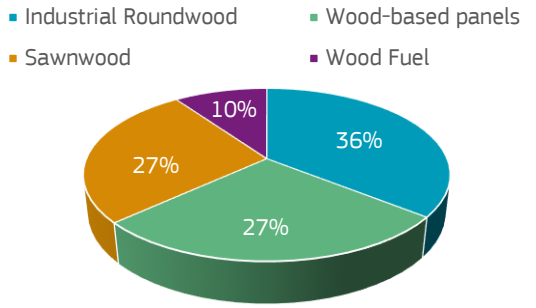
The European forest-based industry grew by 1.3 per cent in 2013 to reach a value of USD 110.1 billion, a volume of around 695.5 million m³.[16] It is forecasted to have a value of around USD 129 billion by 2018 (Figure 3), an increase of 16.8 per cent from 2013. In terms of volume this equates some, 742.1 million m³, an increase of 6.7 per cent since 2013.

Figure 3: A forecast of the value of the European forest-based industry production (excluding roundwood) in $ billion

Source: Marketline[16]

The largest production of roundwood in 2012 was in Sweden (68.9 million m³), followed by Germany, France and Finland (56 million to 50 million m³).[14] Slightly more than one fifth of the EU-28's roundwood production in 2011 was used as wood for fuel, while the remainder was industrial roundwood used either for sawnwood and veneers, or for pulp and paper production. Industrial roundwood occupies the largest share of the European wood industry, followed by wood-based panels, sawnwood, and wood fuel (Figure 4).

Figure 4: The segmentation of the European wood industry by market share in percentage



Source: Marketline[16]

The European forest-based sector is fragmented, with few large incumbents and the leading companies often being vertically integrated. That said, their operations have very little diversification.[16] Smaller companies can develop within the market if their product or service offerings are suitably flexible or niche. In fact, despite 21 per cent of European woodland being protected*, there is a gap between the annual growth of woodland and the amount of wood harvest per annum in Europe, allowing for a potential to further grow the market, and thus in economic growth.

3.2. The socio-economic impact of the trend

The forest-based sector is an important source of employment in Europe

There are approximately 456,000 companies in the forest-based sector in the EU. This includes the activities of companies upstream engaged in forestry as well as those further downstream in the value chain including woodworking industries, the furniture industry, pulp and paper manufacturing and converting industries, and the printing industry. In 2011, the largest workforce involved in the forest-based sector was in Romania, with 49,200 persons. There were also large workforces in Poland (47,400) Germany and Sweden (39,800) and France (28,700 AWUs).† [17]

These companies represent some 21 per cent of all European manufacturing companies. Of particular note is that, with the exception of the pulp and paper manufacturing industries, the majority of wood-based companies later downstream in the value chain i.e. processing, and are more often than not small-to-medium sized enterprises (SMEs). Further upstream in some parts of processing such as sawmilling, in harvesting, and in forestry, companies tend to need to benefit from economies of scale and are, as such, more often large companies.[14]

Between 2005 and 2010 the total number of enterprises within the EU-27's forest-based industries fell by 9.1 per cent at a similar rate to that of the average of the rest of the manufacturing sector (-8.3 per cent).[14] As such, introduction of innovations in this sector and the support of enterprises could help mitigate this trend and support employment in forest-based industries.

Wood is a renewable source of carbon-neutral energy

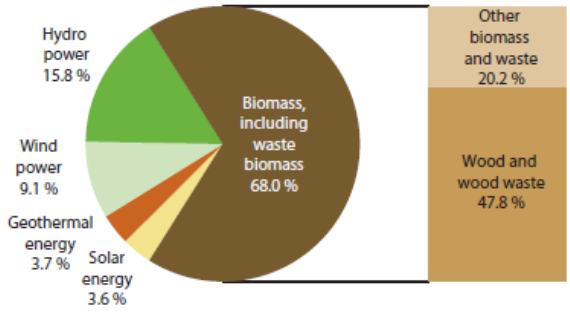
In addition to its use in the multitude of aforementioned markets, wood also has important applications as a source of renewable energy within the European context. As a result, policy interest in energy security and in renewable sources of energy in Europe, combined with relatively high oil and gas prices lead to the recent classification of biomass (from wood amongst others) as a source of renewable energy in Europe.[18] This has meant that while only a carbon-neutral source of energy, a fraction of some energy generation through the combustion of fossil fuels could be fractionally replaced by incorporated wood fuel, generally in the form of wood pellets.[19] Thus contributing to achieving legally binding targets on reductions of GHG emissions.

Energy generation from biomass fuel sources is an important contributor to achieving renewables energies targets. In 2011, it accounted for just under 70 per cent of all gross inland energy consumption of renewables in Europe, of which biomass from wood and wood waste accounted for the largest share (Figure 5). In many EU Member States wood energy is the most important source of renewable energy, particularly in countries like Latvia and Finland. In 2011 it accounted for 4.8 per cent of the total energy consumed in the EU.

* 21 % of European woodland is protected under the Natura 2000 network[13]

† Note: Eurostat information for forestry employment statistics is limited to only 17 EU Member States

Figure 5: Share of renewable energy consumption in 2011 across the EU-28



Source: Eurostat

Virtuous wood harvesting is a means to sequester and store carbon

In addition to being an important biome with a rich variety of fauna and flora and with an intrinsic value to the peoples of Europe, forest land serves an important role in the sequestration of carbon and as such forests act as a carbon sink. The ability of forests to help sequester carbon dioxide that would otherwise be emitted into the atmosphere is an important contributor in the fight against climate change.

Improvements in forest management practices and environmental changes in the post-war era are thought to have led to an upward trend in forest stem volume (and hence sink capacity) from 1960-2005. That said, a European Joint Research Centre (JRC) publication suggests that while at over 24 billion m^3 in area, European forest land is likely reaching a saturation point[20], meaning that plantations would be required to increase this.

A greater reliance on virtuous wood harvesting, new forest management practices and even mitigating the risks of fire, flood and pests can help improve the ability of European forests, and forests in general, to absorb carbon dioxide. As such, the trend has the potential to help further contribute to the reduction of carbon dioxide into the atmosphere.

*"Most significantly: reforestation captures and stores carbon and is the basis for future production of renewable materials". – **Green Resources***

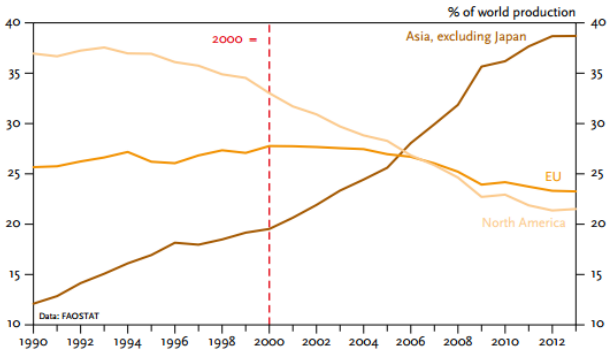
4. Drivers and obstacles

The wood-harvesting sector is heavily impacted by certain drivers and barriers, both market-driven and policy-driven. Given the important influence the sector has in mitigating climate change and environmental preservation, it is heavily impacted by environmental policy as well as the carbon market. New innovations in the use of wood and new wood products are also helping diversify its potential and drive growth in the market. That said, the forest-based sector is highly globalised, and has close links with markets further downstream, which in recent times have negatively impacted it. This is particularly the case with the construction, as well as the paper and pulp markets. In addition, the market suffers from a lack of unifying regulation at the level of the single market.

4.1. The state of the wood market is closely linked with that of the declining construction and paper & pulp markets

Wood products used in construction as well as in paper and pulp account for a sizeable proportion of the forest-based industries. Both of these markets have been in decline in recent history which has a knock-on impact further upstream, affecting companies involved in the processing of wood, its harvesting, even sometimes for companies engaged in forestry activities.

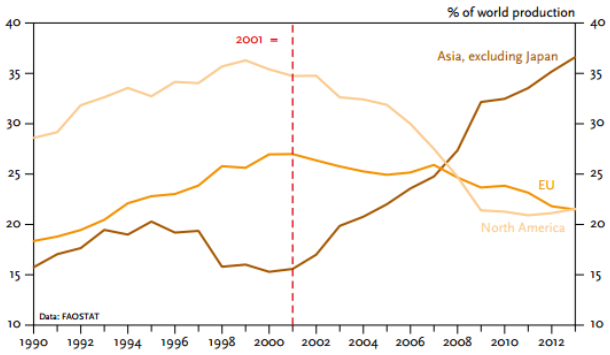
Figure 6: The market share of global paper and pulp production by geographic region



Source: European Forest Institute[21]

The pulp and paper industry has seen decline following the increasing digitisation of written communications and publications. With text messages and emails replacing handwritten letters, and books downloaded onto tablets replacing paperback books (Figure 6)[22]. This pattern of decline has similarly been emulated in similar forest-based industry practices such as sawmilling which is linked to the construction sector (Figure 7).

Figure 7: Global market share of sawn wood and wood panel production, by geographic region



Source: European Forest Institute[21]

Similarly, the construction sector has seen a decline that has had knock on impacts on forest-based industries spurred on by the impact of the sub-prime mortgage crisis.[23] In the USA for example, this resulted in significant production cutbacks and consumption declines in almost all segments of the wood-working industries. Demand for softwood timber dropped 50 per cent from 2005 rates; hardwood timber by 35 per cent; structural panels by 37 per cent; and engineered wood products by 30 per cent.

Figure 8: The employment rate in the European wood, paper sectors as well as the manufacturing sector

Source: European Forest Institute[21]

This vulnerability to market forces is demonstrated by the decline in employment over the last decade. This is exemplified in Figure 8 which shows a greater decline in employment in the European wood-working and paper sectors, than that of the manufacturing sector.

That said, demand for wood as a commodity for the construction sector is expected to increase. The value of wood products and solutions used in construction is predicted double by the year 2030.[5]

4.2. Environmental and forest policy helps encourage investment in the wood-harvesting sector as well as innovation

With only 60 to 70 per cent of the annual forest increment being cut, there is a growing stock of wood to be cut. That said, Member States' projections estimate an increase in harvesting by around 30 per cent by 2020, from 2010 levels.

The wood-harvesting d sector in Europe benefits from policy support in the form of the EU Forest Strategy which aims to promote sustainable forest management. This strategy aims to help create and preserve employment in rural areas; environmental protection and climate change mitigation; improvement of forest based industries; promote wood as an "environmentally friendly product"; and the support of populations in developing countries where wood is harvested[24].

"The regulations on illegal timber have become much more stringent in Europe recently, to meet this we can provide a clear chain of custody and provenance." – ***Triton***

Investment in development helps drive a sustainable forest-based sector. The EIB for example has invested into forest projects on the grounds that these help drive economic growth, providing important environmental products and services as well as a social platform for health, recreation and tourism[25]. Between 2009 and 2013, this investment has amounted to some EUR 4.4 billion in loans.

This kind of public sector-driven investment can come into different aspects of the value chain including planting management, fire management, processing, timberland funds, and REDD+ operations.*

Policy driving a minimisation of environmental impacts also helps drive new innovations. For example, minimising the construction of roads into forest land is now a more pressing factor given their negative environmental impact on top of economic constraints[26]. Roads allow an influx of invasive species, and increase erosion and runoff to surface waters. As such, technologies that help harvest harder-to-reach wood become more attractive, such as the harvesting solutions proposed by Triton. Given their operation is done on water, this minimises the need to construct roads to be used by harvesters.

* "Reducing Emissions from Deforestation and Forest Degradation (REDD)" is a UN-driven effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development.

Other regulations have demonstrated impacts in driving innovation in this sector. For example, Arbonaut stated that a market for their LIDAR technology grew almost overnight after a major power loss across the North American Eastern seaboard because of a falling tree cutting a power line. The US Government responded swiftly by imposing severe penalties to companies that did not properly manage this risk, which led to a surge in demand for solutions like the one proposed by Arbonaut.

The market for powerline checks was created almost overnight because of a massive short circuit that shut down hundreds of power plants across the eastern seaboard. We have capitalised on this by helping scan forests to help remove trees that grow too close to power lines."
*- **Arbonaut***

4.3. Carbon pricing and other financial instruments have a role in driving growth in the forest-based sector

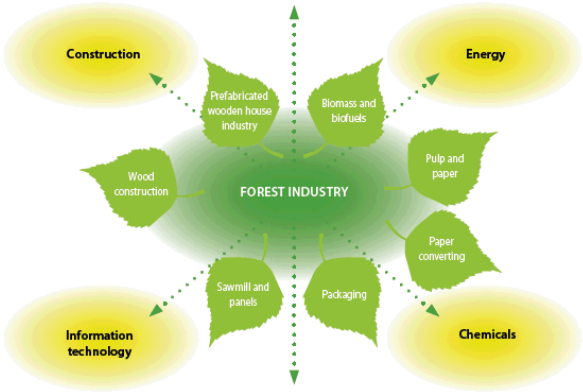
Forests have an enormous potential to sequester carbon dioxide (a greenhouse gas) during the process of photosynthesis through which trees synthesis the chemical energy necessary to grow. As well as there being a need to avoid deforestation and thus reducing the amount of sequestered carbon dioxide, there is a potential for value through increasing the amount of carbon dioxide sequestered in forests which can be monetised as savings in the social cost of carbon dioxide emissions. There are pushes to try and create a market value that matches this, which would develop a market for solutions to help mitigate climate change[27].

The REDD+ Programmes, driven by the, UN is an example of how policy can drive the market. The programme aims to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

4.4. Innovations and new wood products helps drive market growth

The wood-harvesting industry relies on staple downstream and processing industries such as construction and interior decoration, packaging and tissues, and bio-based energy. An increasingly important driving force for the wood-harvesting sector is in the advent of new wood products and the demand for these new products. These include high profile biofuels and biochemical, as well as products developed through combining wood and fibre with other materials.[5]

Figure 9: Expansion trends of the forest sector



Source: Finnish Forest Industry[5]

Smart paper and packaging products and building materials are developed using information technology and products manufactured using nanotechnology have entirely new properties such as greater durability to mechanical stress. The Finnish Forest Industry group stress the potential of applications, such as for the foodstuffs and pharmaceutical industries, to be created alongside existing products as a means of diversifying the production of the forest-based sector.

New innovative industries are helping drive demand for wood. Birch plywood-fibreglass-carbon fibre composites can be used to make windmill blades because it offers an unparalleled strength-to-weight ratio and is also the most cost-effective alternative for the customer. At the same time demand for wood is developing in established industries: because of their light weight and durability, plywood panels are used in the transport sector, such as for the flooring of trains and road vehicles, as well as in gas tankers.

4.5. Non-alignment of wood standards across EU Member States hinders intra-European trade

Today, European regulation to combat illegal logging practices is very stringent. The European Union Timber Regulation (EUTR) puts obligations on businesses who trade in timber and timber related products.[28] These must ensure that harvesting wood conforms to sustainable logging practices and that both the provenance and the chain of custody of the log is recorded. It applies to timber originating in the domestic (EU) market, as well as from third (non-EU) countries.

On the other hand, some regulations for other aspects of the forest-based sector are at the level of the Member States. This isn't so much the case today because it is in line principle of subsidiarity, rather more it is because the forest-based sector is very old and well established and extensive regulations already exist at this level. While these may be

suitable in helping regulate the local market, they hinder trade in the event a company from outside of the Member State attempts to enter. While there are political considerations to this market barrier to entry, there is an issue between of the lack of alignment between certain regulations. Particularly in cases such as wood standards, which determines how dimensions and volumes are measured.

Microtec suggested that a big blocking point in their sector, is that these wood standards regulations are not aligned and would benefit from better coordination at the EU level. These changes in wood standards meant that ultimately the price for the same amount of wood could differ widely from Member State to Member State.

"To compare the yield of a sawmill is impossible in Europe"…"You can take a certain amount of logs from Scandinavia to the south of Europe and have a difference of 7 to 8 per cent less because of their regulation" - ***Microtec***

5. Policy recommendations

Given the potential impact of innovations in the forest sector, a number of policy recommendations can be considered. First, the environmental policy driving virtuous wood harvesting and good forest management should be continued. Second, given its high labour intensity, Member States should include forest sector jobs in their general labour policies. Third, investment into the sector's research and development should continue. Fourth, wood standards across the Single Market should be aligned with means to enforce it. Finally, support systems to help European companies operate in developing nations should be strengthened.

5.1. Continue to support sustainable harvesting and forest management and relevant environmental policy

The first and most obvious means by which policy can help foster business innovations within the wood-harvesting sector, is through continuing to drive sustainable harvesting policy. Companies such as Arbonaut, Green Resources and Triton have become successful because they have capitalised on the need for sustainable harvesting and incorporated it into their strategy.

Environmental policy helps drive business innovation in this field. This is particularly the case for climate change policy. Innovative financial instruments help make the planting of new forests a more economically attractive prospect, as demonstrated by Green Resources or Arbonaut (which benefitted from involvement in policy driven REDD+ programmes).

Stronger regulations stating mandatory requirements for the management of forests could also be beneficial for the wood-harvesting sector. While sustainable forest management is enshrined in most EU Member States, certain risk management procedures are not.

Arbonaut gave an example of power outages because of falling trees on power lines, which resulted in strict regulations. These outlined the responsibilities of energy providers and forest managers to manage the risks of trees growing too close to cables. This is however not the case in many European Member States. Enshrining such principles would help create demand for solutions like the one offered by Arbonaut, and would still be acceptable by the industry, which anyway faces fines for any preventable power shortages of this kind.

"In Finland thousands of households almost every month suffer from outages lasting several days just because trees haven't been removed from near power lines" – ***Arbonaut***

5.2. Encourage Member States to capitalise on the wood-harvesting sector's need for labour

The wood-harvesting sector is well placed to help contribute to economic growth and create jobs. Given the labour intensity of the wood-harvesting sector, work programmes could be established at the level of the Member State to help companies in certain labour-intensive operations linked to wood-harvesting such as the forest management and improvement (e.g. removing pests and sickly trees), or forest reclamation. Even tasks such as maintaining a forest inventory are better done in a manual manner for smaller forests where technological solutions are less cost-effective.

The wood-harvesting sector could benefit from economic stimulus programmes such as an extension of unemployment benefits or tax credits for companies that provide work programmes to bring in unskilled labour for seasonal work. Given the highly globalised nature of the forest sector, interviewees stressed the importance of limiting unnecessary barriers to hiring international staff. Not only did they state that it was important to hire the best people for skilled positions, but that it was vitally important to be able to bring in people with knowledge of the international markets in which they would look to operate.

"One half of my employees come from outside Europe, more than twenty nationalities. Those are the people who allow us to operate in Indonesia or Tanzania. It is a global industry, so it is important to have people on your team who help you understand and identify local needs." - ***Arbonaut***

5.3. Set out clear wood-harvesting sector research objectives for funding schemes and empower industrial partners

While EU framework programmes have helped provide opportunities for forest research, recent evaluations have found these to be fragmented.[29] Research funding should continue its investment opportunities and look into all facets of the forest-based sector value chain albeit under a single programme.

Research priorities that have been proposed in evaluations include: the role of forests in creating economic and social welfare, the expectations of society regarding the economic, social and environmental values and services from forests, and the value of trade-offs between them. Research funding should continue towards the development of new products and services based on wood, just as there should be investment towards the validation of the importance of wood-based products as carbon pools.[30]

"According to the opinion of the people at the EU funding bodies we always need to have people from universities who specialise in fundamental research in our consortium. Why? We experienced that the young, new generation of scientists seems to be more interested in publications than in innovative, applied research." - ***Microtec***

Companies like Microtec have benefitted enormously from research funding throughout their history. They have collaborated with many international research institutions and have stated that without publicly funded initiatives, a lot of their growth might not have happened. This company has based its services by adapting CT, laser, microwave and other scanning technologies from the medical sector into the wood-harvesting sector. However, the administrative formalities are still a burden while applying for research funding. Fulfilling them meant, for example, bringing in partners from research institutions only to provide authority for the application. Allowing SMEs to apply based on their own research capabilities would help to address this shortcoming. On the other hand, some programmes were praised for allowing being flexible once awarded e.g. TEKES in Finland.

In response to the increased price of wood as a commodity, some interviewees stated that a research focus should be placed on investigating both increasing efficiency in operations across the value chain and in value optimisation. The results of research programmes should also be better disseminated between scientific bodies and industrial partners to maximise the potential for innovation.

"We benefit from the Finnish government and the EU's liberally managed programmes, where you're given some resources and allowed to change course if something changes and not end up in personal debt." - ***Arbonaut***

5.4. Promote a better coordination of wood standards across the single market

For companies like Microtec addressing different standards for the measurement of wood is an important policy requirement for the opening of the wood market. As stated before, the fact that wood volumes are measured in different ways across Member States, means that the amount of product varies. This discourages smaller players from entering other European markets.

While the principle of subsidiarity should be respected, a better coordinated system through which wood measurements are made could facilitate trade across the Single Market. The European Commission could consider the opportunity to promote best practices and encourage networking between national authorities.

Alignment of regulations could well be envisaged for more than just measurements, but for many more products across the forest value chain. It has come across in several interviews that the wood-harvesting sector is relatively conservative. Actions aimed at assuring the good application of mutual recognition and of Single Market rules would also

"In some fields the European forestry applies different standards of measurement, e.g. the cubic meter of wood – a key element in the forest-wood chain – is defined differently in many member states. At this point, a harmonized standardization would reduce trade obstacles as well as simplify and accelerate approvals for measurement devices because Microtec as a machine producer must currently fulfil different national requirements for each Member State" - ***Microtec***

help combat complaints of protectionism by certifying bodies at the level of the Member States.

5.5. Support forest-based company operations in developing nations

"The countries that we've operated in are all third world countries, with varying degrees of infrastructure available as well as rules and regulations. Those markets aren't mature enough to source capital there, and then how do you offer western banks to secure assets over there?" – ***Triton***

The final policy recommendation to come out of interviews with the showcased companies, is that SMEs could benefit from public assistance in helping them establish operations in developing countries, where a lot of wood is sourced from.

According to Triton, while compensation levels for operating in developing countries are attractive, other aspects can in fact be very costly. Infrastructure to reach forests or future plantations might require building roads and bridges, which is a costly investment. And given concerns on securing assets many potential investors might be reluctant to do so.

While public investment systems through the World Bank exist, the EIB could potentially envisage propping up investment into forest-based activities in developing nations to create a leverage effect and bring in public investment. Cooperation activities between the EU and African nations already exist (e.g. Renewable Energy Performance Platform), and they could be capitalised on at a later stage to bring in European private sector.

In addition to financing, overcoming legal barriers in these markets is often problematic for smaller companies. Bodies such as the EU External Action or Member State chambers of commerce could provide advisory services for companies trying to enter these markets.

6. Appendix

6.1. Interviews

Company	Interviewee	Position
Arbonaut	Tuomo Kauranne	President, CEO
Green Resources	Emma Shepheard-Walwyn	Sustainability and Stakeholder Relations Manager
Microtec	Federico Guidiceandrea	CEO
	Simon Schweigkofler	Marketing & Communication
	Thomas Prenn	Research & Development
Ponsse	Katja Paananen	Communications manager
Triton	Chris Stead	CFO

6.2. Websites

Company	Web address
Arbonaut	www.arbonaut.com
Green Resources	www.greenresources.no/
Microtec	www.microtec.eu/
Ponsse	www.ponsse.com/
Triton Logging	www.tritontimber.com/

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