Drax Power Limited

Catchment Area Analysis in Latvia

Final Report

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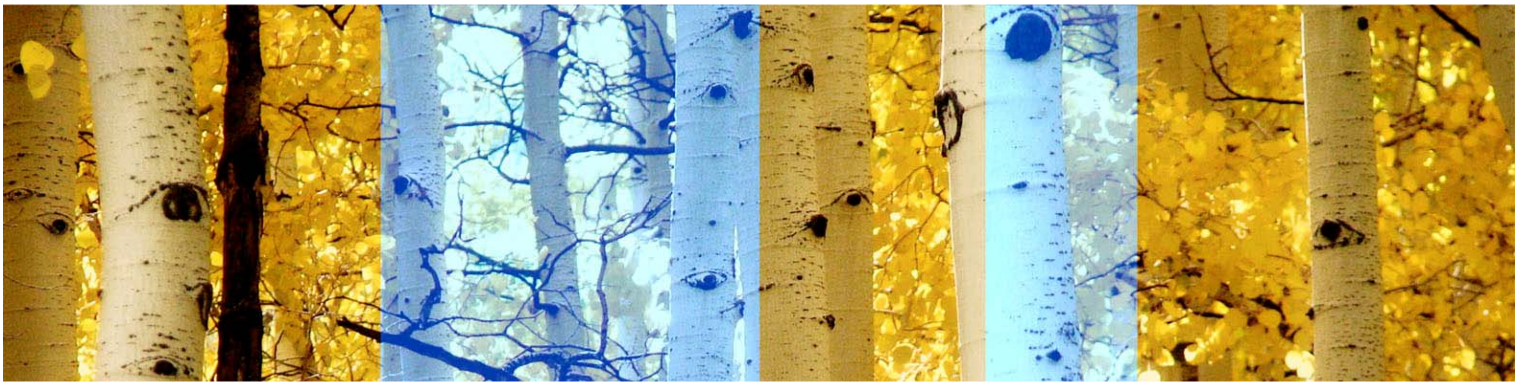

DISCLAIMER

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ABBREVIATIONS

BCTMP	Bleached Chemi Thermo Mechanical Pulp
CAGR	Compound Annual Growth Rate
CHP	Combined Heat and Power
CIF	Cost, insurance and freight
CSB	Central Statistical Bureau of Latvia
CTL	Cut-to-length harvesting method
EC	European Commission
EU	European Union
FOB	Free on board
FSC	Forest Stewardship Council
GDP	Gross Domestic Product
GHG	Greenhouse gas
LULUCF	Land use, land use change and forestry
LVM	Latvijas Valsts Meži, Latvian State Forest Company
NFI	National Forest Inventory
NBSK	Northern bleached softwood kraft (pulp)
OECD	Organisation for Economic Co-operation and Development
OSB	Oriented Strand Board
PEFC	Programme for the Endorsement of Forest Certification
P&P	Pulp and paper
SFS	State Forest Service
SOC	Soil Organic Carbon
SWP	Solid Wood Products
TL	Tree-length method
UN	United Nations
WBP	Wood-Based Panels

EXECUTIVE SUMMARY

Objective

The objective of this study is to give an overview of the forest management, roundwood and wood product market trends affecting forest structure and use in Latvia and to provide the Consultant's view on Drax's impact on the observed developments.

Background

Drax has been sourcing wood pellets from Latvia since 2013, and during 2015–2018 the annually procured pellets accounted for ca. 600 000–700 000 tonnes. The procured pellets are manufactured by 10 mills located in Latvia, using domestic wood-based biomass.

Woody biomass has become an increasingly important fuel in Latvia, accounting for 40% of all energy generation in 2018. Household consumption is mainly concentrated on firewood and wood pellets, while wood waste and wood chips are used in the industry and construction sectors. Wood chip demand in Latvia has been steadily increasing, as a result of both increased export demand and domestic capacity in combined heat and power (CHP) and heat plants. Household consumption of wood pellets has been rising as a result of government support and incentives as part of the renewable energy initiative.

In terms of trade, Latvia is a net exporter of wood fuel, mainly wood pellets and chips. Domestic consumption of wood pellets in Latvia is marginal compared to the exports with an estimated 9% of available pellets (production plus imports) consumed domestically in 2019. The export volumes of wood pellets and chips fluctuated somewhat in recent years but the overall trend has been an increasing one. The imports of wood chips and pellets to Latvia have been increasing as well but are only a fraction of the exports. The use of wood fuel in energy-generation is expected to continue to rise in the future, as a result of firm national commitments and policies to reach 50% of the renewable energy share in the energy mix.

Based on a recent Worldwide Governance Indicators aggregate update, the rule of law in Latvia has been relatively effective. The rule of law reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. In 2018, Latvia has scored 0.96 in the estimate of governance (ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance) and has ranked 79 in the world. In addition, Latvia has scored 56/100 in 2019 on the perceived level of public sector corruption on a scale of 0 (highly corrupt) to 100 (clean), according to Transparency International.

Changes and Trends in Forest Resources

The forest area (along with the forest cover) has increased in Latvia throughout the last two decades. According to FAO's forest definition, Latvia's forest area increased from 2.98 million to 3.38 million ha during 2000–2015. The main driver of the forest area increase is the natural afforestation of the agricultural lands that have been left uncultivated under and after the Soviet regime.

In terms of area, pine is the most common species in Latvia, followed by birch and spruce. While birch and spruce dominate both young and mature age classes, pine forests in average are mature. Therefore, it can be expected that the share of pine forests of the total clear-cut area will increase in the coming years. After the privatisation that followed Latvia's independence, birch became a more popular option in regeneration. One of the reasons behind birch's popularity among new private forest owners was active influencing by the plywood industry, which uses birch logs as raw material for veneer.

The total growing stock has been increasing throughout the last two decades and the increase is expected to continue since the annual harvesting levels have typically accounted for only 65% of the annual increment. If the growth continues, it also accumulates the forest carbon storage. The growing stock development between 2009 and 2019 (from which uniform inventory data are available) shows a slight increase in the share of hardwoods, which mainly results from the naturally regenerating forest areas in private forests.

State-owned company LVM manages approximately half of Latvia's forests. LVM has adopted a role as a steady supplier of wood for the domestic industry and showed its capability to quickly increase harvesting during the 2008–2009 financial crisis when log prices were low and the private forest owners withheld from selling. In general, LVM tends to clear-cut forests as early as the forest law allows, while private forest owners' harvesting decisions are more driven by log prices.

The restitution process initiated after Latvia's independence in 1991 was completed by the year 2000. A major on-going trend among the private forest owners is the consolidation of the forest assets, meaning that the total number of forest owners is decreasing while the average size of assets is increasing. Currently, 28% of forests are owned by private individuals, while companies own approximately 20%. Foreign ownership is increasing, Swedish pulp and paper companies being the largest foreign forest owner group in Latvia.

Changes and Trends in Forest Management Practices

The Law on Forests sets definitive boundaries and regulations for forest management practices, and it is among the strictest in Europe regarding biodiversity and sustainability issues. At the moment, Latvia is discussing possible changes in the law that would lower the minimum diameter of trees that can be clear-cut, while regeneration regulations would be tightened. Due to the strict regulations, an increase in small-diameter roundwood demand (for e.g. energy purposes) has not shortened forest rotation cycles. EU-level subsidies have significantly increased the amount of tending in private forests, which will improve the quality of roundwood.

A bit over half of Latvia's forests are certified. Certification is mostly driven by export partners' demand. Many Latvians think that the national forest law already sets high standards for forest stewardship and that there is no advantage in paying for certification.

The total harvesting area has declined, while the total harvested volume has increased in the past 20 years. This can be explained by the diminished share of thinnings and increased share of clear-cuts. While the state forests are managed and harvested regularly, private forest owners fell their forests when timber prices are high. Large-scale forest owners with more than 50 ha (41% of the private forest land) are more active in regular forest management and timber sales. Regeneration practices vary between state and private owners: the state prefers artificial regeneration (on average 60% of the state reforested area), whereas private forest owners strongly rely on natural regeneration (on average 80% of the private reforested area). Many naturally regenerated forests later grow with broadleaves and spruce, which has increased the area of these species and diminished the area of pine.

The most common harvesting method in Latvia is the fully mechanised cut-to-length method (CTL), covering 70% of harvests. The level of mechanisation had improved in Latvia since 2005 when a change in legislation increased the share of the harvested area that could be covered by machine tracks from 12% to 20%.

Improved mechanisation has had a positive impact on the availability and cost of harvesting residues. Harvesting residue collection was minimal 15 years ago, but it has grown with the increased demand from the energy sector due to investments into CHP and heat plants. The prices of harvesting residues have also increased in the past 15 years, which has created more incentive to collect them. Also, small households have started to switch from oil to bioenergy for heat and energy generation. Since the national felling volume is only about 65% of the national forest increment, the felling level can be increased in the future, which would increase the potential availability of harvesting residues as well.

The carbon storage in Latvia's forests has grown. Latvia's growing stock in the past decade has increased by 32 million m^3 – or 5% – to a total of 679 million m^3 in 2019. The total forest cover has also increased by 1% since 2010. Harvesting levels have remained steady and well below the national forest increment level. However, according to Latvia's national forestry accounting plan, the forests are decreasing their GHG sequestration capacity, and are modelled to turn into minor GHG emitters temporarily between 2025–2030. Even a small sequestration rate increases carbon storage, which explains the increases in forest growing stock and area. Ageing forests approach the balance when the increment compensates harvesting, natural loss, and

GHG emissions from soil, but do not increase the stored carbon volume. There are significantly more young or middle-aged than mature stands in Latvia now, but soon these forests start slowing their growth and consequently their carbon sequestration rate.

Changes and Trends in Solid Wood Products Production, Raw Material Prices and Cross-Border Trade

The Latvian solid wood products sector is dominated by the sawmilling industry, which consists of 20 industrial sawmills. Birch plywood production has historically been an important industry in the country, but OSB production has developed into the most significant wood-based panel (WBP) product by production volume, in only a few years since production began in 2007. In addition to these products, also particleboard and pellets are produced in Latvia, with the pellet industry spanning 14 industrial mills and several smaller plants.

Sawnwood production decreased by 42% between 2006–2009 due to the financial crisis. Since 2009 the industry has been recovering, but production volumes have yet to reach pre-crisis levels and have been stable at between 3.7–3.9 million m^3 during the past four years. WBP production has continued to increase steadily since 2000, driven especially by OSB production since 2007. The sawnwood and WBP industries consume approximately 10–11 million m^3 of roundwood annually.

Sawlog prices have been on an increasing trend since 2009, when prices plummeted due to the financial crisis. In 2017 all wood prices surged. In Latvia, poor harvesting conditions constricted raw material availability which pushed all prices up. Pulpwood prices increased the most due to a very high global pulp price, which motivated pulp producers in Finland and Sweden to increase pulpwood sourcing from Latvia to maximize production. Prior to the price hike, pulpwood prices had remained very steady since 2015. Fuelwood price development has followed pulpwood price development closely. No significant movements are observed in pulpwood or fuelwood prices due to Drax's sourcing from Latvia. Sawlog prices are to a large extent driven by demand from the domestic sawmilling and wood-based panels industry, while pulpwood prices are driven by domestic OSB production and the Finnish and Swedish pulp industries.

Sweden is the largest destination for Latvian roundwood and wood chip exports, followed by Finland and Estonia. The largest roundwood import partners are Lithuania, Belarus and Russia. Wood chips are mainly imported from Belarus, Estonia and Lithuania. Lithuania has been by far the most significant source of roundwood imports, while Belarus has been the dominant wood chip supplier in the past two years. Roundwood imports are mainly sawlogs, while exports are mainly pulpwood and other roundwood. The Swedish and Finnish pulp industries are large demand drivers for Latvian roundwood exports. Sawlog import and export volumes are very close to one another, which is mainly due to Latvian companies aiming to profit from low sawlog prices in neighbouring countries. In the past two years, wood chip imports from Belarus have skyrocketed while roundwood imports have diminished. This is due to Belarus implementing new export duties to incentivise further domestic processing. Instead, roundwood exporters invested into chipping equipment and began exporting wood chips.

Impacts of Wood-Based Bioenergy Demand to Latvian Forest Resources

Forest Area / Forest Cover	
No impact	• Both forest area and forest cover have increased during the last two decades. The main driver of the growing forest area has been the natural regeneration of agricultural lands that were left uncultivated during the Soviet regime.

Forest Growing Stock	
No impact	• Forest growing stock has steadily increased throughout the observation period. • The main driver for harvesting level is the roundwood demand from sawmills, panel mills and export. Wood-based bioenergy demand may increase thinnings and residue collection, but it is not as significant a driver for total harvests as the aforementioned. Exported pellets have accounted for approximately 10-14% of the total volume of annual harvests in recent years, depending on the assumed average dry densities of the harvested wood and pellets.
Harvesting Levels	
No impact / slight increasing impact	• The national felling volume is only about 65% of the national forest increment. The total harvesting area has been declining, while the total harvested volume has increased in the past 20 years. This can be explained by the diminished share of thinnings and increased share of clear-cuts. A decline in both area and volume of fellings can be seen between 2002–2008 and 2010–2016. • The main drivers of harvesting levels are sawmill industry, panel industry and export demand. However, wood demand for energy purposes can still improve the overall income for the forest owner and therefore increase the total harvesting levels in private forests
Harvesting Residue Collection	
Increasing impact	• Most of the collected residues originate from clear-cuts in state forests. Most produced harvesting residues are left in situ, and they are not over-exploited. • Collection of wood residues from harvesting operations has been increasing for the last 15 years as a result of increased capacities and demand from heat and CHP plants. Latvia is increasingly relying on woody biomass for energy generation.
Forest Growth / Carbon Sequestration Potential	
No apparent impact	• The total forest area and growing stock have grown in the last decade. • According to Latvia's National Forestry Accounting Plan 2021–2025, the forests are decreasing their GHG sequestration capacity. Even a low sequestration rate increases carbon storage, which explains the increases in forest growing stock and area. The decrease in GHG sequestration capacity is due to forest ageing, emissions from soils and the increased share of broadleaved forests, which have lower carbon accumulation capacity than conifers. • Removal of harvesting residues decreases carbon sequestration since the residues are an input to the soil carbon pool. However, the majority of the harvesting residues' carbon is released to the atmosphere when the biomass decays, so the ultimate impact of harvesting residue collection is minimal if the collection is done on a sustainable level. The sustainability of the collection is determined by how the soil nutrient balance is impacted by collection. This is not accounting for the substitution effect that the harvesting residues may have, by, e.g. reducing the need to burn fossil fuels.

Impacts of Wood-Based Bioenergy Demand to Forest Management Practices

Rotation Lengths	
No impact	• The Law on Forests regulates minimum forest age and diameter for clear-cuts. The LVM and large-scale forest owners often conduct clear-cuts at minimum diameter, whereas smallholders tend to wait until roundwood prices are high. Due to the regulation, an increase of wood-based bioenergy demand has not shortened rotations.
Thinnings	
Increasing impact in naturally afforested former agricultural lands. No impacts on thinnings overall.	• The total harvested area has been declining, while the total harvested volume has increased in the past 20 years. This can be explained by the diminished share of thinnings, due to existing forest age structure, and increased share of clear-cuts. Most of the harvesting residues are collected from clear-cuts. • There is an increased demand for small diameter wood and harvesting/processing residues overall. • The increased demand for small-diameter hardwood has increased harvesting in previously unmanaged afforested agricultural lands, which usually overgrow with broadleaved trees. These kinds of lands are usually otherwise not significant for forest management.
Conversion from Hardwood to Softwood	
No impact	• No indication of hardwood conversion to softwood was found. Instead, pine forests are decreasing due to the favouring of natural regeneration, which usually results in spruce or broadleaved forests in nutrient-rich and/or wet soils.

Impacts of Wood-Based Bioenergy Demand to Solid Wood Product Markets

Diversion from Other Wood Product Markets	
No apparent impact	• Production of sawnwood and wood-based panels have increased or remained steady, i.e. no evidence of diversion. • Several interviews confirmed that sawlogs are not processed for other products besides sawnwood and wood-based panels.
Wood Prices	
No apparent impact	• Prices of all wood assortments increased in 2017–2018, most notably the prices of pulpwood. This was due to difficult harvesting conditions and increased demand for pulpwood in Finland and Sweden, because of high market pulp prices. Pulpwood prices returned to pre-surge levels in 2019. Fuelwood prices also increased temporarily, but at a much more moderate rate. The main driver for fuelwood price increases was the surge of pulpwood prices.

1. INTRODUCTION

Drax Group (the Client) is a large British electrical power generation company that was founded and listed at the London Stock Exchange in 2005. Its roots extend back to 1967 when the construction of Drax Power Station began under the Central Electricity Generating board. This is still the Group's key asset and is the largest single-site renewable energy generator in the United Kingdom. The Group is composed of Drax Power, Drax Biomass, Haven Power and Opus Energy. The Group places much emphasis on sustainability and decreasing its carbon footprint, which is evident from the Group's previous and planned investments. Drax is one of the world's largest single point consumers of wood and is committed to sourcing that wood sustainably.

Drax wants to take the sustainability of its wood sourcing further by implementing a forest resources and management monitoring program. As part of the monitoring program, Indufor has conducted earlier studies for the Group, covering catchment areas of Amite pellet mill in Mississippi (Healthy Forest Landscapes) and Graanul Invest in Estonia (Catchment Area Analysis). The approach used in the Catchment Area Analysis will be applied in this work, too. However, small scope modification has been added based on the Client's request.

1.1 Brief History of Latvian Forests

During the 19th century, the industrial revolution together with a population boom inflicted severe pressure towards the utilisation of Latvia's forest resources for heat, manufacturing and construction purposes. The heavy exploitation of timber resources diminished Latvia's forest area to approximately 10-30% of the land area. Despite the time of heavy and unsustainable exploitation, understanding of sustainable forestry practices improved, adopting methodologies from, e.g. German forestry practices.

After over a century under the rule of the Russian empire, the Republic of Latvia declared independence in 1918. Along with the independence came the right and responsibility to plan and govern the country's forestry. The Forest Department was quickly established to govern the forests that earlier belonged to the crown and nobility, but now to the state of Latvia and private individuals. Harvesting volumes were regulated, but their enforcement was not a priority and allowed deviations from the plans. In a Europe devastated by the First World War, Latvian timber was in high demand, making timber Latvia's most important export commodity and contributor to the country's economic development.

From the end of the Second World War to 1991, Latvia was occupied by the Soviet Union. During this time, decision-making regarding Latvia's forests was centralised and private forest ownership was impossible. Latvia's relatively developed forest industry was not a priority sector, and the forest industry's significance in Latvia decreased compared to the time of independence. Differing from many other Soviet states, a joint Ministry of Forestry and Forest Industry was established in 1957 in Latvia.

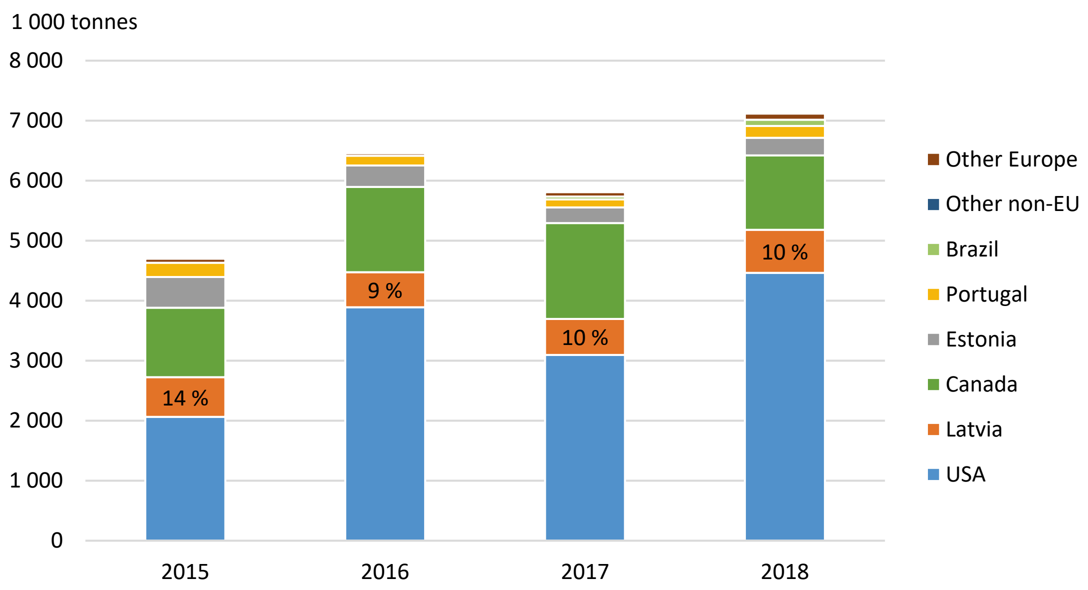
After Latvia regained independence in 1991, the forestry sector went through a radical transformation, changing from centralised planning to a more de-centralised management model. Key elements in the transition included quick restitution and privatisation of vast forest areas, privatisation of logging companies, implementation of a forest lease model, trade agreements with many European countries and improved utilisation of the mature forest resources grown during the past decades. After becoming independent again, Latvian forest sector's production increased rapidly, including both logging and mechanical wood products. The country's only pulp and paper (P&P) mill was closed in 1994, but its pulpwood consumption was easily substituted by exporting pulpwood to Sweden and Finland. The quick development of the country's forest industry led to Latvia becoming a net importer of sawlogs.

1.2 Drax in Latvia

Since 2013, Drax has procured wood-based pellets produced in Latvia or produced in the neighbouring countries using biomass from Latvia. During 2015–2018, Drax has sourced annually approximately 600 000–700 000 tonnes of pellets produced in ten Latvian pellet mills. Roughly 5 000 tonnes of pellets produced from imported Latvian feedstock have been sourced from eight mills located in Latvia's neighbouring countries.

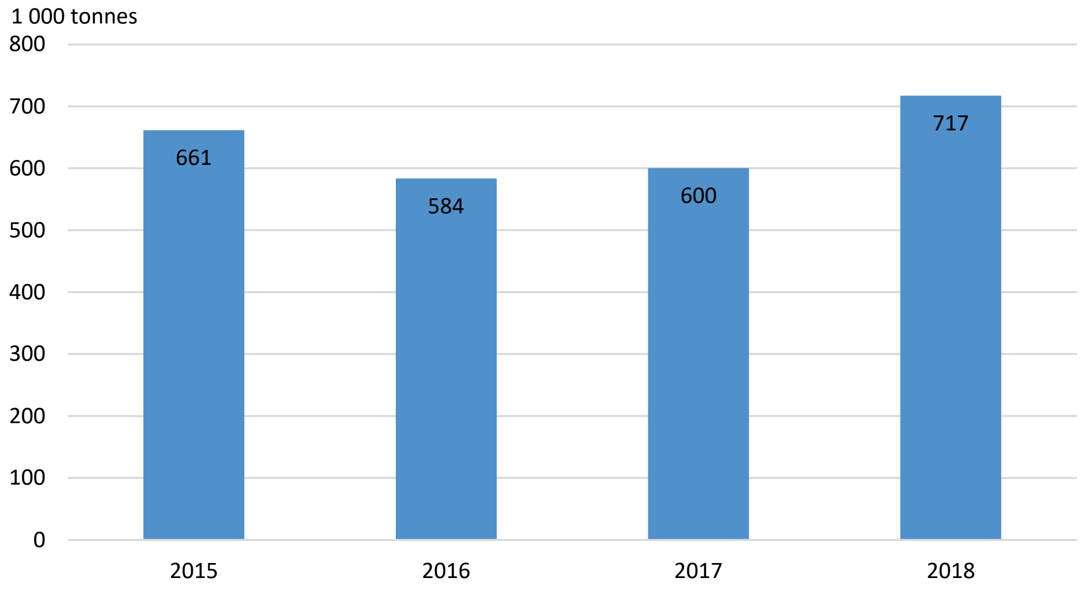
In total, pellets from Latvia have accounted for approximately 9–14% of Drax's imported woody biomass, making Latvia the most important European source of woody biomass for Drax.

Figure 1.1 Drax Woody Biomass Sourcing by Country or Region



Source: Drax Annual Reports

Figure 1.2 Drax Woody Biomass Sourcing from Latvia



Source: Drax Annual Reports

1.3 Objective of the Assignment

The objective of this assignment is to give an overview of the forest management, roundwood market and wood product market trends affecting the forest structure and use in Latvia and to provide the Consultant's view on Drax's impact on the observed developments.

2. WOOD-BASED BIOENERGY IN LATVIA

Box 2.1 Chapter Highlights

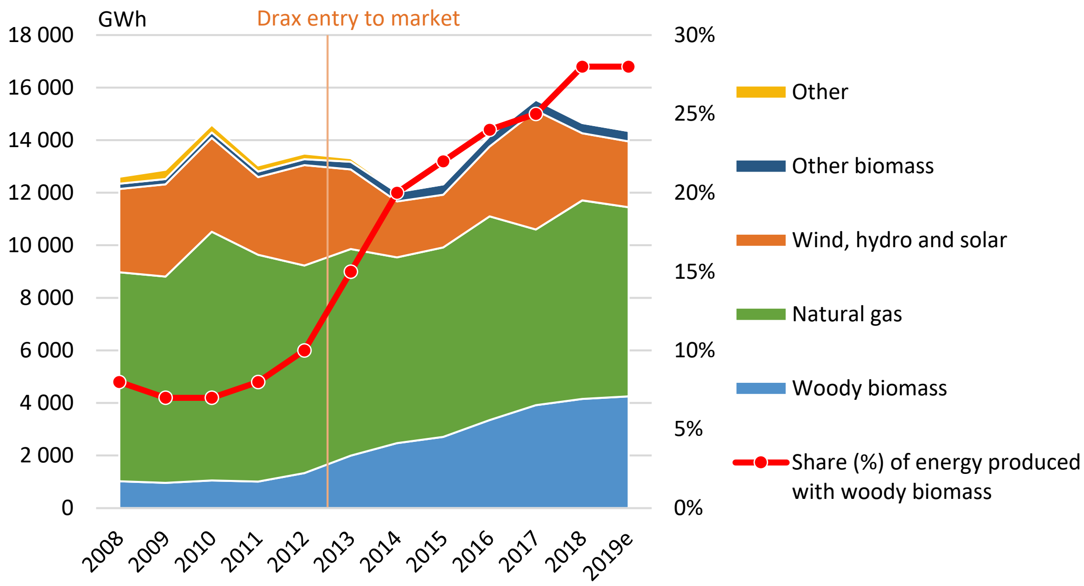
General

- Woody biomass is an increasingly important fuel source for energy generation in Latvia, accounting for 40% of all energy generated in 2018. Fossil fuel use is generally becoming less critical, although use of natural gas is still significant.
- Consumption of wood fuels in Latvia is mainly concentrated on firewood and wood pellets in household consumption, and wood waste and wood chips in the industry and construction sectors.
- Wood chip demand in Latvia has been steadily increasing as a result of both increased export demand and increased domestic capacity in combined heat and power (CHP) and heat plants.
- Household consumption of wood pellets has been increasing as a result of government support and incentives as part of renewable energy initiative.
- Latvia is a net exporter of wood fuel, mainly wood pellets and chips. The export volumes of wood pellets and chips have had some fluctuations in recent years but overall experienced a positive trend.
- Latvia’s imports of wood fuels have been increasing as well, mostly consisting of wood pellets and chips.
- The use of wood fuel in energy-generation is expected to increase in the future, as a result of firm national commitments and policies to reach 50% of renewable energy share in the energy mix.

2.1 Energy Mix in Latvia

The importance of wood as an energy source (electricity and heat) in Latvia has been increasing in the past decade (Figure 2.1). Since 2008, the use of woody biomass has had a compound annual growth rate (CAGR) of an estimated 15% and in 2018 woody biomass accounted for 28% of all energy produced in Latvia; its importance is likely to continue growing. Woody biomass consists primarily of wood chips and pellets.

Figure 2.1 Total Domestic Electricity and Heat Generation by Source



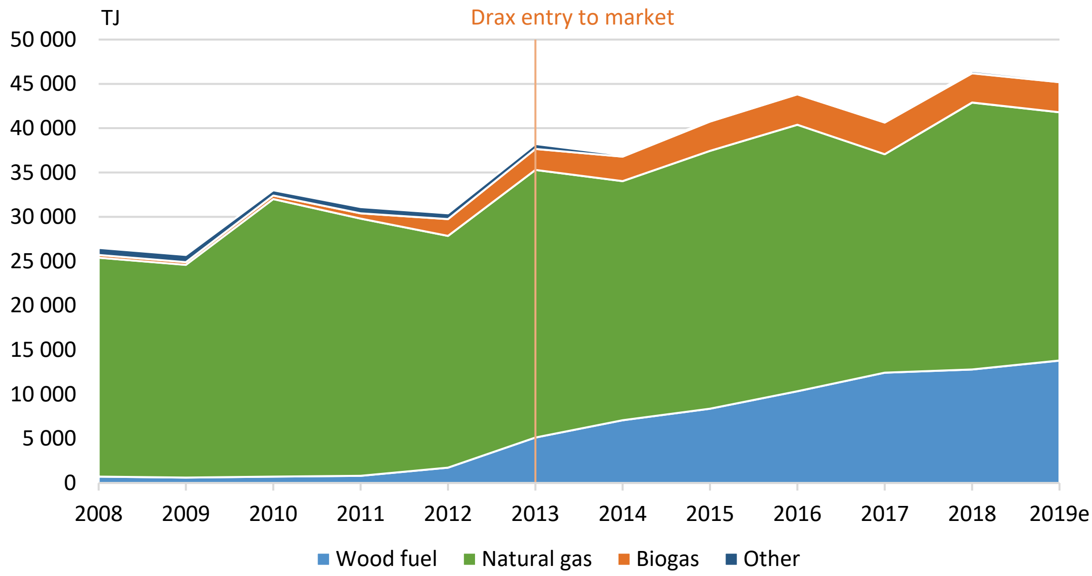
Source: Central Statistical Bureau of Latvia, International Energy Agency (IEA) and Indufor analysis

The total energy generation has fluctuated in the last ten years, with an interval of 2–3 years. Oil and coal have been consistently losing their significance in the energy mix, accounting only for 0.3% of the total energy generated in 2018. Natural gas remained an important source, and in 2018 it accounted for 48% of all electricity generation and 54% of all heat generation. The use of renewables has consistently increased since 2008, mainly for biofuels with 14% CAGR. Biofuels, primarily consisting of woody biomass, account for 45% of all heat generated and for 14% for all electricity generated in 2018. Other renewable energy sources, mainly hydroelectric power, account for 17% of the energy generated in 2018 and have remained an important source of energy in electricity generation.

According to Eurostat, the share of energy generation from renewable sources is 40% in 2018, which also means that Latvia has achieved its 2020 national targets as per 2009 EU Effort Sharing Decision (No 406/2009/EC). Latvia's share of renewable energy use is also one of the highest in Europe, and the country is already moving forward with the National Energy and Climate Plan 2021–2030 with the new target of 50% share of renewable energy in final consumption. The plan also calls for cutting consumption of resources, especially fossil and unsustainable ones, switching instead to sustainable, renewable and innovative resources. This would fuel the demand for renewable energy further.

The importance of woody biomass as fuel in CHP plants has increased significantly over the last decade, at a 34% CAGR (Figure 2.2). The strong growth of woody biomass consumption in CHP plants is particularly evident after 2012, mainly due to significant investments in capacity increases and governmental support. In 2018, woody biomass accounted for 28% of all energy generated by CHP plants. The use of other energy sources, such as coal and oil, have decreased significantly (-13% CAGR 2008–2018) and fossil fuel usage in heat plants overall has been declining in importance in the last decade. Woody biomass is an essential resource for heat generation and has accounted for 67% of total fuel consumed in 2018, followed by natural gas with a 31% share.

Figure 2.2 Domestic Fuel Consumption in CHP Plants



Source: Central Statistical Bureau of Latvia

Since 2008, several new CHP and heat plants have been installed and upgraded, which in turn increased the capacity and drove the demand for woody biomass resources further. Heat capacity in CHP and heat plants that use woody biomass was 1 700 MW in 2013, representing a 32% increase from the previous year, while electricity capacity in CHP plants that use woody biomass was 54 MW in 2013, which is a 210% increase of the prior year. This can explain a significant growth of woody biomass consumption in CHP plants from 2012 onwards (Figure 2.2). Total heat capacity in CHP and heat plants that use woody biomass has increased at a 6% CAGR between 2008 and 2018 reaching 1 900 MW, while the total electricity capacity in those has risen at a 41% CAGR during the same period reaching 96 MW. Significant increases took place during this period in the installation of new energy plants that use woody biomass, particularly in 2012 and 2016.

For instance, Fortum has inaugurated a biomass CHP plant in Jelgava in 2013, which is almost entirely run by domestically sourced wood chips. The project has been one of the first large-scale biomass plants in Latvia with a combined capacity of electricity and heat of 68 MW. The Enefit Green Valka power plant, established in 2012, and owned by Estonia-based company Eesti Energia since 2016, has the combined production capacity of 10.4 MW of energy and heat. It also relies on domestic wood chip suppliers in Latvia. In Riga, Axis Technologies has completed the country's largest bioenergy project to date – a 48 MW district heating plant for Rīgas BioEnerģijas. Built together with the Latvian company VELVE, the EUR 15 million project features two 20 MWth woodchip fired boilers and two 4 MW flue gas condensing economisers. A new 14.5 MWt per 3.3 MWe biomass CHP plant in Lizums was commissioned in 2017 for the Awoti furniture component and pellet plant, relying primarily on sawmilling residues from local suppliers. Most of the future investments into capacity increases would likely be concentrated in the Riga area; for example, JSC Riga Siltums and Riga BioEnerģijas are planning to establish a heating plant with 45 MW capacity. JSC Riga Siltums already have another heat plant with the same 45 MW capacity expected to be finalised in autumn 2020.

Such capacity increases have driven the demand for woody biomass further, particularly for wood chips and pellets. As a result, the overall demand for harvesting residues has also been on the rise. The wood raw material that is not suited for sawmilling or plywood production is typically used as a raw material source in pellet, OSB and particleboard production, well as fuel in CHP and heat plants in Latvia.

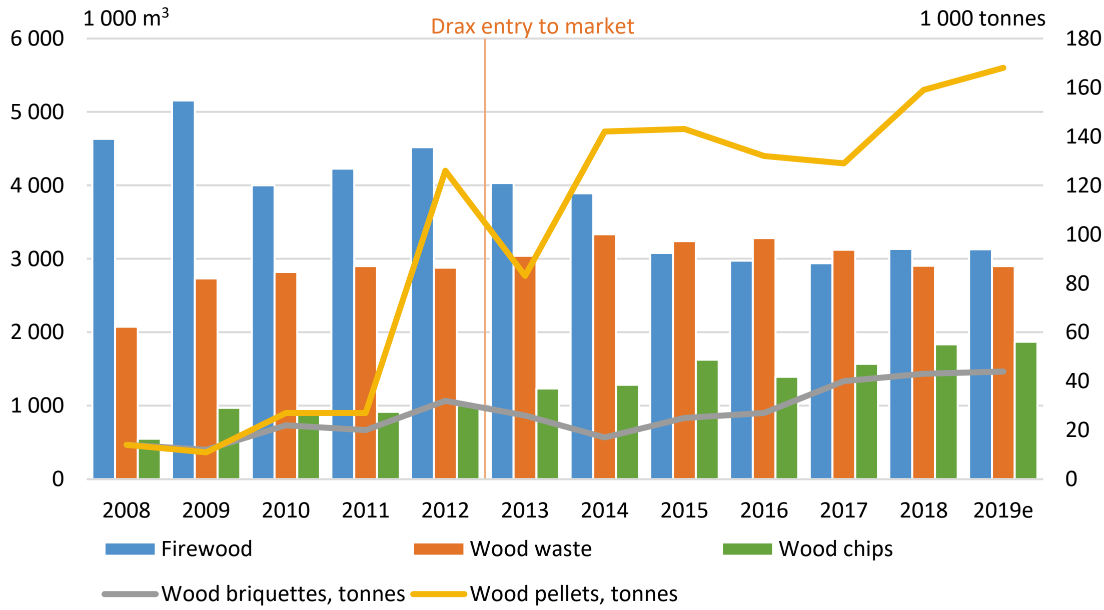
2.2 Domestic Consumption of Wood Fuels

Consumption of wood fuels in Latvia is mainly concentrated on firewood in household consumption, and wood waste and wood chips in the wood industry and construction sectors (Figure 2.3). The majority of wood chips and pellets is exported, and a smaller portion is consumed domestically. An estimated 9% of available pellets (production plus imports) and 20% of available wood chips were consumed domestically 2019. Wood briquettes are mainly produced for domestic consumption. The increase in wood chip and pellet consumption in the last decade is driven by the new CHP and heat plants inaugurated between 2008–2018. Before 2019 domestic consumption of wood fuel has been increasing significantly, but in 2019 consumption has overall stabilised.

Wood chips generate the most heat and electricity in Latvian power plants among other woody biomass sources, accounting to 95% of all energy produced from woody biomass in heat and CHP plants in 2018. This is a significant increase from 85% in 2012. The primary consumption of wood chips lies in the wood industry and construction sectors. The consumption of wood chips has been growing steadily since 2008 at a 12.8% CAGR, reaching its peak of 1.8 million m^3 in 2018.

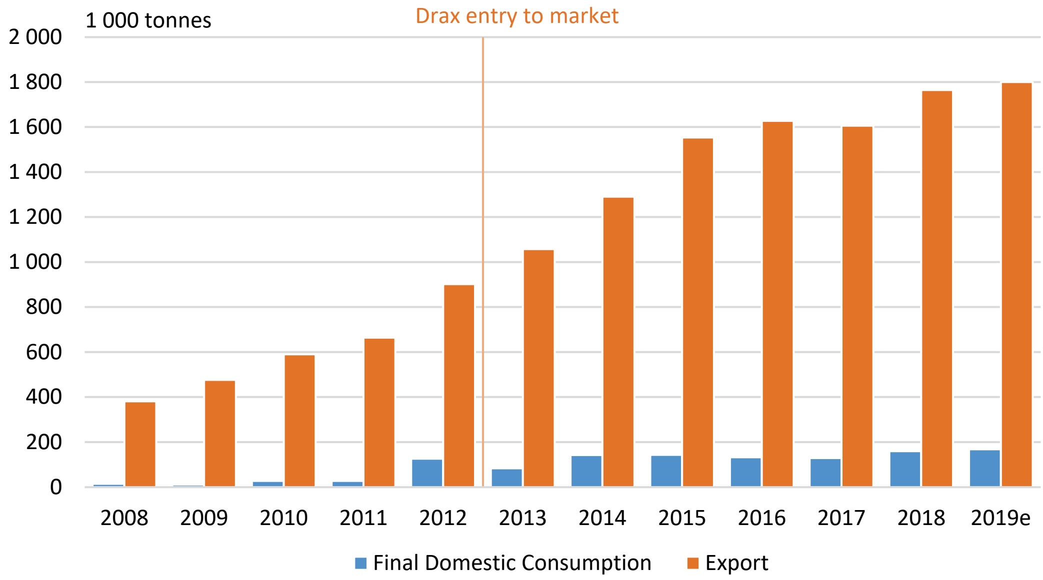
Out of all wood fuels, pellet consumption has experienced the most significant growth since 2008 at a 27.5% CAGR reaching 159 000 tonnes in 2018. However, 75% of this growth occurs between 2011–2014, and development has been notably more modest outside of this period. Wood pellet consumption remains minimal compared to exports (Figure 2.4). The consumption of wood briquettes has grown more consistently only since 2014. Wood briquettes are mainly consumed in households. The overall consumption of wood waste has been increasing, reaching 2.9 million m^3 (3.4% CAGR 2008–2018), of which 91% is used in the wood industry and construction sectors. Firewood consumption has been fluctuating since 2008, with an estimated volume of 3.1 million m^3 consumed in 2018 (-3.8% CAGR 2008–2018). This decline is partly due to encouragement from local municipalities to switch to other woody biomass sources, such as chips and pellets. In recent years, the consumption has more or less stabilised and has seen some slight increase. Firewood covers approximately 3% of all heat produced in 2018.

Figure 2.3 Final Domestic Consumption of Wood Fuel by Type



Source: Central Statistical Bureau of Latvia

Figure 2.4 Wood Pellet Final Domestic Consumption and Export



Source: Central Statistical Bureau of Latvia
Note: Trade data does not add up exactly to the consumption figure because it excludes production into or consumption from stock.

Consumption of wood fuels in households is dominated by firewood and pellets, with 81% of all domestically consumed firewood and 70% of all domestically consumed pellets consumed in households in 2018. Households have been the largest domestic end-use sector for pellets since 2012, with an estimated 70% of total domestic consumption of pellets consumed in households in 2019. Approximately 20% of total domestic pellet consumption was in commercial and public sector in 2019, and an estimated 9% in industry and construction sector.

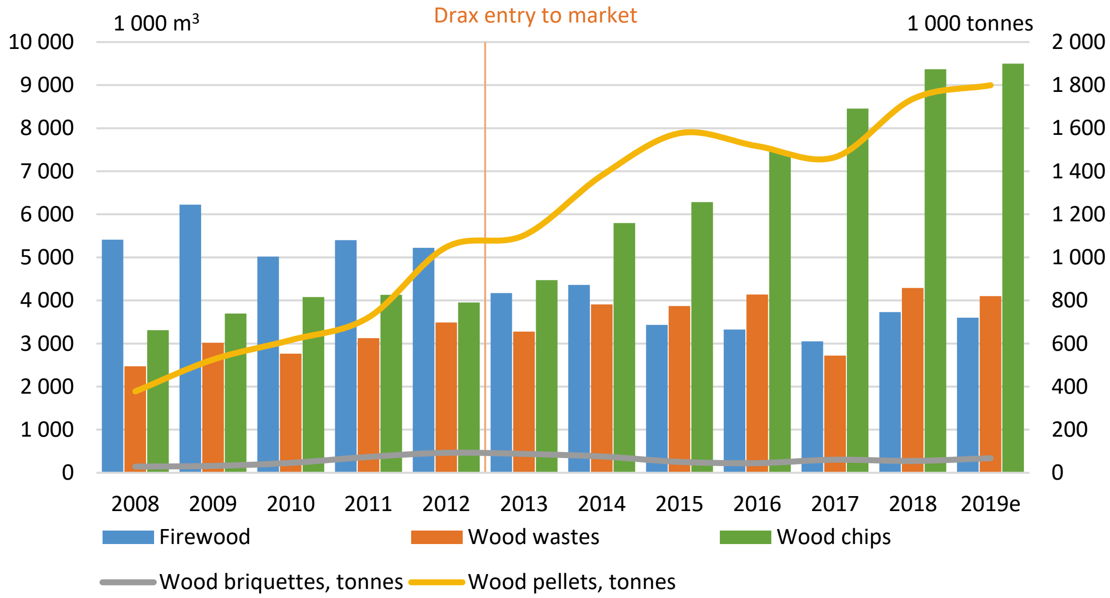
Firewood consumption in households has decreased since 2008 (-5% CAGR 2008–2018), yet remains significant, with 2.5 million m^3 consumed in 2018. Wood waste consumption in households has also decreased to 126 000 m^3 in 2018 (-16% CAGR 2008–2018). The consumption of briquettes has been increasing relatively consistently, while that of pellets has been fluctuating, reaching the highest level in 2015 of 115 000 tonnes. A downward trend for pellet consumption in households between 2015 and 2017 can be explained by a decrease in production and slowed export growth (Figure 2.5 and Figure 2.6). The pellet consumption has been on the rise again since 2018. Overall, households using wood for energy generation use less firewood and wood waste, and more briquettes and pellets. Moreover, prices for natural gas for household consumption has been decreasing recently, which might impact the overall consumption of woody biomass in households.

2.3 Production and Trade of Wood Fuels in Latvia

Raw material sources for woody biomass for energy are the by-products of the wood products industry, as well as energy wood from thinnings, low-quality logs and other roundwood and harvest residues. Harvest residues are a significant raw material for energy plants, e.g. Graanul Invest has collected 850 000 tonnes of harvesting residues in 2018 for all of its operating CHP plants, including those collected in Latvia.

Wood chips and pellets have become increasingly significant wood fuels over the last decade in Latvia, with production increasing at a CAGR of 16.5% and 11%, respectively (Figure 2.5). Graanul Invest alone produced 890 000 tonnes of pellets in their Latvian factories in 2018. The use of other wood fuels, such as wood wastes and wood briquettes, has grown at a more moderate pace, with 5.7% and 6.6%, respectively (CAGR 2008–2018). Firewood is the only wood fuel that has experienced a significant decline in production, with volumes decreasing 31% between 2008–2018. Raw material available from decreased firewood production is mainly directed to pellet production and, to a lesser extent, to wood chip production.

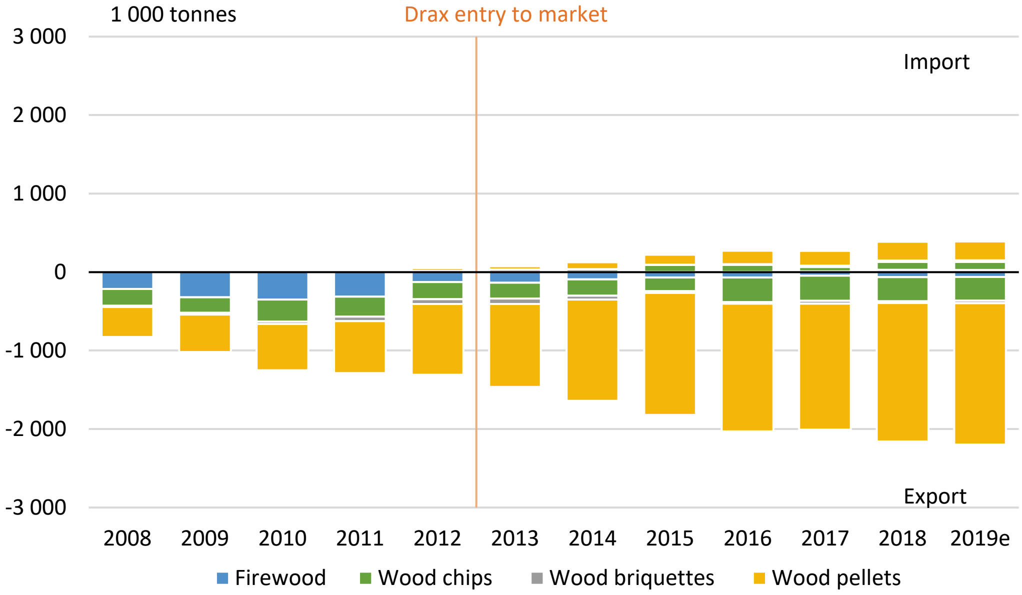
Figure 2.5 Production of Wood-Based Primary Energy Sources in Latvia



Source: Central Statistical Bureau of Latvia.

Latvia is overall a net exporter of wood fuel. Nevertheless, wood fuel imports have been increasing since 2012, particularly for wood pellets and chips (Figure 2.6). Latvia imports mostly wood pellets and chips, with 603 000 m^3 (of solid sawdust equivalent) and 570 000 m^3 respectively imported in 2018. Imported pellets are likely domestic grade (premium) pellets, suitable for household consumption. Wood chip imports in 2018–2019 have increased significantly as a result of increased imports from Belarus and due to increased prices for domestic chips. In addition, firewood and wood briquette imports have picked up significantly since 2016. Wood waste imports have experienced more fluctuations in the past, reaching the highest volume in 2018.

Figure 2.6 Imports and Exports of Wood Fuels



Source: Central Statistical Bureau of Latvia
Note: Wood waste has been excluded due to uncertainties in the conversion rate to tonnes. Conversion rate depends on the composition of wood waste, which can vary significantly region to region.

Latvia's exports mainly consist of wood pellets and chips (Figure 2.6). Exports of pellets have increased significantly, from 381 000 tonnes in 2008 to 1.8 million tonnes in 2018 (15.7% CAGR). No significant fluctuations have been observed, and despite an increased pellet consumption between 2013 and 2014, it had no significant impact on pellet exports. Majority of exported pellets are for industrial consumers.

Exports of wood chips have grown slower with some fluctuations in the last decade, reaching 1.7 million m^3 in 2018 (3.7% CAGR). Wood chip exports have decreased between 2012–2015 mainly due to decreased export demand and growth in domestic demand. Wood chip exports reached their lowest volume in 2015 of only 992 000 m^3, primarily due to increased domestic consumption. Still, the following year the export volume almost doubled to 1.7 million m^3, as the domestic demand slumped that same year. The highest exported volume of wood chips in the last decade was recorded in 2017, where it reached 1.8 million m^3. In 2018, wood chips were primarily exported to Sweden, Finland and Lithuania.

Firewood and wood waste export trends have experienced shifts during the past decade. Firewood exports increased substantially between 2008–2010 but have since dwindled. Wood waste exports increased notably between 2008–2015, but also decreased to below 2008 levels by 2018. Exports of wood briquettes have been fluctuating significantly, reaching the highest amount in 2013 with 68 000 tonnes, followed by a consistent decrease until 2017, after which exports have picked up again.

3. FOREST RESOURCES AND FOREST MANAGEMENT

3.1 Development of Forest Resources

Box 3.1 Chapter Highlights

Forest Area

- During 2000–2019, the forest area in Latvia has gradually increased by approximately 400 000 ha, mainly due to natural afforestation of agricultural lands that were left unmanaged during the Soviet regime. Corresponding development of the forest cover shows an increase from 46% to 52%.

Forest Quality

- Total growing stock in Latvia's forests has been growing steadily over the past decades. Comparison of annual increment and harvesting levels show that this development is not threatened even if harvests would be increased to the maximum level seen in the past two decades.
- In 2019, softwood species accounted for 53.2% of the total growing stock, while in 2009 (earliest comparable year) the corresponding share was 53.8%. The main driver behind the slight increase of hardwoods' share is the natural regeneration of abandoned agricultural lands. When regeneration occurs without human activities, the typical pioneer species include birch, alders and aspen.
- Latvia's vast pine forests are getting older, while the share of pine in young forests is staying relatively low.
- Regenerating clear-cut stands to birch was relatively popular in the years following the privatisation of the forest lands, which can be seen as birch having a very large share of stands regenerated 10–20 years ago. One of the reasons behind birch's popularity as a regeneration species was that Latvian plywood producers encouraged private forest owners to select birch.

Forest Ownership

- After Latvia's independence in 1991, private owners regained control of their lands. The privatisation process was completed between 1991 and 2000.
- Half of Latvia's forests are owned and managed by the state company LVM, which has been an important wood supplier to Latvian wood product industry in times when supply from private forests is low.
- Consolidation of private forest properties is an on-going trend changing the forest ownership structure. Typically, a Latvian forestry company accumulates forest properties from local small-holders, who have recently clear-cut old forest, and sells them as a larger portfolio to a foreign company. Recently, foreign buyers have been Swedish P&P companies.

Latvia has approximately 3.4 million ha of forest land, of which roughly 80% is primarily used for timber production. Latvian forest area has increased from 2.98 million ha to 3.38 million ha during 2000–2015 (as per FAO's forest area definition). In terms of forest cover, the corresponding increase is from 46% to 52%. The most important driver for the expansion forests has been the natural and artificial regeneration of abandoned agricultural lands. During the Soviet regime in Latvia, forestry and agriculture were not part of the priority sectors, which led to part of the agricultural areas being uncultivated and later being occupied by natural vegetation.

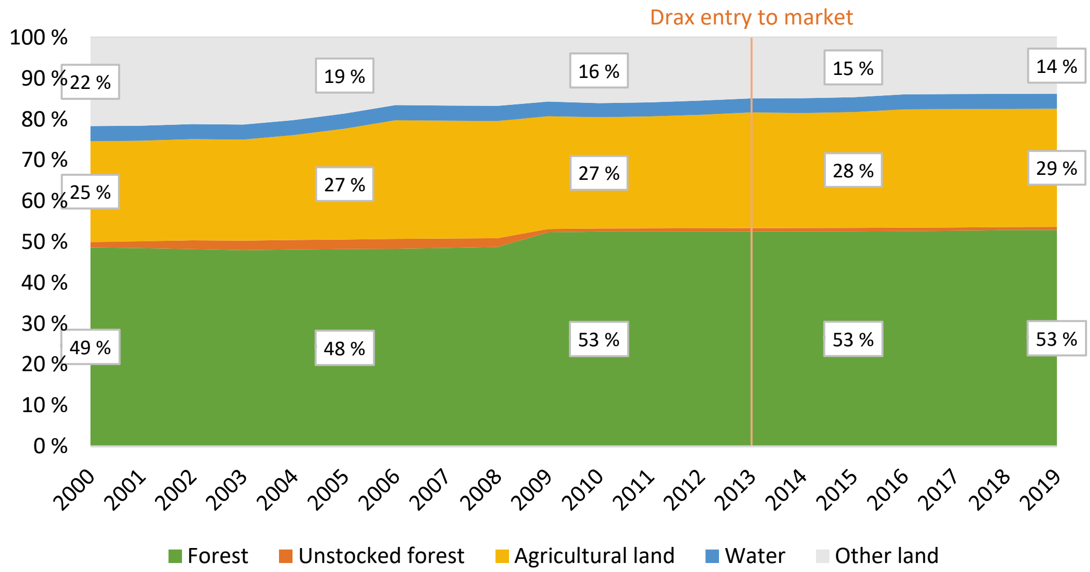
3.1.1 Land Use

Land Use Change

Over half of Latvia's land area is classified as forest, which makes it one of Europe's most forested countries (Figure 3.1). The year 2009 shows a sudden rise in the forest area, which is partly due to the availability of results from the first national forest inventory (NFI). Prior to the completing of the first NFI, the methodology of quantifying the forest area was different. However, increased forest area is also a real trend despite the methodological change. Forest area increment mainly originates from the reduction in the class "Other land", which includes abandoned agricultural areas, built areas, and other types of land uses that do not fall under forest, agriculture and water. The share of agricultural land has been increasing, but the new agricultural land is mainly acquired by converting grasslands to cropland rather than clearing forest.

Class "forest" in Figure 3.1 includes forested bogs and forest glades but excludes temporarily unstocked forests. In FAO's forest definition, temporarily unstocked areas are counted in. However, in Latvia's case, the difference is very minor.

Figure 3.1 Land Use in Latvia



Source: Central Statistical Bureau of Latvia

A recent land use map of Latvia has been added in Annex 2.

Transition from Natural Forest to Intensive Management Areas

Latvia's forests have been a target of human activities for centuries. During the 20th century, the utilisation intensity was lower because the Soviet Union's focus in Latvia was in other sectors than forestry. The present forest management is more active than in the 20th century, but due to the legally binding minimum clear-cut ages, it is still not intensive compared to the intensive management seen in short-rotation plantations.

During the past two decades, the use of artificial regeneration, i.e. planting and sowing, has become more common in terms of area. However, the share of artificial regeneration from all regeneration has been varying between 30–40%.

Considering the long rotations and large share of natural regeneration, a conversion towards intensively managed monoculture forests is not a trend in Latvia.

3.1.2 Forest Resources

Since 2004, Latvia's forests have been monitored through a systematic national forest inventory (NFI), implemented by the State Forestry Research Institute (SFRI Silava). Before the NFI, the overall resource monitoring was conducted by the State Forest Service (SFS), who aggregated data from stand-level operational inventories. As it was collected for operational purposes only, the coverage and uniformity of the collection methodology were not optimal for national level decision making. Approximately 200 000–300 000 ha of forest land is missing from the SFS' register because the owner of the forest land has not conducted an inventory. A typical forest, from which the stand-level inventory data is missing, is a small privately-owned forest property consisting of naturally regenerated abandoned agriculture land.

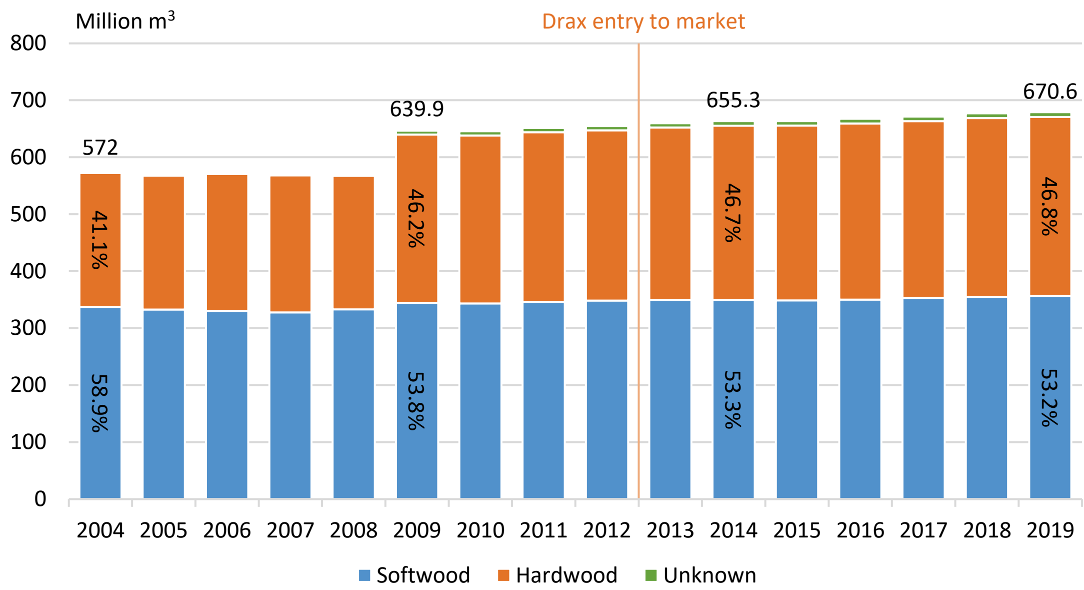
The first country-wide results from the 4-year NFI cycle were published in 2009. The NFI kick-off brought more forests under the monitoring program, which can be seen as a discontinuity in statistics covering years 2008–2009 (Figure 3.2).

Development of Forest Area and Growing Stock

Throughout the last two decades, softwood species have accounted for over half of Latvia's growing stock. However, the share of hardwoods has increased. Data from the NFI show that hardwoods' share has increased by 0.6% during the last 10 years, while the trend in operational level inventory data from 2004–2008 is not as clear as in the NFI (Figure 3.2).

During 2009–2019 (from which uniform data are available), the total growing stock in Latvia's forests has increased by 32 million m^3, which has led to a 5% larger growing stock in 2019 compared to 2009.

Figure 3.2 Development of Total Forest Growing Stock



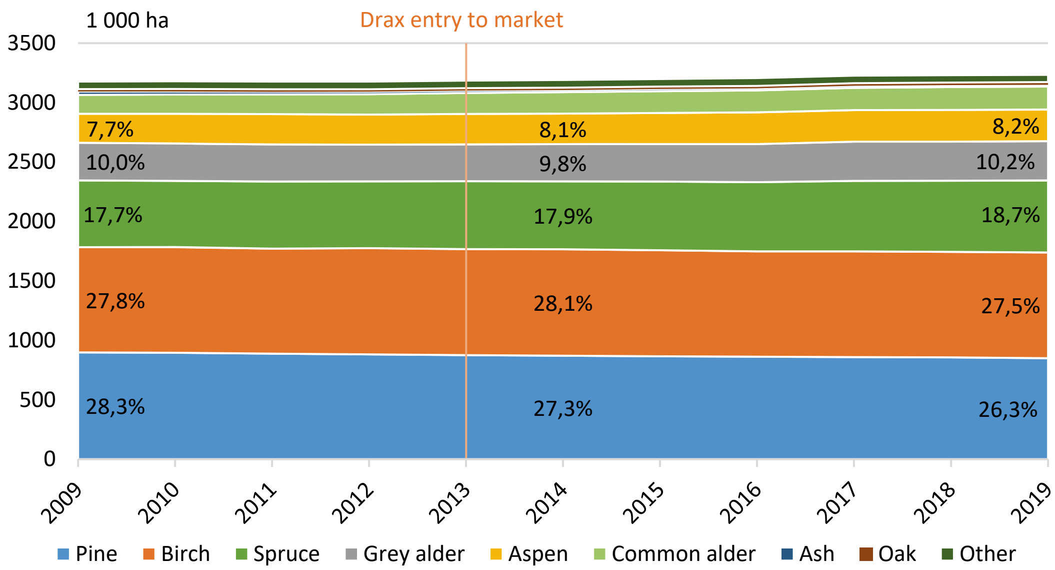
Source: State Forest Service (pre-2008), National Forest Inventory (after 2008)

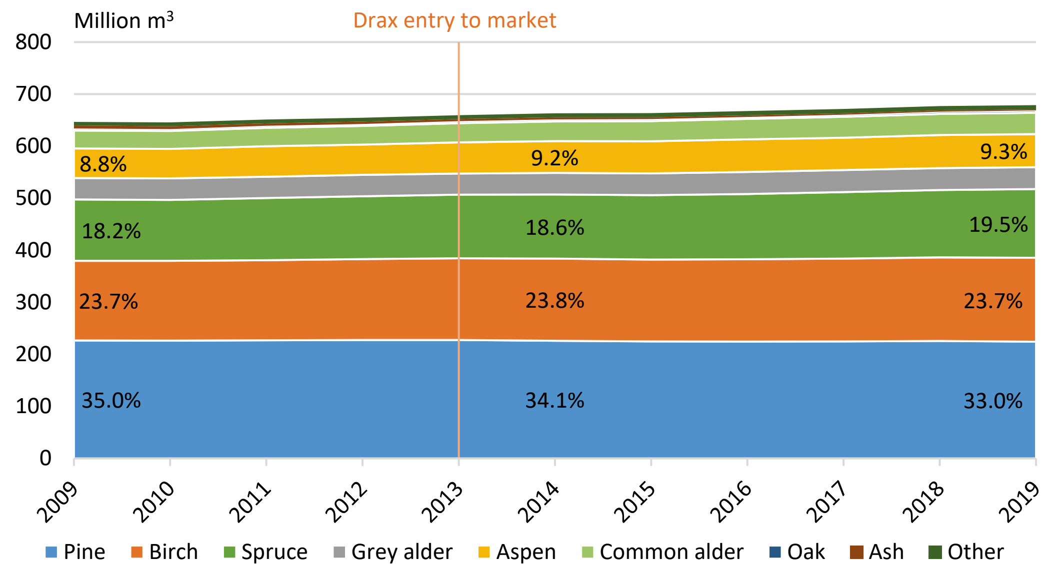
Species-specific development of forest area and growing stock is presented in Figure 3.3. Again, changing the monitoring method between 2008–2009 causes a discontinuity in the time series. Despite the changing monitoring method, the period of 2009–2019 provides a consistent examination period.

During 2009–2019, approximately 48 000 ha of pine-dominated forests have been converted to other species. In terms of area, spruce, black alder and aspen have seen the largest area increment with 44 100, 33 700 and 21 900 ha, respectively. In terms of growing stock, the total volume of spruce has increased by 106 million m^3, while pine has decreased by 94 million m^3. Changes in other species' growing stock are in total less than 8 million m^3.

One of the main reasons behind the conversion from pine to spruce is the large share of natural regeneration in private forests. When stands are not planted or sowed, pine typically does not compete well with spruce or deciduous species. An exception to this can be nutrient-poor sites.

Figure 3.3 Forest Area and Volume of Standing Stock in Latvia by Tree Species

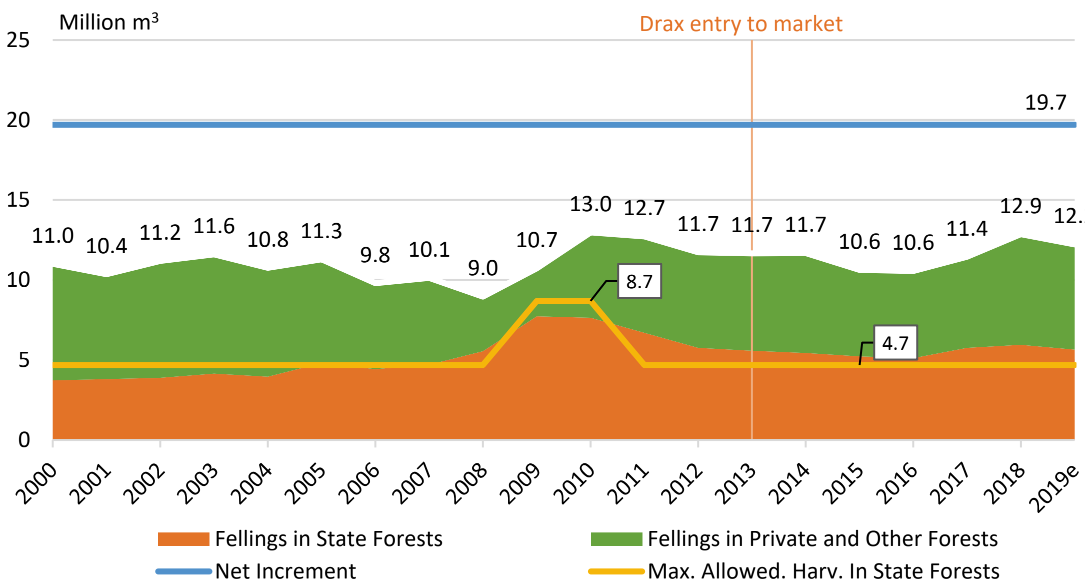




Source: State Forest Service (-2008), National Forest Inventory (after 2008)

Between 2000–2019, the annual harvesting volume in Latvia has varied between 9 and 13 million m^3 (Figure 3.4). The private sector has accounted for 50–60% of the harvests, except during 2008–2011, when Latvia, among other countries, suffered from economic recession. During the recession, harvesting levels were increased by 60% in state-owned forests to provide income for the state treasury. This large increase was enabled through a felling regulation adjustment, which allowed harvested volumes from the state forest to be increased by 4 million m³. The adjustment was put in effect in 2008 and was valid during 2009–2010.

Figure 3.4 Total Net Increment in all forests, Fellings by Ownership Type and Allowed Maximum Harvest in State Forests



Source: State Forest Service, Silava, Ministry of Agriculture

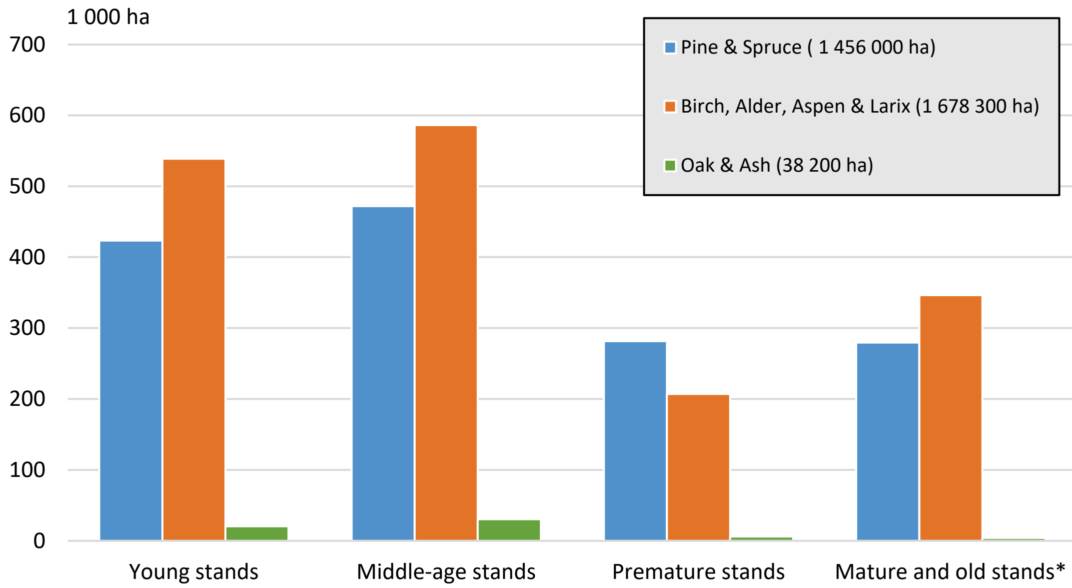
Development of Age Class Distribution by Tree Species

Figure 3.5 presents the current age distribution of Latvia's forests. For both softwood and hardwood species, there are significantly more young or middle-aged stands than mature ones. When the aim is to maintain a maximal but stable flow of wood from the forest, an evenly distributed forest age distribution is pursued. The main reason for the present age structure is that during the Soviet regime, harvest levels were lower, slowly leading to a relatively large proportion of Latvia's forests being mature. After independence and especially after the 2008 financial crisis, mature forests have been clear-cut and regenerated, thus leading to younger age structure.

In terms of area, pine, birch and spruce are the most common species in Latvia (Figure 3.5). While spruce and birch forest age structures are quite evenly distributed, two thirds of pine forests are over 70 years old. One of the reasons behind low shares of pine in younger forests is the common practice of natural regeneration after a clear-cut. Pine is typically a weak competitor against deciduous pioneer species and spruce in fertile soils. In naturally regenerated abandoned agricultural lands, it is unlikely for pine to become the dominant species, and more likely for the site to become a deciduous forest. The typical successor of spruce in naturally regenerated forests is aspen, and most of the aspen forests are young.

There is a disproportionate share of birch forests in the age class of 11–20 years, due to two factors. In the turn of the century, private forest ownership was increasing rapidly, and private forest owners were conducting their first clear-cuttings. Natural regeneration to birch was a popular option after clear-cutting in a private forest due to the low costs involved and the strong market for birch plywood. Also, the Latvian plywood companies had become worried about the availability of domestic birch and were aiming to influence the regeneration in private forests by offering, for example, forest planning assistance. Plywood companies also acquired some lands from small private forest owners, which they then afforested to birch.

Figure 3.5 Forest Area by Age Class and Species in Working Forests, 2019



Note: The chart excludes temporarily unstocked forests.
*Forests that have reached the minimum clear-cut age requirement
Source: National Forest Inventory.

Forest Ownership

Approximately half of Latvia's forests are owned by the Latvian state and managed by a company called Latvian State Forests (LVM, Latvijas valsts meži).

LVM's objective is to conduct forest management that produces economic value to the state while preserving the environmental values. Before 2010, LVM granted harvesting rights through auctions, but since 2010, the company itself has been a roundwood supplier for the industry. However, LVM does not have its own harvesting fleet nor lumberjacks. Instead, harvesting, transportation and regeneration are outsourced to contractors. In addition to timber production, LVM acquires income from selling sand and gravel or granting licences for peat extraction. According to LVM, income acquired from other than timber production activities is used to purchase forest properties from private forest owners.

Private individuals hold approximately 28% of forests, while legal entities account for approximately 20%. The share of legal entities has increased significantly during the observation period, acquiring land from private individuals. The total number of private forest owners in Latvia is approximately 144 000, which is a large number for a country with a total population of a little under 2 million. Typical property size is small, e.g. 60% of the private forest owners own less than 5 ha, and they represent only around 11% of the total privately owned forest area. The largest share of private forests is held by owners whose properties are 20–50 ha or over 1 000 ha.

Like other Baltic states, Latvia experienced major changes in forest ownership structure after regaining independence from the Soviet Union in 1991. Forest lands were returned to former landowners or their successors through the land reform and restitution process. The process took place throughout the 1990s and was finished in the early 2000s when the share of private individual's ownership settled at around 45%.

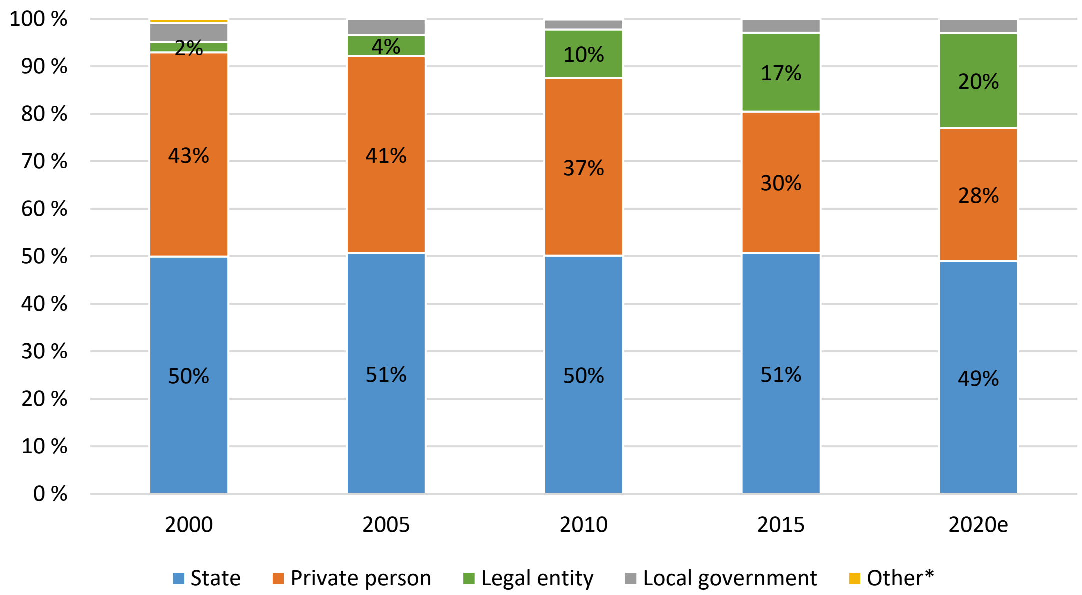
Recent key trends among private forest ownership are the consolidation of forest properties, i.e. reduction of the number of forest owners, increase in the average size of forest assets, and establishment of forest owners' cooperatives. Both trends are increasing the level of professionality in forest management among Latvian forest owners, but the progress is relatively slow. In 2012, the development of forestry cooperatives was supported by the government by providing discounts on corporate tax.

Of the 100 largest forest owners in Latvia, 67% are foreign, of which more than half are Swedish. Södra, IKEA and SCA are the major Swedish forest owners. Large corporations acquire vast forest lands by buying them from local forest investors, who have accumulated their forest assets over the years to sell the lands in bulk for high-profile buyers.

One of the latest large Latvian forest acquisitions by a foreign company was in 2018 when Södra acquired 110 000 ha of Latvian land, of which 80 000 ha were forests. The selling company was Bergvik Skog and the transaction price approximately EUR 324 million. Bergvik Skog originally was a joint company of Stora Enso and Billerud Korsnäs. Since already Bergvik Skog's major wood buyers were Nordic P&P companies, the acquisition's impact on roundwood exports might not be as significant as could be expected.

The largest local forest owner in Latvia is the City of Riga, managing a total of 65 000 ha mainly outside the city borders.

Figure 3.6 Forest Ownership Development, % of Forest Area



Note: Other land includes joint mixed-status ownership land and reserve fund land.
Source: FAO GFRA Country Report Latvia 2015, Indufor estimation.

3.2 Forest Management Practices

Box 3.2 Chapter Highlights

General

- The Law on Forests sets definitive boundaries and requirements for forest management. No additional official forest management recommendations exist.
- State forests have traditionally been well-managed, while private forests, especially those owned by smallholders, have been inactively managed.
- In Latvia, 1.02 million ha of forest area is FSC certified and 1.72 million ha PEFC certified. About 845 000 ha is dual certified and 56% of all forest lands are certified.
- The Law on Forests is stringent and considers environmental and cultural values thoroughly, which has discouraged forest owners from paying for forest certification.
- The Law on Forests currently restricts the maximum clear-cut area to 5 ha, and 10 ha in certain dry pine forests.

State forests

- The quality of forest management has remained at a good level in state forests.
- The state forests are committed to providing a stable wood supply with volumes that can be easily predicted by the long-term management plans, despite market fluctuations.

Private forests

- Natural regeneration is the most popular reforestation method in Latvia. Many naturally regenerated forests later grow with spruce and broadleaves, which has increased the area of these species and diminished the stocks of pine. Subsidies exist for regenerating forests damaged by fire, wind and floods, among others.
- The increase in energy wood demand has made the maintenance and thinning of previously unmanaged hardwood (especially alder) stands economically viable. Also, the Rural Development Fund (funded by EU) has been made available since 2009 to motivate pre-commercial forest management activities.
- Companies and forest owners' cooperatives own an increasing share of the forest land in Latvia. This area is expected to continue growing, which is also expected to increase overall forest management activity. This development is, however, slow.

3.2.1 Change Drivers of Forest Management

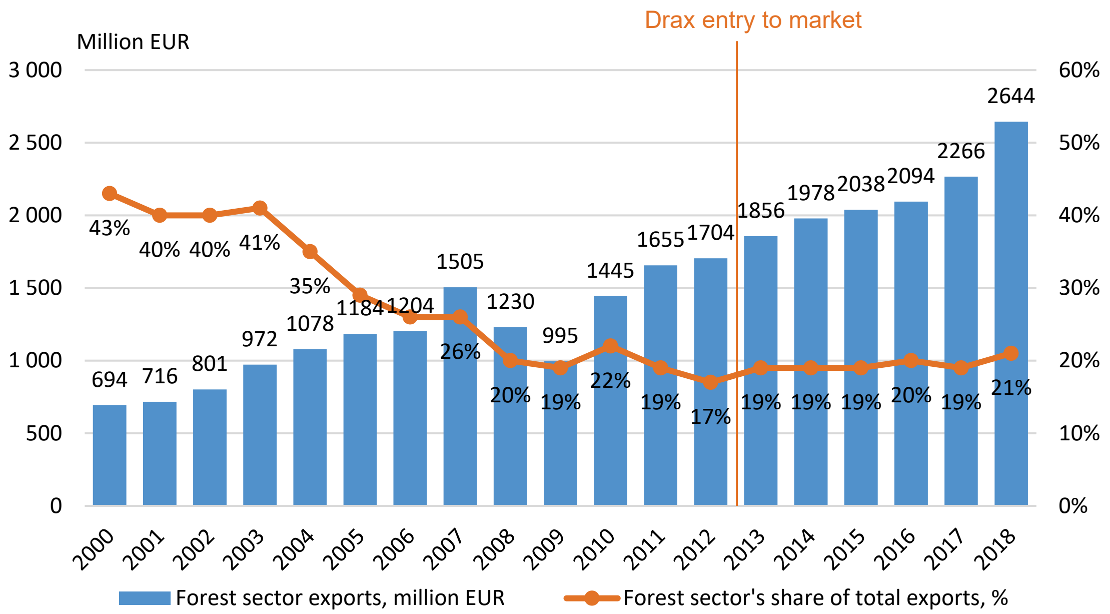
The direction of forest and forestry development is determined by both internal and external factors to the sector. The impact of external factors on forests and forestry can be direct or indirect. These may include changes in demographics, the economic situation, policies and institutions, scientific and technologic progress and the responses of society to critical environmental changes. These often have a significant impact on how forests are managed.

Political, Institutional and Economic Environment

The Latvian population is declining rapidly. The population peaked in 1990 at 2.67 million people, just before its independence from the Soviet Union. Since then, the population has decreased by 28% to 1.92 million in 2019, due to both negative natural population growth and negative net migration. The population decrease was the steepest in the European Union in 2018, and it is a stern challenge for Latvia. The country's urbanisation rate is 68%, and 33% of the population resides in the capital Riga. The proportion of rural and city-dwellers has remained practically unchanged during the last ten years. Urbanisation is commonly regarded as a change driver for forest owners' attitudes, thus affecting forest management practices.

Despite the declining population, Latvia's economy has been growing with its annual GDP growth rate varying between 6.3% and 1.8% since 2011, when it recovered from the recession. The cornerstones of the Latvian economy are agriculture, the chemical industry, logistics and the woodworking industry. The forest sector contributed 5% of total Latvian GDP in 2018. The forest sector has always been Latvia's main net export sector, although its share of total exports has been declining due to diversification of the country's export portfolio (Figure 3.7). However, the value of the forest sector exports has increased at an 8% CAGR since 2010, reaching 2.6 billion EUR in 2018 (Figure 3.7). About 71% of the forest sector output is exported. The sector is mainly composed of professional forest management services, sawmilling and production of further processed wood products. The pulp and paper sector has not established a presence in Latvia, and raw materials that would typically be utilised by the P&P sector are exported to a large extent.

Figure 3.7 Latvian Forest Sector Exports and Share of Total Exports



Source: Central Statistical Bureau of Latvia.

Forestry and woodworking are traditional industries in Latvia, which has also created a strong regulatory environment around the use of this natural resource. The current political climate is based on a very intense history of forest management and ownership, which can be characterised by the development of the forest cover. It was at its lowest in 1923, only 23% of total land area, and has since then more than doubled to 50%. Much of the increase in forest cover is due to afforestation of abandoned agricultural areas. During the Soviet era, large parts of abandoned agricultural lands overgrew with mainly broadleaved forests. These lands were largely privatised during the beginning of the Latvian independence, whereas the state-owned forests tend to be more coniferous due to those lands being forested in the past. Private forest ownership is also very fragmented as a result of the restitution process in the 1990s.

Policies on forest management have evolved since Latvia gained independence. Two historical periods of policymaking can be distinguished – the continuation of Soviet-style policies during 1988–1999, and a new, sustainable management system from 2000 onwards. During the continuation of Soviet-style forest management, state-owned forests were divided into three groups based on their function: production, low-intensity management and protection forests. All categories had their strict limitations on felling ages, regeneration practices and maximum clear-cut width. Forest stands were established as similarly sized rectangles, so maximum clear-cut width was used instead of area. During the last 20 years, the legislation was changed to be more flexible: forests were divided into categories based on their measured productivity instead of declared function, clear-cuts could be carried out if either the minimum age or diameter was achieved, maximum clear-cuts were determined by area instead of width, and regeneration practices allowed both natural and artificial regeneration. Biodiversity issues were considered as well: retention trees and dead wood were required after clear-cutting.

Environmental protection laws were established in tandem with forest policies. During the Soviet era and for a while after, many nature protection areas were established, and many forest areas placed under stricter management limitations than normal forest lands. Such areas include, but are not limited to, protective belts around electric lines, water bodies, cultural monuments and special micro reserves. Today different restrictions apply to 495 000 ha of forest areas, including 237 000 ha where management activities are completely or significantly prohibited. Around 85% of the total forest area is free of any management limitations. In addition to environmental protection laws, the Latvian Forest Law is among the strictest in Europe regarding biodiversity and sustainability issues. Latvia has succeeded in protecting its abundant biodiversity by exceeding the 2020 Aichi targets, with more than 16% of marine waters and 18% of land area under some form of protection. Natura 2000 areas cover 745 000 terrestrial ha (12% of total land area) and 440 000 marine ha. However, most protected areas lack management plans and are chronically short of human and financial resources.

Latvia began implementing forest certification systems in the late 1990s. Both FSC and PEFC are in use, although PEFC is more popular with 1.72 million ha covered in 2019, as compared to 1.02 million ha covered by FSC in 2018. Dual certification covers 845 000 ha. A bit more than half of Latvia's forests are certified, which is near the OECD average but well below other forest-rich countries. Certification schemes are mostly driven by export partners' demand, since many Latvians think that the national forest laws already set high standards for forest stewardship and that there is no advantage in paying for certification.

Latvia's National Development Plan 2014–2020 is the main medium-term strategic policy for the country's development, and it includes the Forest Strategy. The plan includes an objective on natural capital, which aims to increase the organic farming area and forest coverage, promote the sustainable use and biodiversity of the land and other natural resources, and conserve species. The Forest Strategy guidelines are harmonised with other, related policies and updated to respond to new challenges of the forest sector, such as the role of forests in climate change mitigation. To consider opinions of different interest groups, the Forest Advisory Board has been established. The interests of private forest owners are represented by the Latvian Forest Owners' Association. Company interests are represented by Latvia's Timber Industry Federation locally and internationally. The State Forest Service is responsible for supervising that the national laws and government regulations relating to forest management are followed.

On a higher, long-term level, the Sustainable Development Strategy of Latvia until 2030 ties together the development goals for the sustainable use of culture, nature, economic and social capital. The strategy states that the government should introduce a plan for the preservation and restoration of natural capital at the state level, which would also include spatial planning of nature preservation and restoration, as well as reforesting low value abandoned agricultural lands. The strategy also considers relevant international and EU strategies, such as the EU Biodiversity Strategy and the EU Forest Strategy.

Legal Framework of Latvian Forest Management

Forest management is strictly regulated by the Latvian Law on Forests and subsidiary regulations, such as the Regulations on Tree Felling in Forest Lands. The law regulates the full forest harvesting cycle and any associated management practices with specific threshold values and guidelines. There are two main purposes of this law:

1) To promote economically, ecologically, and socially sustainable management and use of the forest by ensuring equal rights, inviolability of the ownership rights, and independence of economic activity of all owners or lawful possessors of the forest, and determining equal obligations, and
2) To govern the conditions for the management and alienation of the State forest land.

The law has been amended many times during the past 20 years.

All private forest owners who wish to do commercial harvesting are required to have a forest management plan covering a 20-year period, based on a full forest inventory. The management plan is made by the State Forest Service, although the owner's wishes and goals are considered as a priority. A typical harvesting process begins with the landowner having to acquire a harvesting permit from the State Forest Service before any harvesting activities can be initiated. The permit includes information on the forest property, harvesting area, contact details of forest owner, etc., allowing the harvested wood to be tracked back to its origin. Before the permit is granted, the State Forest Service officers randomly conduct check-up and monitoring activities to ensure that the forest property is in line with the legal requirements. The permit is not required for pre-commercial thinning, cutting of dead and windfall trees, maintenance of forest clearings, etc.

Clear-cutting is strictly regulated by threshold values that must be achieved first for either rotation age or average diameter (Table 3.1, Table 3.2; a more detailed description of the law can be found in Annex 1). In practice, the diameter is often the first criterion that is met. Different thresholds apply to different forest quality classes (bonitet classes) that are based on the site's wood production ability: quality class I is the most productive, class IV is less productive and so on.

Table 3.1 Minimum Clear-cutting Age by Tree Species and Quality Class

Dominant tree species	Quality class (Bonitet)		
	I and Higher	II-III	IV and Lower
Oak	101	121	121
Pine and Larch	101	101	121
Spruce, ash, linden, elm, flattering elm, and maple	81	81	81
Birch	71	71	51
Common alder	71	71	71
Aspen	41	41	41

Source: Law on Forests

Table 3.2 Average Diameter (cm) at Breast Height of Dominant Tree Species to Allow for Clear-Cutting

Dominant tree species	Quality class (Bonitet)			
	Ia	I	II	III
Pine	39	35	31	27
Spruce	31	29	29	27
Birch	31	27	25	22

Source: Regulations on Tree Felling in Forest Lands

Maximum clear-cut area (including adjacent forests, regardless of owner, see Annex 1) is restricted to:

- 5 ha normally
- 10 ha in dry areas, provided that no less than 20 pine seed trees per ha of felling area are left standing
- 2 ha in sensitive forests
- 2 ha in the restricted management belt along the Baltic Sea and the Gulf of Riga coastlines, where clear-cutting of pine stands is prohibited altogether
- If no more than 0.3 ha are left outside the clear-cut area, it may be included.

After harvesting, roadside piles of wood are usually covered and marked with clearly distinguishable markings for state or private owners. Collection of raw material from roadside requires availability of the information of the sourcing area, volumes, species, type of raw material, owner and contractor. Declarations on timber transactions are required to be available upon request from authorities. Waybills are required to be available in transporting raw materials and undergo random monitoring check-ups by the regional State Forest Service officers. Waybills also must contain information on the origin of wood and a reference to harvesting permit, along with other documentation. Transportation to and from foreign countries requires additional documentation in accordance with international laws.

In addition to thinning and clear-cutting, the Law on Forests also regulates every other type of felling of trees, such as sanitary, landscape, random and deforestation felling. Even the forms for measuring basal areas, average heights and diameters are provided. Forest regeneration and afforestation are also strictly regulated. The threshold values for successful regeneration are 3 000 trees/ha for pine, 1 500 trees/ha for hardwoods and 2 000 trees/ha for spruce and other species after 5 years (10 years on marshy sites) of clear-cutting (Annex 1).

Currently the Latvian Ministry of Agriculture is discussing possible changes in the regulations on tree felling. The main point of contention is lowering the minimum diameter of trees that can be cut down in fertile soils, but artificial regeneration would be mandatory for these areas. If clear-cuts were done according to age limitations (usually reached much later than diameter limitations), regeneration could also be done naturally. The aim of the change is to harmonise the final felling criteria with Estonia and improve the competitiveness of fertile forests by ensuring they are regenerated with better planting material and valuable species. The proposed change would be more ideal for forest industries and would give forest owners more flexibility to decide when to clear-cut. Both foresters and environmentalists have grasped the opportunity to affect the on-going policy-making process. An open letter from foresters asked for sustainability and smart forest management to be considered in the form of more flexible regulations, while environmental organisations announced opposition for such changes.

Nature protection is an integral part of the Latvian Law on Forests. A forest owner has to follow the general nature protection requirements to secure the preservation of forest biodiversity, to preserve the forest’s ability to protect soil from erosion, to protect the surface and subterranean waters from pollution, to protect significant cultural heritage elements in the forest, as well as to facilitate the forest’s stability and adaption to climate change. Such regulations make Latvian forestry one of the most strictly regulated in Europe. The State of Latvia has been mapping high-conservation value forest areas, which would eliminate the need to do the present detailed assessments in future harvesting operations as the information on these areas would be publicly available and incorporated into harvesting permit attainment requirements.

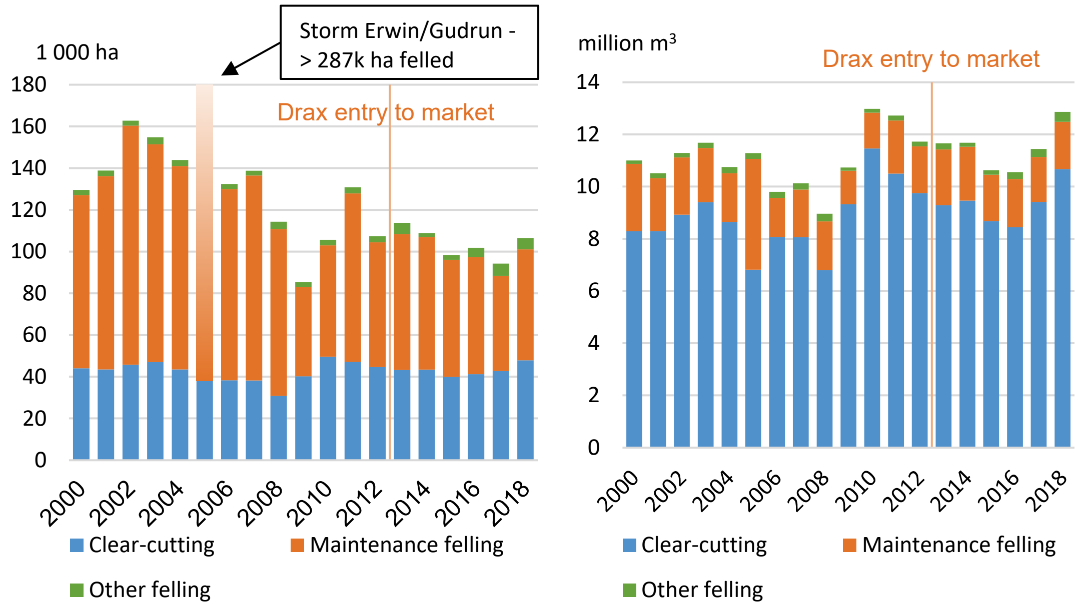
3.2.2 Changes in Forest Management Practices

Forest management practices include actions, such as thinning, regeneration, fertilisation and tending that are undertaken to reach desired outcomes in a forest stand. In Latvia, there are differences in forest management practices between private and public forest owners. High fragmentation and small parcel sizes of private forest owners are discouraging their long-term economic management planning. Public forests are usually more strictly managed by the Law on Forests.

Fellings

Harvesting areas and volumes have remained quite stable in Latvia, although an overall declining trend can be seen between 2002–2008 and 2010–2016 (Figure 3.8). A notable outlier in the statistics is in 2005, when the severe storm Gudrun – or Erwin as it was named in the Baltics – swept over large parts of Northern Europe and the Baltic countries at the beginning of January, hitting Sweden and Latvia especially hard. The EU solidarity fund was mobilised in many countries to clean up forests from the excessive amounts of residue and dead wood to prevent insect outbreaks from damaging the surviving forests in the following years. Altogether, 11 500 ha and 11.3 million m^3 were felled in Latvia that year. In 2008, Latvia fell into economic recession along with the rest of the world. Maximum harvesting levels were temporarily increased by 4 million m^3 in state-owned forests for the years 2009 and 2010 to provide for the state treasury, while private forest owners decreased their fellings in 2008–2009 since timber prices were low (Figure 3.4, Figure 4.4). However, by 2010 the total felling volume had reached the highest level of the last 20 years, with 13 million m^3 felled. After another decline until 2016, felling volumes are now increasing (Figure 3.8). Currently, the national felling volume is approximately 65% of the national forest increment, which means that the felling level could be increased further.

Figure 3.8 Felling Types



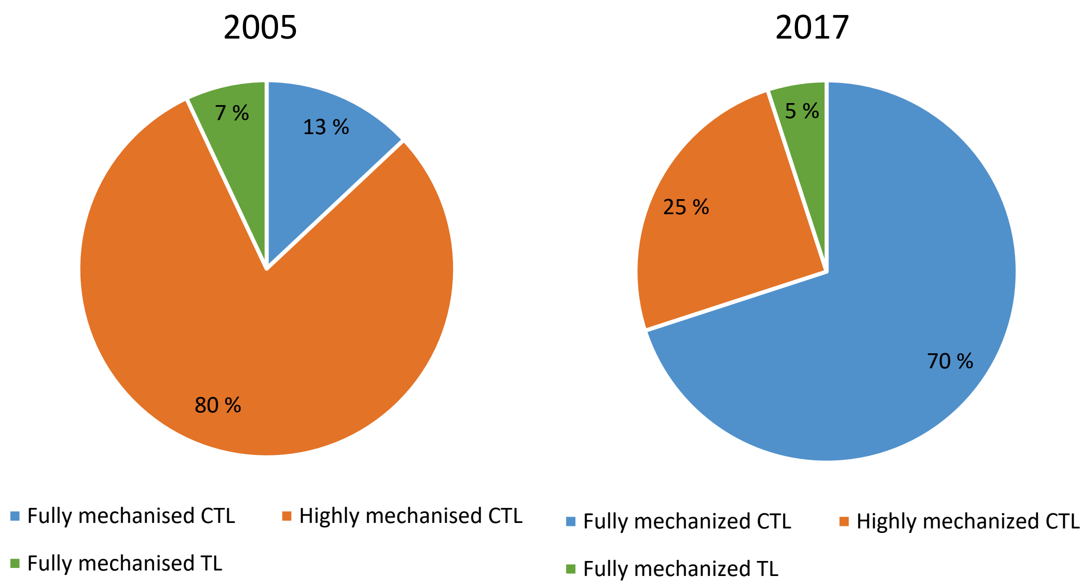
Source: Central Statistical Bureau of Latvia

It is estimated that the flow of roundwood from forest fellings should not fall below 10 million m^3 per year to satisfy the needs of the forest industry. The possibilities for importing wood are somewhat limited, so the industry relies on local resources. Approximately half of the supply originates from state forests, and the rest from non-state owned forests (Figure 3.4). While the state forests provide a stable wood supply with volumes that can be easily predicted by the long-term management plans, private forest owners are more volatile in their management practices. In general, private forest owners that own less than 20 ha (91% of the total number of private forest owners and 39% of private forest land) primarily cut forests for their own needs, mainly for firewood, or to cover personal expenses, investments or loans. The main deciding factor for harvesting is the price of timber, but forest owners do not usually want to sell for less than what has once been the highest price and will wait until prices are better. Large-scale forest owners with more than 50 ha (2% of the total number of private forest owners and 41% of private forest land) are more active in regular forest management and timber sales.

It is important to bear in mind that most private forest owners did not pay for their forests but inherited them or got them through the privatisation vouchers during the first years of Latvia's regained independence. Only a small portion of forests have been obtained from the market. As such, private forest owners do not act like investors and do not plan forest management based on market situations or economic calculations. In most cases, private forest owners of small properties consider their property as a deposit for themselves and future generations and are not interested in selling timber. Forest management is, to a large extent, controlled by the Law on Forests, which means that taxes and subsidies do not play a significant role in private forest owners' decision-making process. However, it can be noted that subsidies for tending have increased the levels of tending in private forests.

The most common harvesting method in Latvia is the cut-to-length method (CTL). Fully mechanized CTL consists of a harvester-forwarder chain, and it accounts for up to 70% of all harvests. Highly mechanised CTL replaces the use of harvesters with manual chainsaw felling, and it accounts for 25% of total harvests. There has been a large shift in harvesting practices since 2005, when highly mechanised CTL was still the dominant practice, accounting for up to 80% of all harvests, and fully mechanized CTL for only 13%. This shift can be explained by a change in the legislature. Until the year 2005, the area of forest machine tracks could not exceed 12% of the total area of the forest stand during felling, which meant that the distances between strip roads could not be less than 30 metres. A harvester boom could not cover the whole area between corridors so far apart. In 2005 the legislation changed to allow 20% of forest stand area to be covered by machine tracks, which meant they could be drawn 20 metres apart and the harvester boom could reach all trees in the stand. The new regulation effectively forbids the use of small-size machinery, which requires even narrower distances between strip roads, but are handy especially in energy wood harvesting. The tree-length method (TL), where whole trunks of trees without treetops are moved with agricultural tractors with a winch or skidder instead of a forwarder, is not very popular in Latvia.

Figure 3.9 Harvesting Practices in Latvia



Source: Moskalik et al. 2017: Indufor analysis

Collection of Felling Residues

The collection, chipping and utilisation of harvesting residues has become more prominent in Latvia in the past decade. Collected harvesting residues are used to produce chips for energy production. Majority of the harvesting residues are left in situ to improve the bearing capacity of the soil for the logging tracks, and due to the current availability of alternative low-value wood assortments for energy generation, e.g. small diameter roundwood from the clearing of former agricultural lands, roadsides and ditches (Figure 3.10). A lot of wood residues used in energy generation are collected from clear-cut stands in former agricultural lands. Foliage and tree stumps are not commonly collected or utilised and as such, not included in the estimation of the utilisation of harvesting residues.

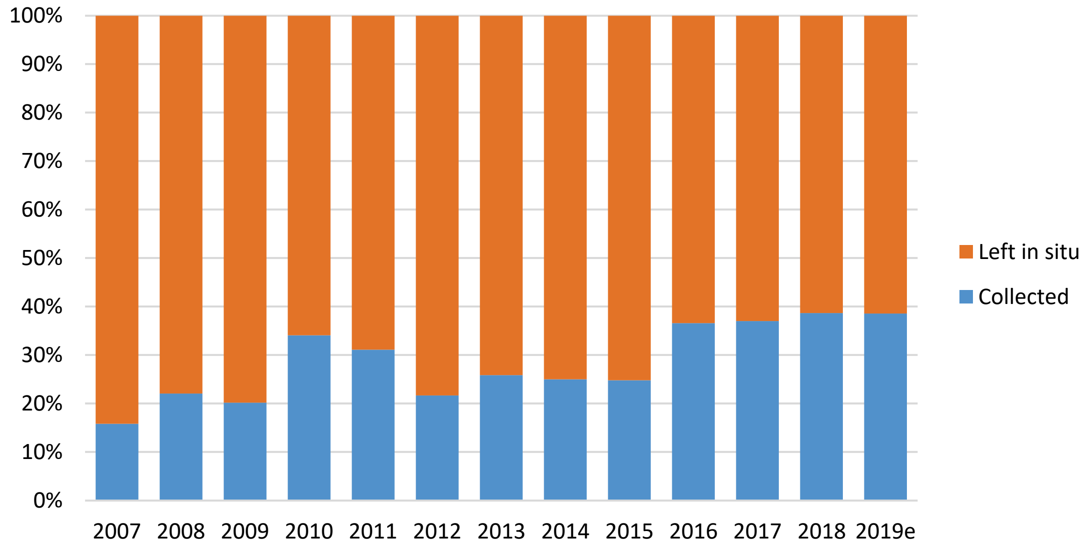
Harvesting residue collection was minimal 15 years ago, but with the increased demand from the energy sector with new investment into CHP and heat plants, the collection of harvesting residues has grown. The use of harvesting residues has grown as a result of continued investments into renewable energy generation in the last decade; woody biomass consumption in CHP plants has been steadily increasing since 2012. As a result of increased demand, prices for harvesting residues have increased in the last 15 years, providing incentives for private forest owners. The energy market is the only notable market for harvesting residues, and they remain as an important raw material for energy plants. Also, small households have started to switch from oil to wood (pellets or firewood) for heat production.

Forest residue utilisation has fluctuated significantly since 2007, with an evident increasing trend, in which approximately 16% of forest residues were collected in 2007 and about 39% in 2018. In the last three years, the utilisation level has remained more stable. Due to bad weather conditions in autumn 2019, a lot of harvesting residues were left to improve the bearing capacity of soil for forwarders, and the total amount collected in 2019 is estimated to have slightly decreased.

One of the reasons for low utilisation is the high cost of collecting and transporting harvesting residues from small stands. Also, the majority of the harvesting residues are left to improve the bearing capacity of the soil and to improve the local soil conditions. Overall, the gap between available and collected residues has been narrowing in recent years.

Residues are collected usually when the right ecological and economic conditions are in place, such as access to road and storage, residue price and cost of collection, soil conditions, relevant permits, among others.

Figure 3.10 Utilisation of Harvesting Residues (Branches and Treetops)



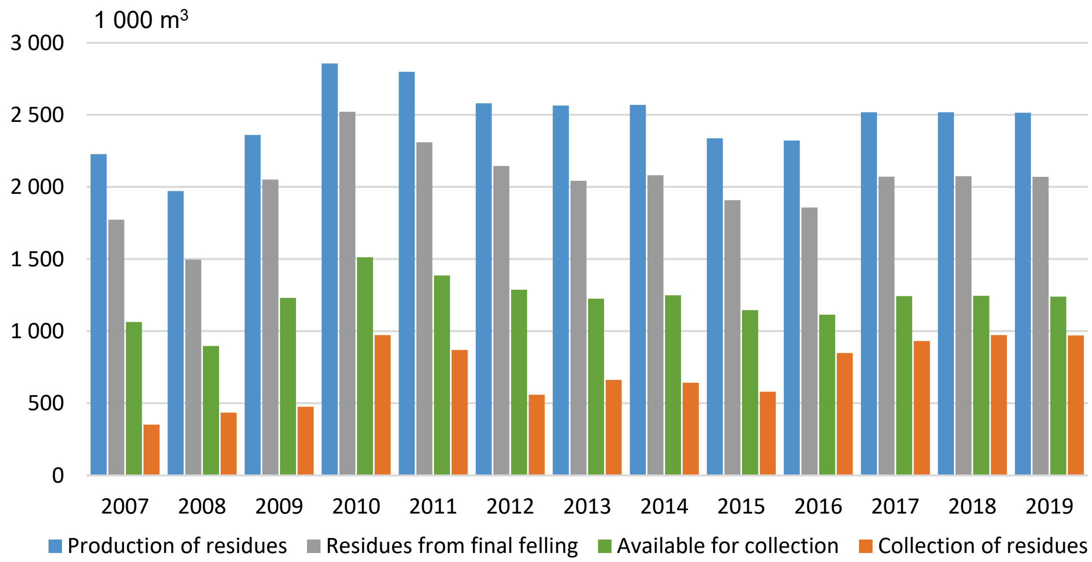
Source: LVM 2019, Indufor analysis

As was highlighted earlier, the most common harvesting method is CTL, which has become increasingly mechanised and further enabling collection of harvesting residues. Most harvesting residues are produced on-site and not transported out of forest stands, but the share of utilised residues transported out of the forest stands has been increasing. The overall wood chip production cost from harvesting residues has been decreasing due to increased mechanisation of the harvesting methods. Improved mechanisation has had a positive impact on the availability and cost of harvesting residues.

In Latvia, most of the harvesting area is allocated for maintenance felling, but in terms of harvesting volume, the share of clear-cut areas is estimated at 80%. As a result, harvesting residues are collected mainly from clear-cut areas, while the collection of maintenance harvest residues is more complicated. Due to local soil conditions and topography, it is estimated that 60% of the harvesting residues from clear-cut stands would be available for collection. Harvesting residues from thinning operations are rarely collected due to cost and poor accessibility. Approximately 70-80% of the available harvesting residues are collected currently, which is a significant increase from 33% in 2007 (Figure 3.11). The share of harvested residues collected is higher in public forests. Public forest owners can store residues for up to 6 months.

Private forest owners do not go out of their way to collect residues and often do it if economically feasible, for instance, if the hired harvesting company also offers services to collect residues. It is estimated that on average, approximately 0.2 m^3 of branches and treetops are produced per each cubic metre that is harvested from the forest.

Figure 3.11 Estimation of the Utilisation of Harvesting Residues (Branches and Treetops)



Source: LVM 2019; Lazdiņš, A. and Lazdina, L., 2009; Indufor analysis

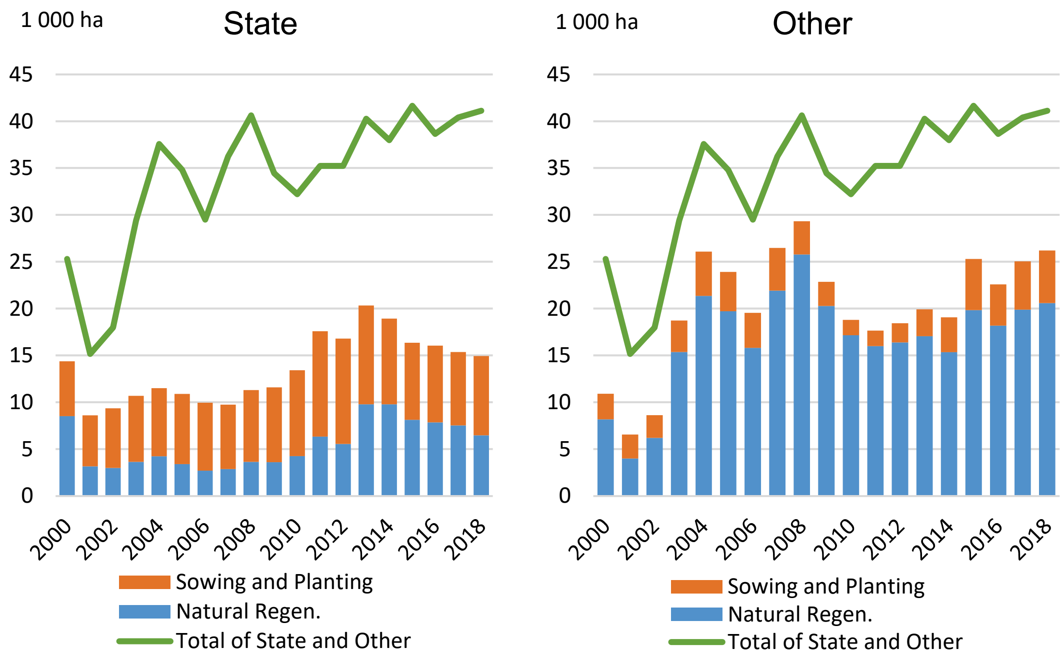
Harvesting residues are collected all over Latvia. Most of the harvesting residues are collected from forests with better soil conditions, occupying about 90% of the total forest area. Nearly half of the poor soil sites have wet soil where harvesting residues are almost entirely used for stabilisation of logging tracks. The rest is considered dry forest type, and there is generally low motivation for a forest owner to collect harvesting residues, mainly due to high costs of forwarding and economy of operation of mobile chipping equipment.

Since the national felling volume is only about 65% of the national forest increment, the felling level can be increased in the future, which would increase the potential availability of harvesting residues too. The demand for harvesting residues has risen significantly in the last 15 years, and it is expected to continue to grow.

Forest Regeneration and Other Forest Management Practices

Latvia regenerates around 40 000 ha of forest land per year. The share of natural regeneration has remained steadily at around 65% of the total reforested area during the past 20 years, and sowing and planting cover the remaining 35%. A forest stand is registered as planted or sown if the number of trees planted or sown exceeds 50% of the minimum required density. Regeneration practices vary between state and private owners: the state prefers artificial regeneration practices (on average 60% of state reforested area), whereas private forest owners strongly rely on natural regeneration (on average 80% of the private reforested area) (Figure 3.12). Private forest owners regenerate more forest area than the state per year, exceptions were years 2011–2014 and all accounted years before 2002. The total regenerated area has more than doubled since the beginning of the century. State and the EU support for forest reforestation in low-value forests or after fires and natural disasters is available in Latvia, but the amounts are only a few hundred ha per year and do not affect the rate of reforestation.

Figure 3.12 Regeneration Practices by Type and Ownership



Source: Central Statistical Bureau of Latvia

As seen from Figure 3.12, the state forest regeneration is quite stable over the years, while private forest regeneration fluctuates a lot. The pattern is similar for final fellings (Figure 3.4), and the reasons are the same: state forests aim to provide a stable raw material supply for the national forest industries, while private forest owners cut their forests when wood prices are high. The state has regenerated more forests than usual between 2011–2014, which can be explained by the 2008 financial crisis and consequent increase in state forest harvesting between 2009–2012 (Figure 3.4). Increased harvesting increases forest regeneration levels with a few years delay because the regeneration is usually done a year or two after the clear-cut, and only successfully generated areas are accounted for. In private forests, the regeneration trend follows the trend on wood prices (Figure 4.4, Figure 4.6) with a slight delay.

Forest regeneration area has been increasing since the 1990s. The increase is partly due to regeneration fellings being done on areas that were afforested at the beginning of the 20th century, and partly due to more accurate accounting methods. Another contributing factor is the development of relevant legal framework and amendments to it, as well as educational measures targeting forest owners. In 2012 the regulations on forest regeneration were updated to give forest owners more freedom to choose the regeneration method, species and tending practices. At the same time, the forest owners' responsibility for successful regeneration increased. The current regulations are presented in Annex 1.

In the past, it was common for private forest owners to leave forests to naturally regenerate without any assistance, but during the last 20 years, the owners have realised that natural regeneration is ineffective under certain circumstances. Besides, natural regeneration usually leads to deciduous forests which are less valuable than coniferous forests. Sowing and planting have become more popular in recent years. The increased share of land in institutional private ownership has also increased the popularity of artificial regeneration, as investors aim at shortening the forest rotation cycles. By far, the most popular soil preparation method in Latvia is disc trenching. However, spot mounding is becoming increasingly popular as up to 30% of forests in Latvia grow on wet soils where disc trenching does not provide satisfactory results.

3.2.3 Impacts of Changes

Production of Sawn Timber

Both the increase of forest area and growing stock indicate a good outlook for the raw material supply for sawn timber in the long term. However, there is a shift in species composition from pine to spruce and broadleaved forests due to afforestation of agricultural lands resulting in mostly broadleaved forests and the preferred method of natural regeneration in forestry resulting in mostly spruce or broadleaved forests. Such a shift in the species composition will be visible in the domestic raw material supply for sawn timber of Latvia in the short term.

The trend of private forest ownership consolidation will increase the level of professional management in forests, improving the roundwood quality and shortening average rotation times. Smallholders are not very active forest managers but can be activated with incentives such as meaningful profits from harvesting residues. On the other hand, the increasing importance of climate change mitigation goals may create political pressure for reducing fellings in the future.

The Law on Forests regulates minimum forest age and diameter for clear-cuts. In state forests, i.e. half of Latvia's forests, stands are usually clear-cut as soon as either of the requirements is fulfilled, while considering LVM's sustainable forest management strategy. Sawlog price is a more important driver for final-felling decision than wood-based bioenergy demand. Due to the strict regulations on forestry and tree felling, an increase of wood-based bioenergy demand has not shortened rotations. There is a call to lower the final felling diameter limit and put stricter regulations in place for forest regeneration if they are cut according to the diameter. Mandatory artificial planting would improve timber quality and increase the share of valuable species in the long term.

Growth Rate, Carbon Sequestration and Carbon Storage of Forestry

Latvia's greenhouse gas (GHG) emissions have decreased by 1.3% since the mid-2000s, as a result of improved energy-efficiency and increased use of renewables (mostly woody biomass) that now cover 40% of Latvia's energy needs. However, GHG emissions from the agricultural sector grew to about a quarter of the total and are expected to continue rising, estimated to account for 30% of GHG emissions in 2030. This is due to the expansion of agricultural land, cultivation of organic soils, growing amounts of production and livestock, and increased use of nitrogen fertilisers. Total GHG emissions are projected to more than double from the 2005 level by 2030. Besides, the LULUCF sector's GHG sequestration capacity has been slowing since 2005, and it became a net GHG emitter in 2014 as a result of increased logging, forest ageing and conversion of grasslands into croplands.[1]

In forestry, a trade-off exists between maintaining a high carbon sequestration rate and high carbon storage. Young forests have a high growth rate and thus a high carbon sequestration rate, however, their carbon storage is small. Old forests have a lower carbon sequestration rate, but they are a significant carbon storage. Increased harvesting would lower the average age of forests, thus increasing carbon sequestration but decreasing storage. To avoid strengthening the greenhouse effect, carbon should be stored away from the atmosphere. Therefore, the pressure to meet climate goals increases the pressure to reduce fellings.

The carbon storage in Latvia's forests is generally positively impacted by forest growth. As indicated in chapter 3.1.2, Latvia's growing stock in the past decade has increased by 32 million m^3 (2009–2019) or 5% to a total of 679 million m^3 in 2019. The total forest cover has also increased by 1% since 2010. As a result of forest expansion and an increase in growing stock, carbon storage has reached 696 million tonnes in 2018, which is an estimated 3% increase from the 2001 levels. Most of Latvia's carbon storage is stored in soil and live biomass, with 391 million tonnes and 263 million tonnes, respectively. For the past 20 years, the harvesting level has been quite steady, which means that carbon storage has not been affected by any drastic changes in harvesting levels. Currently, the national harvesting volume is

[1] OECD, 2019. Environmental Performance Reviews. Latvia.

approximately 65% of the national forest increment, meaning that forests have been harvested in a sustainable manner.

According to Latvia's National Forestry Accounting Plan and Proposed Forest Reference Level 2021–2025, the forests are decreasing their GHG sequestration capacity, and are modelled to turn into minor GHG emitters between 2025–2030. Even a low sequestration rate increases carbon storage, which explains the increases in forest growing stock and area recently. However, the ageing forest structure of Latvia approaches the carbon balance when the increment compensates emissions from natural loss, soils and harvesting but does not increase the stored carbon volume. There are significantly more young or middle-aged than mature stands now, but in the near future these forests start slowing their growth and consequently their carbon sequestration rate as well. Broadleaved forests have short rotation cycles, which means that they reach maturity very fast. Broadleaved forests also have a lower carbon sequestration capacity than coniferous forests, and their share has increased due to the prevalence of natural regeneration practices. In addition, organic soils (30% of forest area) create significant emissions, which must be compensated by biomass growth before the forests can be considered carbon sinks.

There is a conflict between market-conditioned management of forests and carbon balance: it is impossible to reach the best carbon balance and apply a high interest rate at the same time. Political pressures and other environmental issues, such as biodiversity and nutrient loading into water, also play a role in forest management. In a forest management regime purely concentrated on improving carbon balance, both carbon sequestration rate and carbon storage are increased. Carbon sequestration rate of forests can be improved by increasing the growth rate with fertilizing, tree breeding, and harvesting and replanting low-yielding forests. Carbon storage can be increased by increasing forest density, prolonging rotation cycles, avoiding disturbing the soil and restoration of low-yielding peatlands.

The collection of harvesting residues decreases the carbon stock and is also likely to decrease the carbon sequestration potential of the felling area as the removal of felling residues will affect the future carbon input of the soil[2,3,4,5,6]. However, the effects of collecting residues vary between different energy wood fractions[7] and different forest types. The substitution effects of forest residues should also be accounted for. Substituting fossil fuels with biofuels (e.g. forest residues) has the potential to reduce total carbon emission, thus justifying decreasing soil organic carbon levels resulting from collecting harvesting residues. This is, however, strongly affected by the chosen management regime (e.g. continuous cover forestry or clear-cutting and regeneration)[8].

Existing policies in Latvia are developed to ensure significant reductions of emissions and increasing capacity to sequester carbon. Latvia will likely meet its 2020 GHG emission target under the EU Effort Sharing Decision of limiting the increase in GHG emissions to 17% of the 2005 level. It covers emissions from sectors outside of the EU Emissions Trading System,

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[2] Knoepp, J., D. and Swank, W., T., 1997. Forest Management Effects on Surface Soil Carbon and Nitrogen. Soil Science Society of America Journal, 61(3):928–935.
[3] Achat, D., L., Fortin, M., Landmann, G., Ringeval, B. and Augusto, L., 2015. Forest soil carbon is threatened by intensive biomass harvesting. Scientific Reports, 5(1). DOI: 10.1038/srep15991.
[4] Jones, H., S., Garrett, L., G., Beets, P., N., Kimberley, M., O and Oliver, G., R., 2007. Impacts of Harvest Residue Management on Soil Carbon Stocks in a Plantation Forest. Soil Science Society of America Journal, 72:1621–1627.
[5] Gollany, H., T., Novak, J., M., Liang, Y., Albrecht, S., L., Rickman, R., W., Follett, R., F., Wilhelm, W., W. and Hunt, P., G., 2010. Simulating Soil Organic Carbon Dynamics with Residue Removal Using the CQESTR Model. Soil Science Society of America Journal, 74: 372–383.
[6] Nave, L., E., vance, E., D., Swanston, C., W. and Curtis, P., S., 2009. Harvest impacts on soil carbon storage in temperate forests. Forest Ecology and Management, 259:857–866.
[7] Repo, A., Känkänen, R., Tuovinen, J.-P., Antikainen, R., Tuomi, M., Vanhala, P. and Liski, J., 2012. Forest bioenergy climate impact can be improved by allocating forest residue removal. GCB Bioenergy, 4: 202–212.
[8] Pukkala, T., 2014. Does biofuel harvesting and continuous cover management increase carbon sequestration?. Forest Policy and Economics, 43:41–50.

mostly from transport, agriculture, buildings, small industrial facilities and waste. Yet meeting the long-term climate goals consistent with the Paris Agreement is more challenging and will require more effort. Latvia has recently developed the National Energy and Climate Plan 2021–2030, which includes activities targeting the reduction of GHG emissions, an increase of carbon sequestration and growth of renewable energy, among others. Latvia has also been developing its Low Carbon Development Strategy 2050, as required by the Paris Agreement, which envisages reducing GHG emissions by 80% by 2050 from the 1990 level.

Growing agricultural production, use of fertilisation, conversion of grasslands into croplands, and the ageing forest structure will continue to reduce the GHG removal capacity of Latvia's LULUCF sector. Nevertheless, the forest area and growing stock have been growing and have had a positive impact on the forest carbon storage.

Revenue Generation of Forest Owners

The profitability of forestry is mainly based on the timber production capacity of forests and the demand for wood raw material. Forest management aims to promote the growth of valuable species and stands and to improve the quality of roundwood. In addition to wood production, today's forest management focuses on the preservation of natural values, landscape management and recreational values. Developments in forestry technology, information technology, and availability of different support mechanisms, such as subsidies or tax reductions, also improve the revenue generation for forest owners.

Generally, the revenue generation of forests has become better as the demand for different assortments (sawlogs, pulpwood, energy wood) has grown. Demand for energy wood has been in special focus in Latvia as the share of energy produced with woody biomass has increased, and ambitious goals for 2050 aim to increase the share of bioenergy even further. Development of the forest biofuel market and the involvement of private forest owners in it will not only increase the utilisation of forest harvesting residues, but also encourage forest maintenance, thinnings, and afforestation of abandoned lands. Prices of all assortments are very sensitive to the general economic situation (Chapter 4.2). Prices have not yet reached the levels before the financial crisis of 2008, but development has been positive. While large-scale forest owners base their forest management on producing quality wood in minimum rotation periods, small-scale forest owners avoid any expenses and sell what they have when prices are good.

Large size brings many advantages for forest owners. Management can be planned on bigger areas, lowering expenses per hectare. Many small-scale forest owners cannot afford services from big harvesting companies due to high expenses and low income from forestry operations, or incomes from clear-cutting being too far in the future. Forest owner associations aim to consolidate owners and share expenses, profits, experiences and knowledge. The first cooperative society of private forest owners was established in 2011, and in 2015 there were about six cooperatives and 15–20 smaller local associations or organisations. The trend of consolidation is slow due to forest owners' attitudes against it, but the benefits of consolidation are prominent and might change the attitudes.

Some tax reduction and subsidies are offered to private forest owners as incentives. Tax reductions for recently regenerated or newly afforested forest land were introduced in 2003. In case the clear-cut areas are regenerated following regulations, the annual property tax is removed in coniferous and hardwood forests for 40 years and in other types of forests for 10–20 years. 25% of reforestation costs are not taxed. In addition to national tax reductions, EU-level subsidies for the tending of forests are available since 2009. Before 2004, the tending of young stands in private forests did not exceed 10–15% of total tending and in 2008 the share was still low, at 18%. In 2009, the amount of tending in private forests doubled, reaching 44%. The total amount of subsidies for the improvement of forest value (mostly tending) was close to 13 million EUR in 2015, covering approximately 40 000 ha out of 84 000 ha of total forest tending.

4. SOLID WOOD PRODUCT MARKETS

4.1 Domestic Production

Box 4.1 Chapter Highlights

Solid wood products (SWP) Production

- Sawnwood production has recovered well from the financial crisis and has grown since 2009. However, the peak volume of 2006 has not been reached since.
- Wood-based panels (WBP) production has grown steadily during the past two decades. Since 2007 OSB production has been the engine for growth in the panel industry.
- Pellets are a major wood-based product in Latvia and are produced currently in 14 industrial mills and several smaller plants. The production has been gradually increased during the last two decades.
- SWP production consumes approximately 10–11 million m^3 of roundwood annually, of which sawmilling accounts for nearly 80%.

The Latvian Forest Industry

Latvian forest industry consists of 20 industrial sawmills, along with significant amount of pellet mills and fibreboard and plywood production. Most of the sawmills are in the Vidzeme region in the north-central part of Latvia (see Figure 4.1, Table 4.1). The wood-based industry has grown during the last 10 years. There are 14 industrial pellet mills in Latvia and many small pellet plants. The largest producer is AS Graanul Invest with plants all over Latvia. There is only one small paper producer in Latvia (Ligatne) which uses only recycled paper as raw material.

Figure 4.1 SWP Mills in Latvia

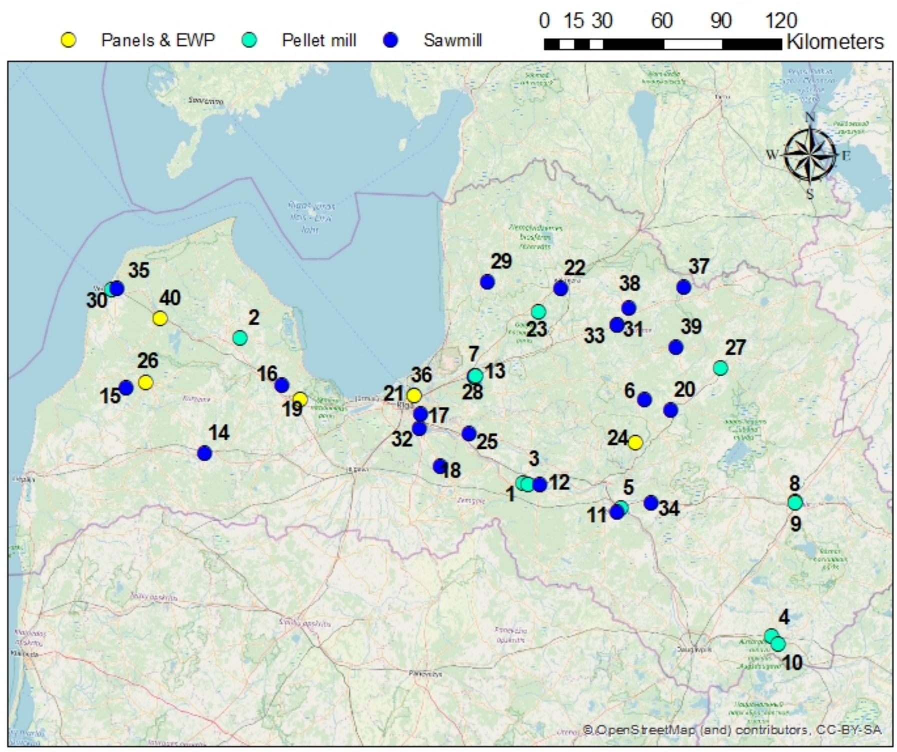


Table 4.1 Legend for SWP Mill Map

Label	Type	Company	Label	Type	Company
6	Sawmill	LV Timber	1	Pellet mill	LatGran Ltd
11	Sawmill	SELKO	2	Pellet mill	Scandbio
12	Sawmill	AKZ	3	Pellet mill	Prowood
13	Sawmill	Rettenmeier Timber	4	Pellet mill	LatGran Ltd
14	Sawmill	PATA Timber	5	Pellet mill	LatGran Ltd
15	Sawmill	Planka Ltd	7	Pellet mill	Graanul pellets
16	Sawmill	Vika wood	9	Pellet mill	EcoEnergy AIFP
17	Sawmill	BSW Latvia SIA	10	Pellet mill	Varpa
18	Sawmill	Piebalgas	21	Pellet mill	Baltic Biogran
20	Sawmill	Krauss LTD	23	Pellet mill	VPV
22	Sawmill	BYKO-LAT	27	Pellet mill	LatGran Ltd
25	Sawmill	Rīgas Meži	28	Pellet mill	Latgranula
29	Sawmill	Latvia Timber International	30	Pellet mill	Kurzemes Granulas Ltd
32	Sawmill	SIA VMS Timber	31	Pellet mill	Graanul Invest
33	Sawmill	Stora enso	8	Panels & EWP	Latvijas Finieris
34	Sawmill	Osukalns Ltd	19	Panels & EWP	Timberex Group
35	Sawmill	Kurekss SIA	24	Panels & EWP	Kokapstrādes Grupa
37	Sawmill	Vaidens Ltd	26	Panels & EWP	Stiga RM Ltd
38	Sawmill	Smiltene Impex	36	Panels & EWP	Kronospan
39	Sawmill	Kraujas Z	40	Panels & EWP	LatIgMa Ltd

Source: Indufor

Production and Wood Consumption

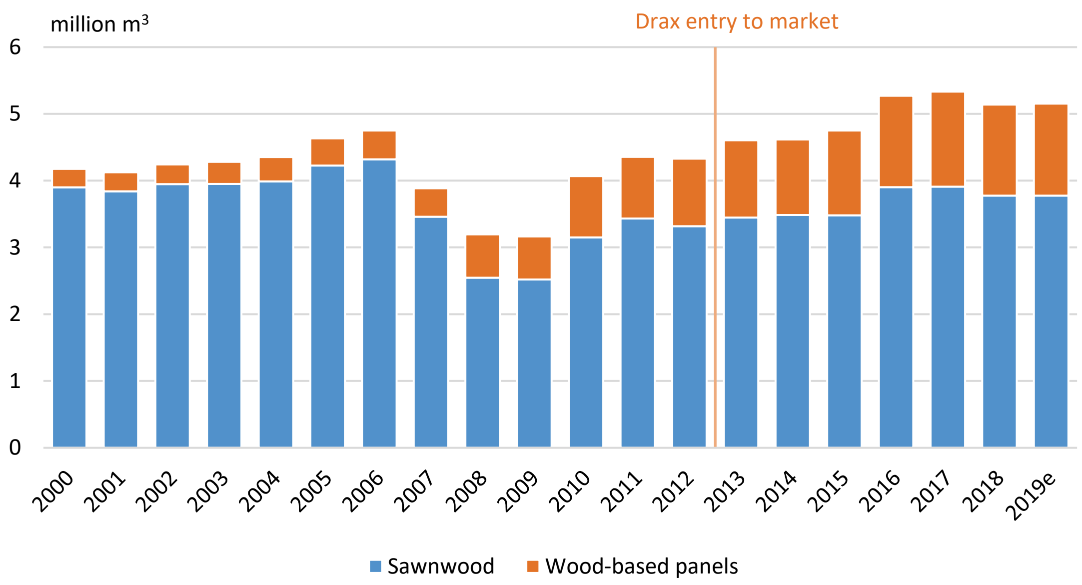
There is no pulp production in Latvia and only one paper mill (Ligatne), which does not use virgin wood fibres as raw material and produces only approximately 16 000 tonnes of paper annually. Thus, pulp and paper production does not play a role in the wood markets in Latvia.

Sawmilling and WBP production, on the other hand, are significant industries in the country. For the past two decades, the wood products sector has accounted for 19–26% of the country's export value and approximately 2–3% of the country's gross value added (GVA), while the forestry sector has accounted for approximately 2% of the GVA.

As in many industries and countries, the Latvian wood products sector was hit hard by the financial crisis between 2007–2009. During this time, sawnwood production dropped by as much as 42% compared to 2006 (Figure 4.2) Since then, sawnwood production volumes have recovered and stabilised to approximately 3.7–3.9 million m^3 per year, but have yet to reach the level of 2006. Growth between 2011–2014 was supported by relatively strong growth in the construction sector, which boosted demand for sawnwood. Interviews with local experts suggest that there is no potential for further increasing sawmilling capacity in the country, due to lack of demand and limited raw material availability.

WBP production has enjoyed steady growth for the past two decades. Production volumes have grown each year except for four years; 2007, 2009, 2014 and 2018. These decreases have mainly been modest and have been dwarfed by subsequent growth in production. For example, even though WBP production decreased between 2006–2007, production jumped by over 52% between 2007–2008, which converts to a 51% growth compared to 2006.

Figure 4.2 Production of SWPs



Source: FAO

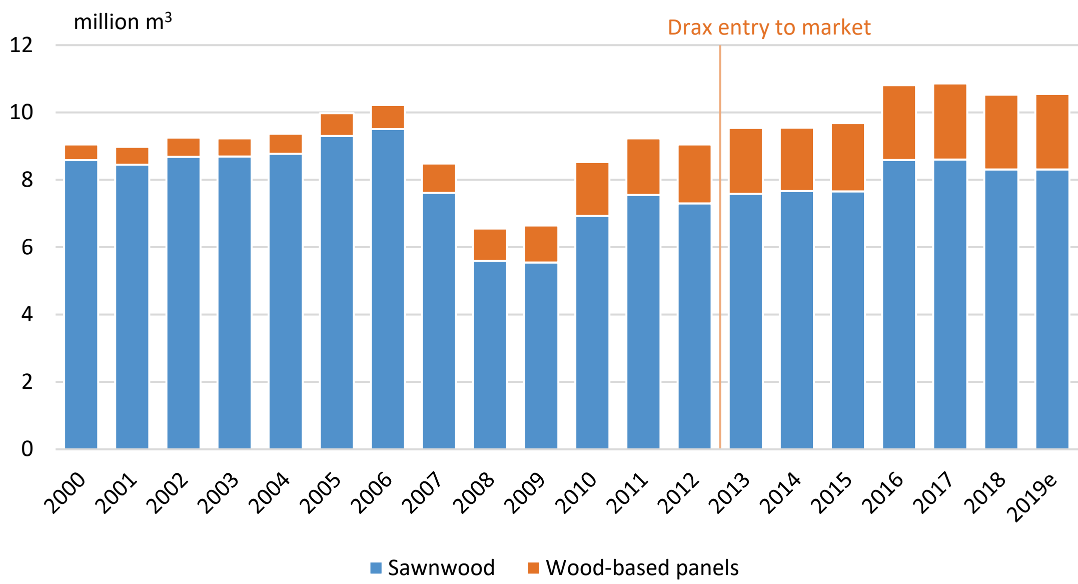
WBP production consists of OSB, plywood and particleboard. In the early 2000s plywood was the main WBP produced in Latvia, but in 2007 OSB production began and ramped up fast from 100 000 m^3 to over 300 000 m^3. OSB became the largest WBP product by volume by 2009. Particleboard production also surpassed plywood production in 2008, momentarily becoming the most produced WBP in Latvia.

Plywood and OSB are the main WBPs utilising roundwood in production. OSB production also utilises chips and sawmilling residues, but in Latvia, in the absence of domestic pulp production, roundwood pulpwood is readily available. The SWP industry in Latvia utilises between 10–

11 million m^3 of roundwood annually (Figure 4.3). Sawmilling accounts for nearly 80% of roundwood consumption.

WBP production consumes a smaller proportion of roundwood compared to production volumes than sawnwood because much of the WBP volume is OSB and particleboard, which can be produced from wood chips and residues, and do not rely solely on roundwood. However, the OSB industry currently consumes approximately 1.2–1.3 million m^3 of roundwood annually. There is no indication that energy-use of wood would have impacted the use of sawlogs or the production of SWPs, at least adversely, in Latvia.

Figure 4.3 Roundwood Consumption by SWP Production



Source: FAO, Indufor analysis

4.2 Raw Material Prices

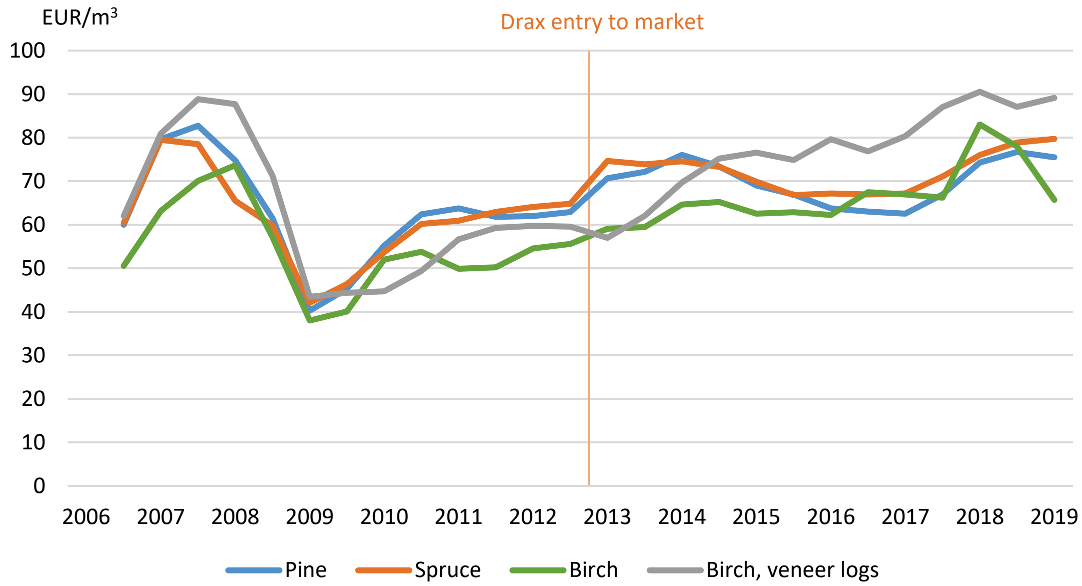
Box 4.2 Chapter Highlights

General

- The financial crisis caused a large shock to raw material prices in 2009.
- Since the financial crisis, prices have steadily been increasing; some have reached pre-crisis levels while others have not. Birch veneer log prices have increased at the fastest rate.
- In 2017, prices surged due to flooding and a warm winter when the land did not freeze as it usually does; both reasons prevented regular harvesting. Prices remained high during 2018, because global market pulp prices were very high, driving demand for pulpwood in Finland and Sweden as producers aimed to maximise production.
- Energy-use of wood did not seem to have an impact on pulpwood prices during the past decade. Fuelwood prices have remained relatively steady since 2013, with a slight increase during the 2017 price hike.

The prices of saw- and veneer logs have fluctuated strongly during the 2000s. All prices surged upwards between 2006–2008, but crashed within a year in 2009, to much lower levels than those seen in 2006 (Figure 4.4, Figure 4.5). These drastic developments were due to the financial crisis. Since 2009, prices have developed with varying trends.

Figure 4.4 **Average Purchase Prices of Large-diameter (d>18cm) Saw- and Veneer Logs**

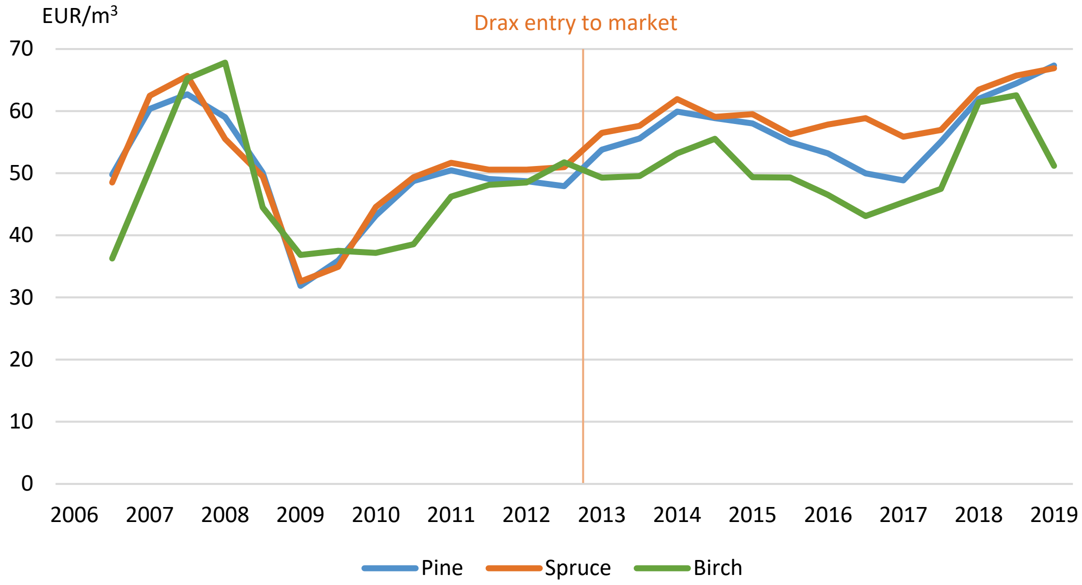


Note: Prices exclude VAT.
Source: Central Statistical Bureau of Latvia

All prices began recovering fast after the crash of 2009, but it has taken a long time for them to reach pre-crisis levels; prices of large-diameter (large) pine sawlogs have yet to reach the level of 2007–2008, even with prices growing at a CAGR of 5.2% between 2009–2019. Large birch saw- and veneer logs reached pre-crisis levels in 2018 and spruce sawlogs reached pre-crisis levels only in 2019. Birch veneer log price development has been the steadiest of large logs, which converts to the highest CAGR of the group (7.2% between 2009–2019). Prices of large pine and spruce sawlogs increased relatively steadily until 2013–2014, after which they have declined until 2017. In 2017, prices once again surged upwards. This development was due to a few different factors. Firstly, between August–October, Latvia experienced severe flooding, especially in the eastern parts of the country. The flooding resulted in significant damages to crops and infrastructure, as well as prevented harvesting operations in forests. Especially harvesting in the private forest was impacted, as private forest owners were incapable of maintaining forest roads during the flooding. This restricted raw material supply and drove prices up. Secondly, the winter between 2017–2018 was warm, and the land did not freeze as expected, which again restricted harvesting operations. Thirdly, the global market price of pulp was very high in 2017–2018, pushing up demand and prices of pulpwood globally. Roundwood exports increased notably to especially Sweden in 2018, pushing up sawlog prices. The price of large birch sawlogs decreased to end-of-2017 levels in 2019 already (CAGR 2009–2019: 5.1%), while spruce prices seem to perhaps continue on an increasing trend for a short while longer (CAGR 2009–2019: 5.6%). The growth of large pine log prices has already halted, and prices have begun to decrease once more.

Small-diameter (small) birch logs have not reached pre-crisis levels yet (Figure 4.5). Small pine and spruce logs reached pre-crisis levels in 2018–2019. Similar to large logs, the price of small birch logs has returned to end-2017 levels by the end of 2019, while the price of small pine and spruce logs seem to continue on their upwards trajectory. Interviews indicate that log prices are not expected to decrease significantly in the short-term, but to remain on a relatively steady trajectory.

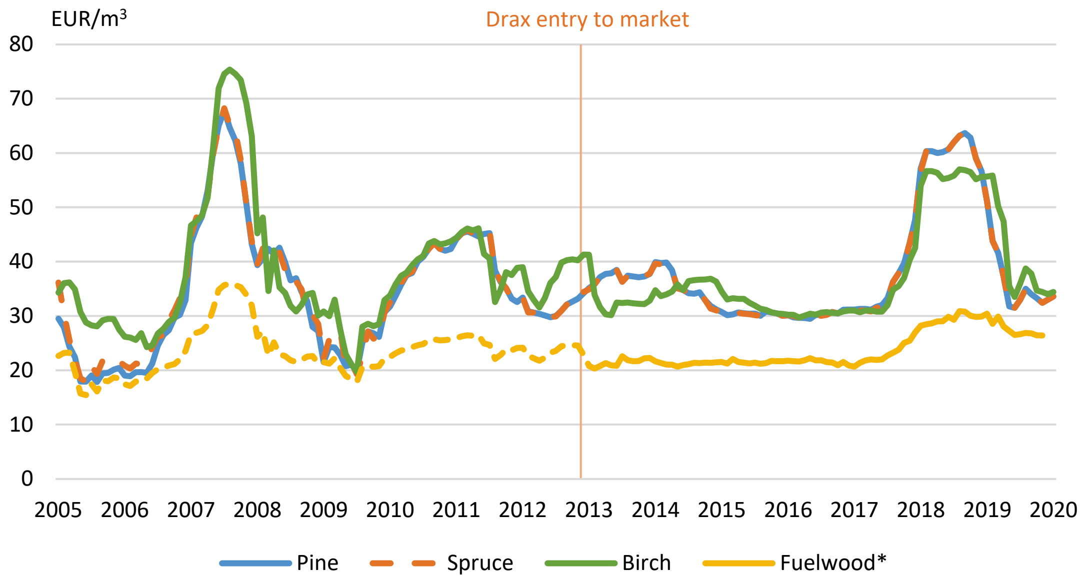
Figure 4.5 Average Purchase Prices of Small-diameter (d<18cm) Logs



Note: Prices exclude VAT.
Source: Central Statistical Bureau of Latvia

Pulpwood and fuelwood prices have either remained steady or slightly decreased between 2013–2017. In mid-2017, prices began to surge, peaking in early 2018. Birch, pine and spruce pulpwood prices remained high throughout 2018 and dropped quickly in the turn of 2018–2019, returning to 2017 levels. Aspen pulpwood has followed a very similar trajectory as the three other species, but on a much lower level, and shifts in price have not been quite so drastic. In 2018, pulpwood demand in Finland and Sweden was a major driver for pulpwood price peak. The global market price of long-fibre (softwood) pulp was high in 2018, mainly driven by Chinese demand.

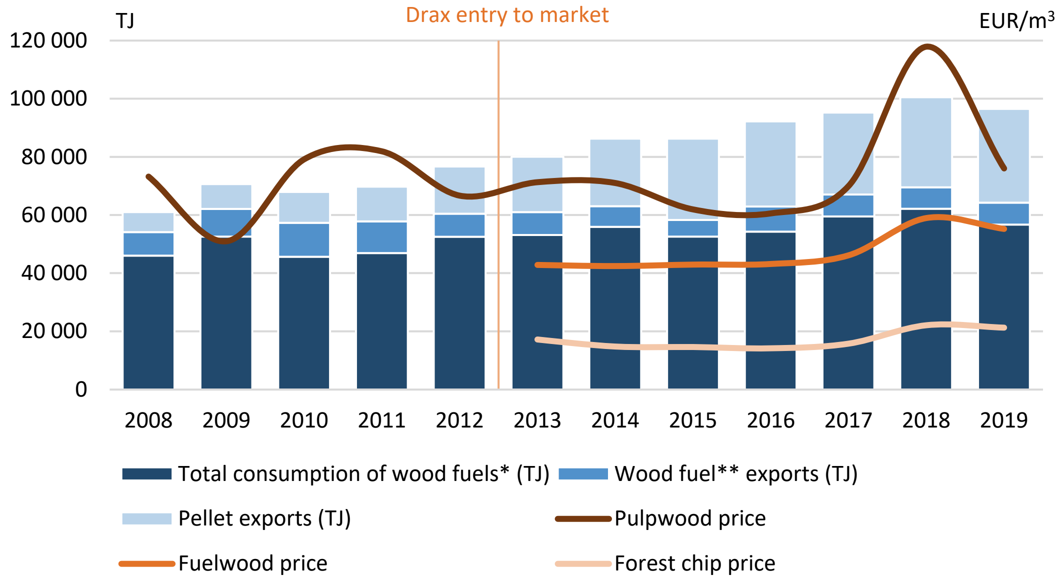
Figure 4.6 Ex-mill Prices of Pulpwood and Fuelwood



*Pre-2013 prices of fuelwood are estimates, actual data unavailable.
Source: Wood Products Research and Development Institute.

The total consumption and exports of wood fuels have grown steadily between 2008–2018. This trend is not apparent in wood fuel prices (Figure 4.7). Pulpwood prices have spiked in 2018, but demand from the energy sector has not been the main driver for this development.

Figure 4.7 Wood-based Bioenergy Production, Pellet Exports and Raw Material Price Development



* Firewood, wood pellets, wood briquettes, wood chips, wood wastes.
** Firewood, wood briquettes, wood chips, wood wastes.
Source: Wood Products Research and Development Institute, Central Statistical Bureau of Latvia

4.3 Cross-border Trade

Box 4.3 Chapter Highlights

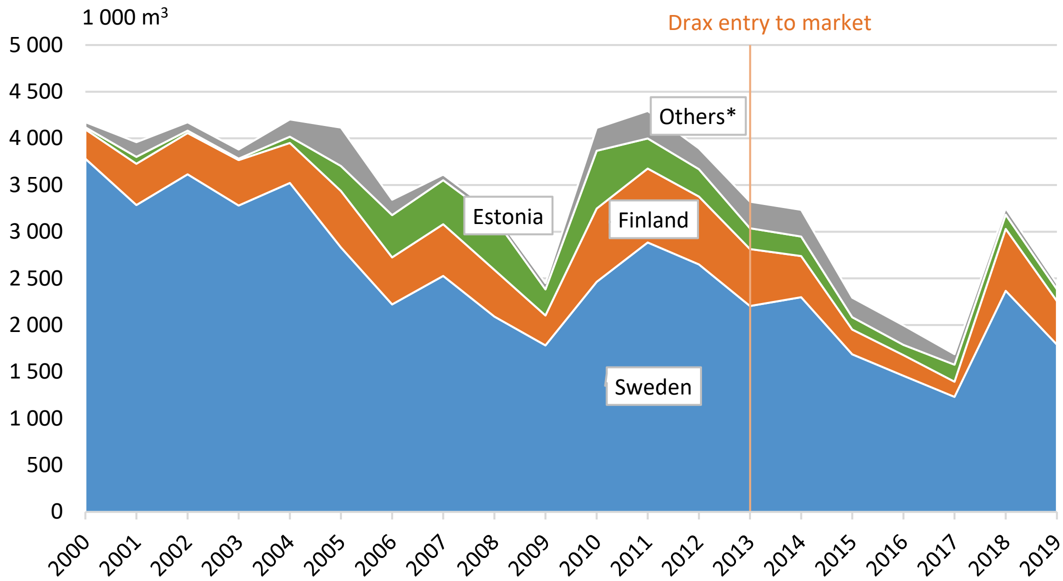
General

- Sweden is the largest single destination of roundwood and wood chips from Latvia, followed by Finland.
- Lithuania has been the largest supplier of roundwood to Latvia in recent years, while Russia accounted for the majority of roundwood imports before 2010.
- Latvia is a net importer of roundwood. Imports are mainly sawlogs, while exports are mainly pulpwood. Import volumes grew explosively between 2012–2014, due to low wood prices in Lithuania.
- Wood chip imports from Belarus have skyrocketed in the past two years, driven by low pulpwood prices in Belarus and export duties incentivising chipping of roundwood before exporting from Belarus.
- The growing pellet and OSB industries demand significant volumes of roundwood pulpwood and wood chips, which has at times impacted trade volumes.

Roundwood Trade

Sweden has been the largest destination of roundwood exports from Latvia during 2000–2019 (Figure 4.8). Smaller importers of Latvian roundwood are Finland and Estonia. Roundwood exports consist mainly of pulpwood (Figure 4.10), which is used by the Nordic pulp industries, and as such the export volumes are highly dependent on, e.g. global pulp demand and prices. The Baltic region, including Latvia, can be considered a raw material reserve for the Nordics, which is exploited especially in times of high demand or when sourcing domestic feedstocks is difficult for some reason. Exports from Latvia decreased between 2010–2017 by nearly 60%, with volumes declining in each export market. Much of this decrease was diverted to domestic OSB and pellet production. Pellet mills located far from seaports are preferred buyers for surrounding forest owners; transporting pulpwood over long distances to seaports reduces the price that forest owners could obtain for it and pellet producers can offer competitive prices. In 2018, volumes increased by over 80% compared to 2017 levels, due to high global pulp price, which drove producers to maximize output. Naturally, this required increasing feedstock sourcing also from the Baltic fibre basket. In 2019 export volumes decreased again by 25%.

Figure 4.8 Roundwood Exports from Latvia to the Baltic Sea Region

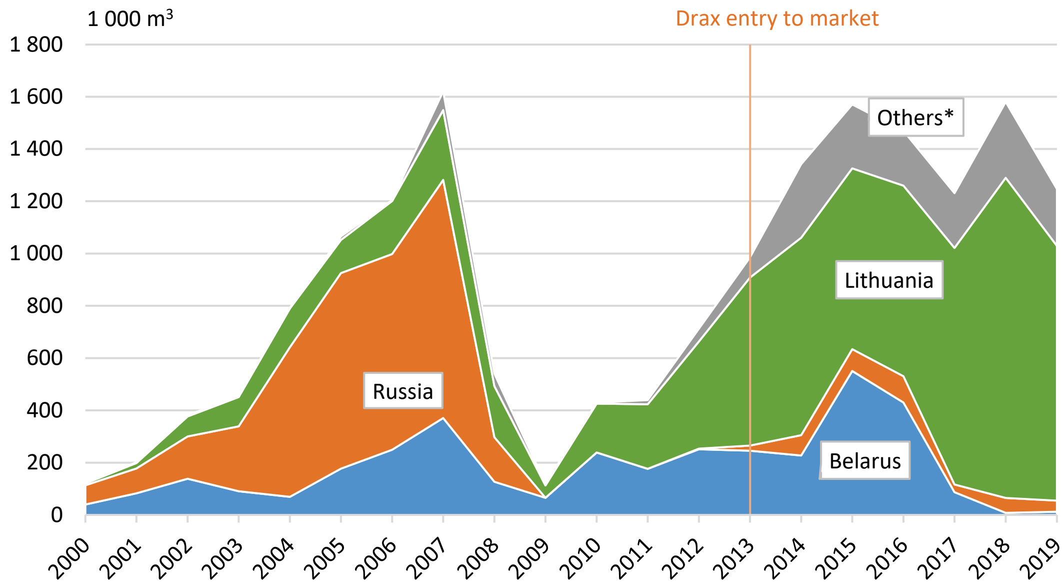


* Others: Denmark, Russia, Belarus, Norway, Lithuania, Germany.
Source: Comtrade, Central Statistical Bureau of Latvia

Roundwood imports to Latvia from the Baltic Sea region have experienced large shifts since 2000 (Figure 4.9). In the early 2000s, imports were very small, but by 2007 imports reached 1.6 million m^3 with Russia supplying the majority. Prices of Russian raw materials were competitive for Latvian producers, which incentivised trade. In 2008, volumes plummeted to 560 000 m^3 and to 120 000 m^3 in 2009. The drop in 2008–2009 is attributable to Russia implementing new export duties in 2008, and to the slowing of the global economy due to the financial crisis. This can also be seen above in the roundwood exports from Latvia. After 2009, import volumes began recovering. Between 2009–2015 import volumes grew at a CAGR of 53%, after which trade slowed down for two years only to jump again in 2018. In 2019, import volumes had once more decreased to 2017 levels.

Growth in imports between 2009–2015 was fast because of low pulpwood prices in Lithuania and Belarus, which incentivised increasing imports of pulpwood over utilising domestic raw materials. After 2009, the main suppliers of roundwood to Latvia have been Lithuania and Belarus, with the previously significant Russia only supplying a small stream.

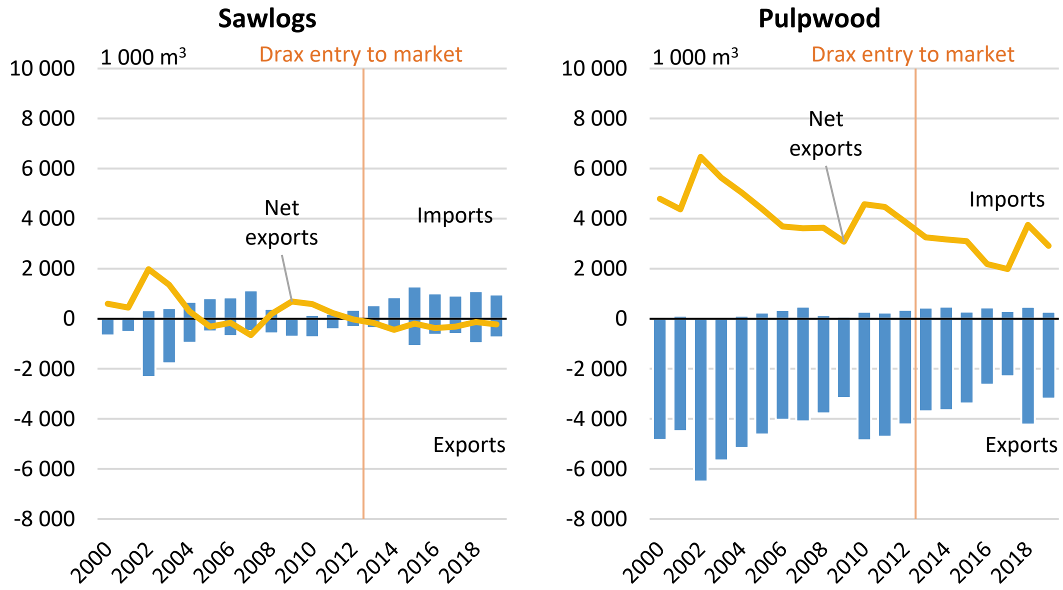
Figure 4.9 Roundwood Imports to Latvia from the Baltic Sea Region



* Others: Denmark, Finland, Sweden, Estonia, Germany, Norway.
Source: Comtrade, Central Statistical Bureau of Latvia

Latvia is a net-exporter of roundwood (Figure 4.10). However, the country has been a net importer of sawlogs at times. Exports are mainly pulpwood, but also approximately 1 million m^3 of sawlogs are exported annually. Imports are, to a large extent, sawlogs. Sawlog imports have been nearly equal to exports since 2011. Roundwood trade between the Baltic states is partly driven by arbitrage; companies in Latvia will purchase raw material from Lithuania and then sell it at a higher price to Estonia or to the Nordics. Trade is also fuelled by processing facilities near the borders that source raw material from both sides of the border. The Nordic pulp industry is the single largest export driver for Latvian roundwood. This is also enabled by the increasing forest ownership of Swedish companies in Latvia.

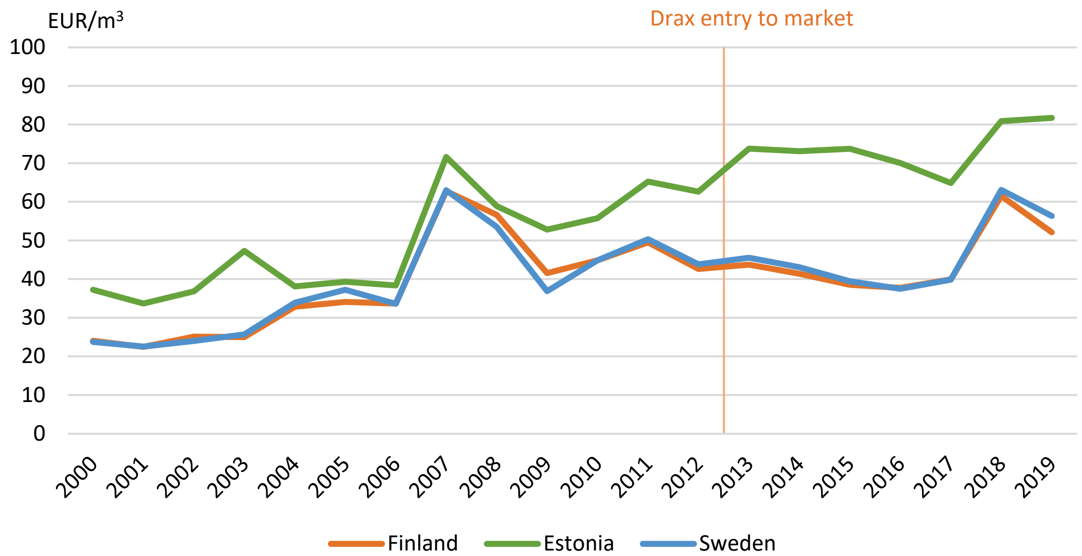
Figure 4.10 Total Sawlog and Pulpwood Imports and Exports to and from Latvia



Source: Central Statistical Bureau of Latvia

The price of Latvian roundwood is highest in Estonia (Figure 4.11). Prices paid in Finland and Sweden are very similar, and at a notably lower level than Estonian prices. This is explained largely by the differences in assortments exported to these markets; Finland and Sweden import mainly pulpwood roundwood, while Estonia imports sawlogs, which warrant a notably higher price. Between 2011–2016 prices in Sweden and Finland declined, while in Estonia the decline began only after 2013. In 2018, roundwood prices in all three countries jumped, following the development in Latvian domestic prices. Prices have increased by over 100% since 2000.

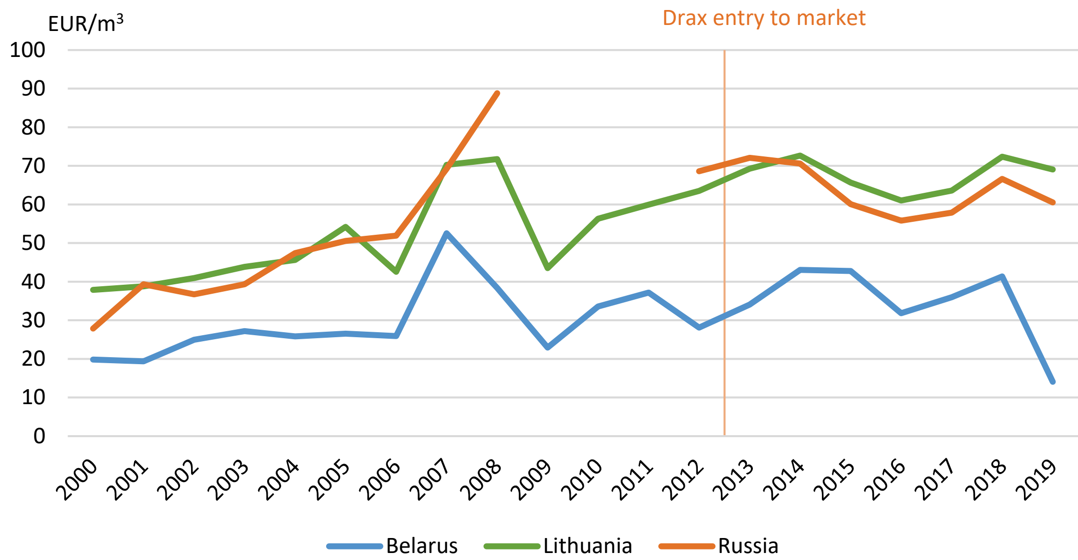
Figure 4.11 Price (FOB) of Roundwood Exported from Latvia to the Baltic Sea Region



Source: Central Statistical Bureau of Latvia

Roundwood from Belarus has the smallest import price in Latvia (Figure 4.12). Import prices of Lithuanian and Russian roundwood have been very similar between 2000–2019 with some fluctuations. In 2008, for example, Russian prices jumped as import volumes shrank. Since 2014, Lithuanian prices have been slightly higher than Russian prices. The price of roundwood imported from Belarus is much lower than that of Lithuania or Russia. This is mainly explained by the fact that imports from Belarus are mainly pulpwood, while imports from the other two countries include more sawlogs.

Figure 4.12 Price (CIF) of Roundwood Imported to Latvia

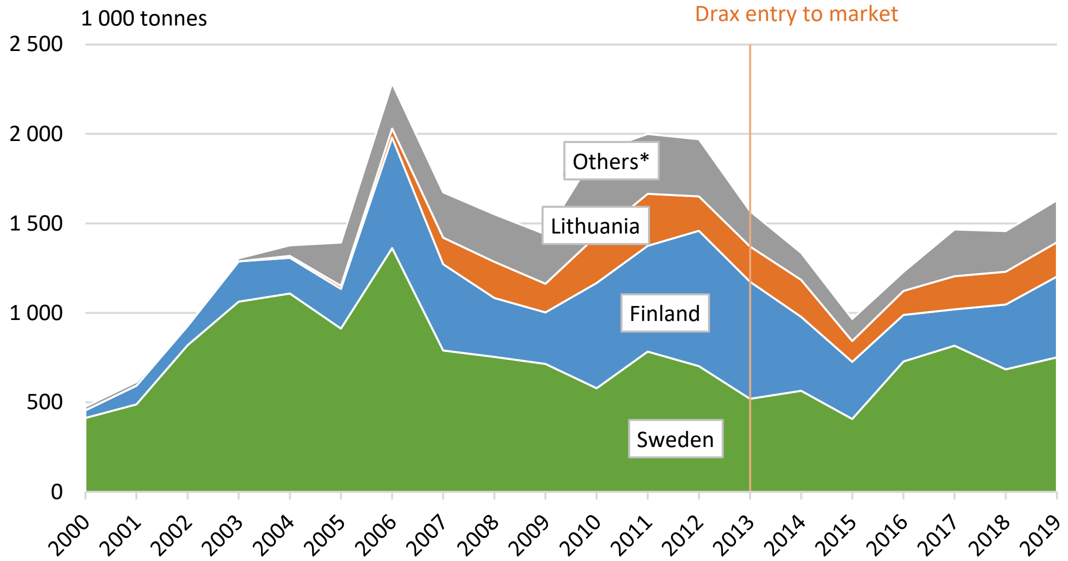


Source: Central Statistical Bureau of Latvia

Wood Chip Trade

As with roundwood exports, Sweden is also the main destination for wood chip exports from Latvia, with Finland and Lithuania representing the majority of the remaining export volumes (Figure 4.13). Wood chip exports peaked in 2006 (2.3 million tonnes) and 2011 (2 million tonnes). Between 2012–2015 export volumes decreased by over 50% compared to 2011 levels, after which they have recovered and seemingly stabilised at 1.45 million tonnes. In the early 2000s, Sweden accounted for over 80% of wood chip exports, but in recent years its significance has decreased and accounts now for less than 50%. Especially Finland's importance as an export market has grown.

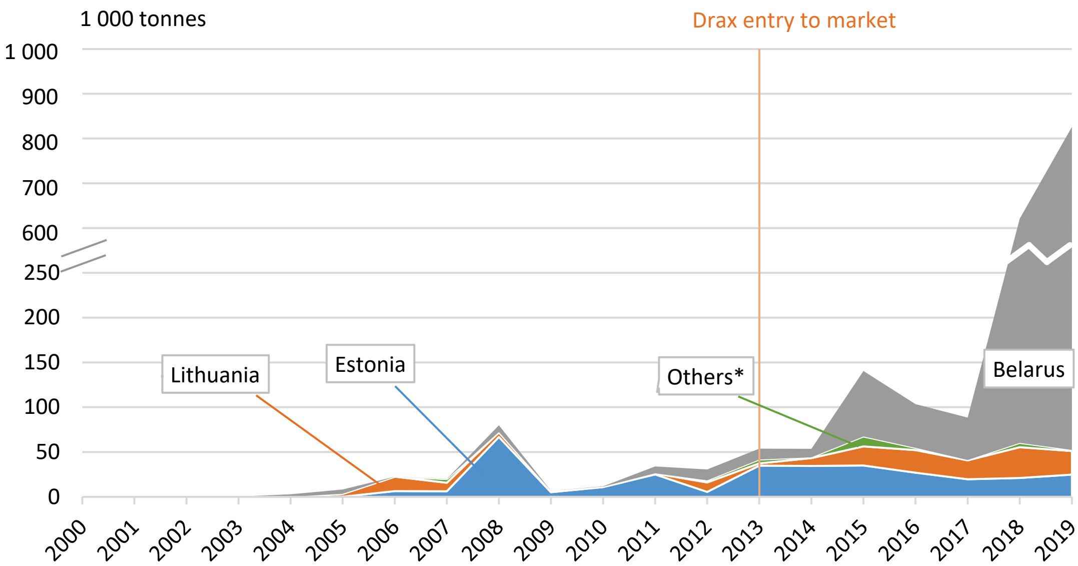
Figure 4.13 Wood Chip Exports from Latvia to the Baltic Sea Region



*Estonia, Denmark, Belarus, Germany, Norway, Russia. Source: Comtrade, Central Statistical Bureau of Latvia

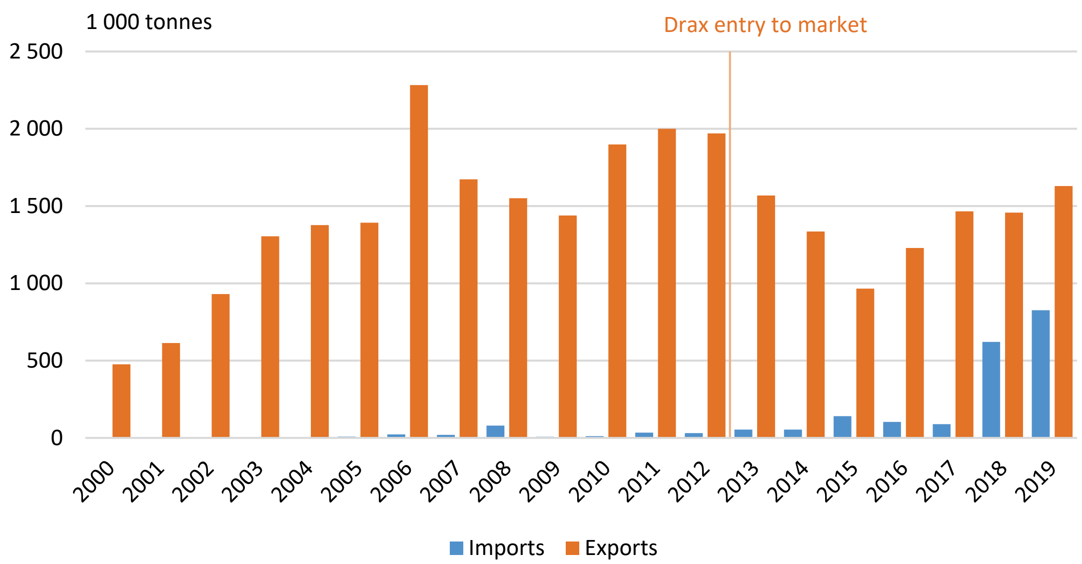
Latvia has not historically been a significant importer of wood chips (Figure 4.14, Figure 4.15). Estonia and Lithuania have typically been the main suppliers of imported wood chips for Latvia, but total import volumes have mainly been under 100 000 tonnes per year. Import volumes from Belarus skyrocketed in 2018 and further increased in 2019. Prices of Belarussian pulpwood were low, which made importing pulpwood appealing for Latvian companies. However, Belarus implemented duties for exporting roundwood pulpwood to slow exports of unprocessed wood raw material. This did not stop pulpwood exports from Belarus to Latvia, as Belarussian suppliers invested in chipping equipment and began exporting wood chips to Latvia. Demand for this cheap pulpwood has been driven by OSB and pellet production according to interviews with local industry experts.

Figure 4.14 Wood Chip Imports to Latvia from the Baltic Sea Region



* Belarus, Finland, Sweden, Russia, Germany, Norway, Denmark.
Source: Comtrade, Central Statistical Bureau of Latvia

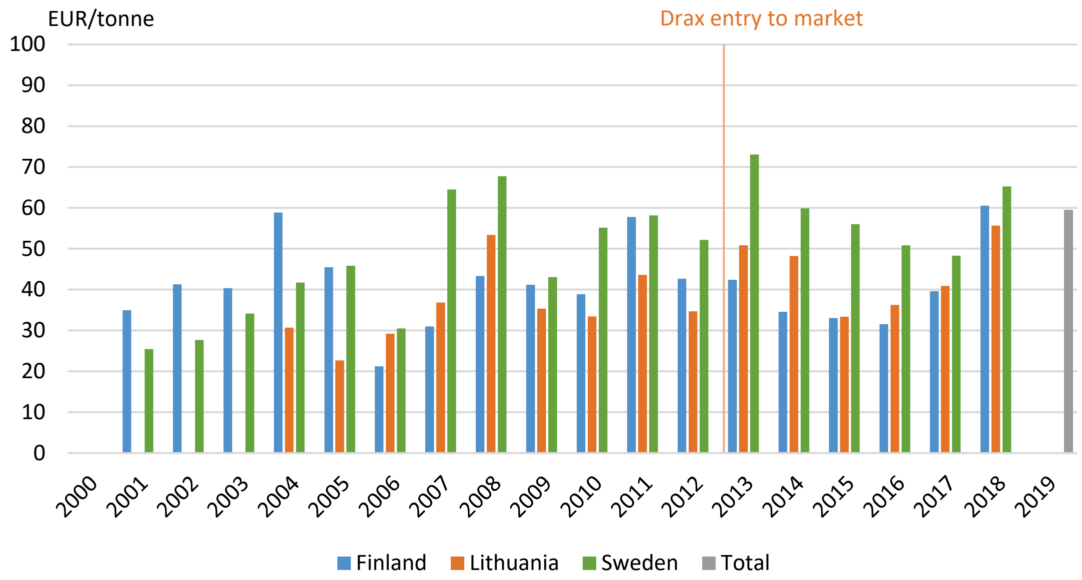
Figure 4.15 Total Wood Chip Imports and Exports between Latvia and the Baltic Sea Region



Source: Comtrade

The price of exported wood chips from Latvia have typically warranted the highest prices in Sweden (Figure 4.16). The lowest prices have been in either Finland or Lithuania, depending on the year. Wood chip export prices follow a similar trend as roundwood export prices. Prices in Sweden have declined between 2013–2017 but have jumped in 2018, while prices in Finland and Lithuania began recovering already in 2016–2017. Finnish and Lithuanian prices have been approaching Swedish prices since 2016. In 2018, Finnish prices were only 5 USD/tonne below Swedish prices, while in 2016 the difference was still 19 USD/tonne.

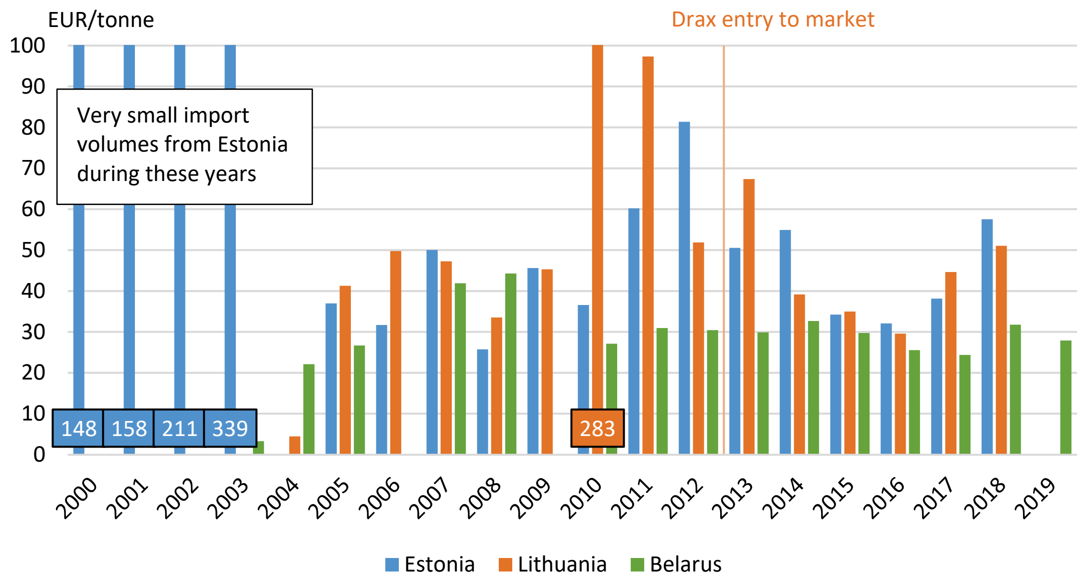
Figure 4.16 Price (FOB) of Wood Chips Exported from Latvia to the Baltic Sea Region



Source: Eurostat, Central Statistical Bureau of Latvia

Import prices of wood chips from Estonia and Lithuania declined between 2011–2016 and increased again between 2016–2018. In recent years prices of wood chips imported from Lithuania and Estonia have been quite similar, with the higher price alternating between the two. Prices of wood chips imported from Belarus have been relatively stable since 2011, regardless of large changes in volumes. Prices did decrease in 2016 and 2017 but returned to the long-term average level in 2018–2019.

Figure 4.17 Price (CIF) of Wood Chips Imported to Latvia



Source: Comtrade, Eurostat

Annex 1

Overview of Law on Forests

Section 9 of Forest Law and related amendments:

1. **Final felling** shall be permitted if:

1.1. a forest stand has reached the following final felling age:

Rotation ages (in years) per tree species and quality class

Dominant tree species	Quality class (Bonitet)		
	I and higher	II-III	IV and lower
Oak	101	121	121
Pine and Larch	101	101	121
Spruce, ash, linden, elm, flattering elm, and maple	81	81	81
Birch	71	71	51
Common alder	71	71	71
Aspen	41	41	41

Source: Law on Forests

1.2. a forest stand has reached the final felling diameter:

Average diameter (in cm) at breast height of dominant tree species to allow for clear-cutting

Dominant tree species	Quality class (Bonitet)			
	Ia	I	II	III
Pine	39	35	31	27
Spruce	31	29	29	27
Birch	31	27	25	22

Source: Regulations on Tree Felling in Forest Lands

2. The clear-cutting shall be permitted in the cases when in one unit of land in the current forests:

2.1. the area of the intended clear-cutting does not exceed the maximum area of clear-cutting specified in laws and regulations together with all the forest stands in the adjacent areas that:

2.1.1. have not been recognized as regenerated and in respect of which the time period for regeneration specified in laws and regulations has not become due yet;

2.1.2. have been recognized as regenerated but have not reached the age specified in laws and regulations;

2.1.3. have not been recognized as regenerated within the specified time period but the total area of which does not exceed one ha;

2.2. the area of the intended clear-cutting does not have adjacent forest stands, and the area of the intended clear-cutting does not exceed the maximum area of clear-cutting specified in laws and regulations;

2.3. the forest stands in the adjacent areas of the area of the intended clear-cutting have been regenerated and have reached at least the age specified in laws and regulations, and the area of the intended clear-cutting does not exceed the maximum area of clear-cutting specified in laws and regulations.

3. If a forest in the ownership or lawful possession is divided in two or more parts as a result of a lawful transaction, then the restrictions specified in Paragraph two of this Section and the conditions referred to in Section 13 shall be applicable to the part of the forest established after each division in the same way as to the forest prior to its division for seven years from the moment of its division.

Maximum clear-cut area (including adjacent forests, regardless of owner) is restricted to:

- 5 ha normally
- 10 ha in dry areas, provided that no less than 20 pine seed trees per ha of felling area are left standing
- 2 ha in sensitive forests
- 2 ha in the restricted management belt along the Baltic Sea and the Gulf of Riga coastlines, where clear-cutting of pine stands is prohibited altogether
- If no more than 0.3 ha are left outside the clear-cut area, it may be included

(Regulations on Tree Felling in Forest Lands).

Section 10 of Forest Law and related amendments

1. **Thinning** shall be permitted in the cases when the basal area of a forest stand exceeds the minimum basal area.
2. As a result of a felling the basal area of the forest stand shall not become smaller than the critical basal area.

The minimum and critical basal area shall be determined:

1. Directly – if the average height of dominant trees is more than 12 meters:

Minimum basal area (G_{min}) and critical basal area (G_{crit}) (m^2/ha) depending on dominant tree species and average height of trees

Average height of dominant trees	Dominant tree species											
	Pine		Spruce and other conifers excl. pine		Birch, linden		Aspen, black alder, grey alder, and other unnamed deciduous trees		Oak, elm, flattering elm, maple, beech, hornbeam		Ash	
(m)	G_{min}	G_{crit}	G_{min}	G_{crit}	G_{min}	G_{crit}	G_{min}	G_{crit}	G_{min}	G_{crit}	G_{min}	G_{crit}
12	13	7	11	6	8	4	10	5	9	5	7	4
13	14	8	12	6	9	5	10	6	10	5	8	4
14	14	8	12	7	10	5	11	6	10	6	8	5
15	16	8	14	7	10	5	11	6	11	6	9	5
16	17	8	15	7	11	6	12	6	12	6	10	5
17	18	8	16	8	11	6	12	7	12	6	10	6
18	19	8	17	8	12	6	13	7	14	7	11	6
19	19	8	19	8	12	6	13	7	15	7	13	6
20	20	9	20	8	13	6	14	8	16	7	13	6
21	21	9	22	8	14	7	15	8	17	7	14	6
22	21	9	23	9	14	7	16	8	17	8	14	6
23	21	9	24	9	16	7	16	8	18	8	14	6
24	21	9	24	9	16	7	18	9	18	8	14	7
25	22	9	26	10	17	8	19	9	19	8	15	7
26	22	9	26	10	17	8	19	9	20	8	15	7
27	22	9	27	10	17	8	20	10	20	9	15	7
28	22	9	28	10	18	8	21	10	21	9	16	7
29	22	9	28	10	18	8	22	10	21	9	16	7
30	22	9	29	10	19	8	22	10	22	9	16	7
31	23	9	30	11	19	8	23	10	22	9	–	–
32	23	9	30	11	20	9	23	10	22	9	–	–
33	23	10	31	11	20	9	24	11	23	10	–	–
34	23	10	31	11	21	9	24	11	23	10	–	–
35 and more	23	10	32	11	21	9	24	11	23	10	–	–

Source: Regulations on Tree Felling in Forest Lands

2. Indirectly – if the average height of dominant trees is less than 12 meters:

Minimum number of trees (Nmin) and critical number of trees (Ncrit) per hectare depending on dominant tree species and average height of trees

Average height of trees	Dominant tree species											
	Pine		Spruce and other conifers excl. pine		Birch, linden		Aspen, black alder, grey alder		Oak, elm, flattering elm, maple, beech, hornbeam		Ash	
(m)	N_{min}	N_{krit}	N_{min}	N_{krit}	N_{min}	N_{krit}	N_{min}	N_{krit}	N_{min}	N_{krit}	N_{min}	N_{krit}
1	3000	1000	2000	800	2000	800	2000	800	1500	500	1500	500
2	2200	1000	1600	800	1500	800	1500	800	1500	500	1500	500
3	2000	1000	1600	800	1300	800	1300	800	1500	500	1500	500
4	1700	1000	1500	800	1300	800	1300	800	1500	500	1500	500
5	1500	1000	1400	800	1300	800	1300	800	1500	500	1500	500
6	1400	1000	1300	800	1300	800	1300	800	1500	500	1500	500
7	1400	950	1300	800	1300	800	1200	750	1500	500	1500	500
8	1300	900	1200	750	1200	750	1100	700	1500	450	1500	450
9	1200	850	1200	750	1200	750	1000	650	1500	450	1500	450
10	1100	750	1200	750	1200	750	900	600	1500	400	1500	400
11	900	700	1100	700	1000	650	800	550	1500	400	1500	400

Source: Regulations on Tree Felling in Forest Lands

A summary of the legal framework on forest regeneration:

- Immovable property tax is not imposed on land under regenerated or newly established forest stands.
- All native (and a few non-native) species are accepted for reforestation with exception of some forest types suitable only for Scots pine (see list below)
- The area must be reforested within a 5-year period (10 years on marshy sites)
- The minimum height of regenerated forest stands shall be 0.1 meters for conifers and 0.2 meters for deciduous trees
- Minimum density requirements according to tree species are:
  - Pine – 3 000 trees per ha
  - Oak, ash, Scots elm, fluttering elm, maple, beech, hornbeam – 1 500 trees per ha
  - Others – 2 000 trees per ha.

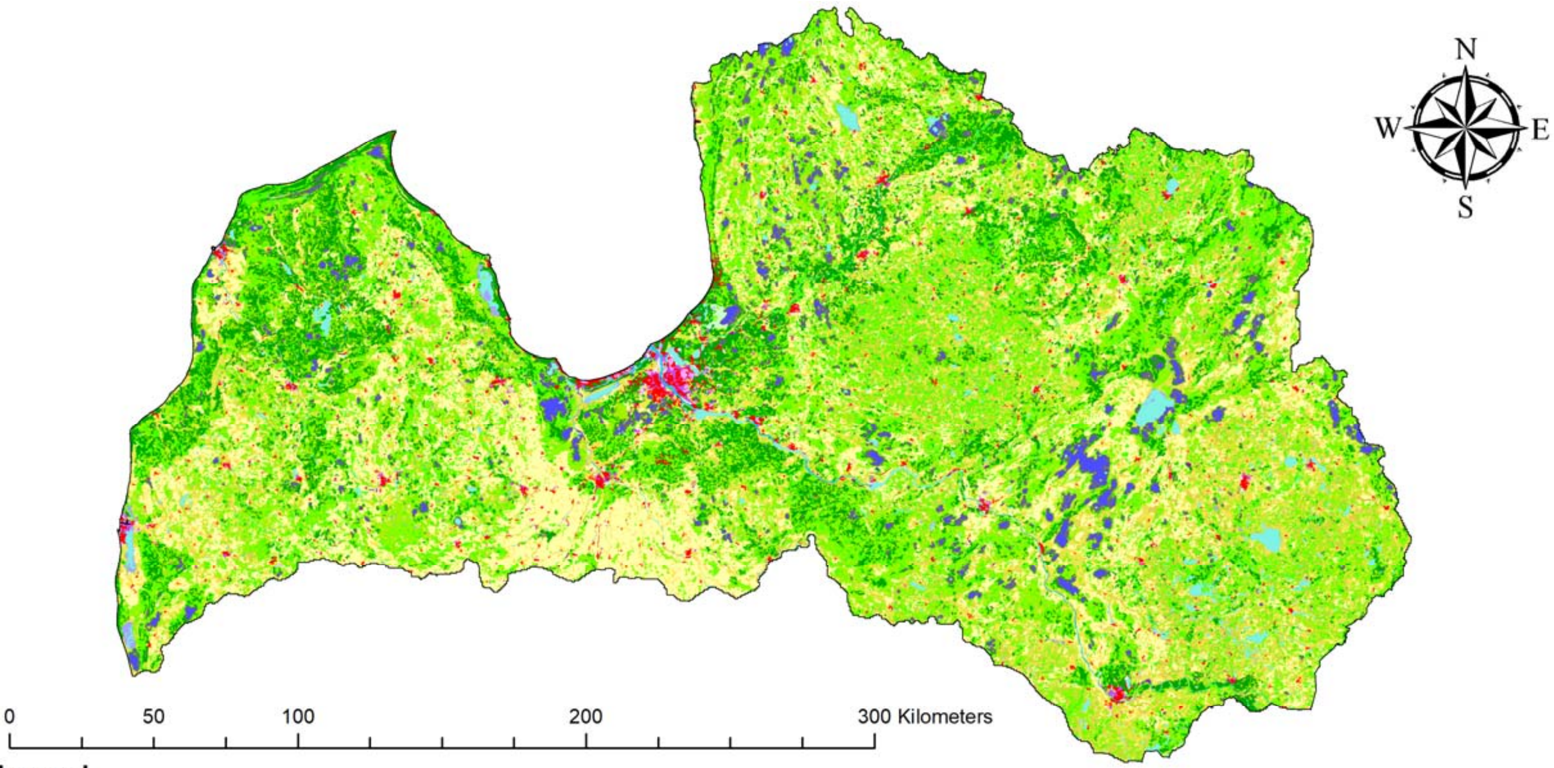
Indufor Celebrating 40 years

Tree species used for reforestation and afforestation

Name of tree species in English	Scientific name of tree species
Scots pine	*Pinus sylvestris* L.
Norway Spruce	*Picea abies* (L.) Karst.
Silver birch	*Betula pendula* Roth.
Downy birch	*Betula pubescens* Ehrh.
European aspen	*Populus tremula* L.
Black alder	*Alnus glutinosa* (L.) Gaertn.
European ash	*Fraxinus excelsior* L.
Pedunculate oak	*Quercus robur* L.
Small-leaved linden	*Tilia cordata* Mill.
Norway maple	*Acer platanoides* L.
Scots elm	*Ulmus glabra* Huds.
Fluttering elm	*Ulmus laevis* Pall.
Grey alder	*Alnus incana* (L.) Moench.
European hornbeam	*Carpinus betulus* L.
European beech	*Fagus sylvatica* L.
Wild cherry	*Prunus avium* (L.) L.
Willows	*Salix spp.*
Rowan	*Sorbus aucuparia* L.
Larches	*Larix spp.*
Poplars, hybrid poplars	*Populus spp.*
Northern red oak	*Quercus rubra* L.
Alders	*Alnus spp.*

Annex 2

Latvia Land Cover Map



Legend

- 111: Continuous urban fabric
- 112: Discontinuous urban fabric
- 121: Industrial or commercial units
- 122: Road and rail networks and associated land
- 123: Port areas
- 124: Airports
- 131: Mineral extraction sites
- 132: Dump sites
- 133: Construction sites
- 141: Green urban areas
- 142: Sport and leisure facilities
- 211: Non-irrigated arable land
- 222: Fruit trees and berry plantations
- 231: Pastures
- 242: Complex cultivation patterns
- 243: Land principally occupied by agriculture, with significant areas of natural vegetation
- 311: Broad-leaved forest
- 312: Coniferous forest
- 313: Mixed forest
- 321: Natural grasslands
- 324: Transitional woodland-shrub
- 331: Beaches, dunes, sands
- 333: Sparsely vegetated areas
- 411: Inland marshes
- 412: Peat bogs
- 511: Water courses
- 512: Water bodies

Annex 3

Glossary

Word	Definition
Afforestation	The establishment of a forest or stand of trees in an area where there was no previous tree cover.
Bonitet, Forest quality class	A measure of the ability of a piece of land to produce wood, expressed e.g. as medium length of trees in a certain age
Carbon footprint	The amount of greenhouse gases—primarily carbon dioxide—released into the atmosphere by a particular human activity.
Carbon pool	A reservoir of carbon. A system that has the capacity to accumulate or release carbon.
Carbon sequestration	The process of increasing the carbon content of a carbon pool other than the atmosphere.
Carbon sink	Any process or mechanism which removes a greenhouse gas, an aerosol or a precursor of greenhouse gas from the atmosphere. A given pool (reservoir) can be a sink for atmospheric carbon if, during a given time interval, more carbon is flowing into it than is flowing out.
Carbon stock/storage	The quantity of carbon contained in a “pool”, meaning a reservoir or system which has the capacity to accumulate or release carbon.
Clear-cutting, regeneration felling	A method in final felling. This type of felling implies that within a year since its outset the basal area of the forest stand or a part of it is reduced below the critical basal area.
Even-aged forestry	Group of forest management practices employed to achieve a nearly coeval cohort group of forest trees. As opposed to un-even aged forest management.
Ex-mill price	Price at the factory
Final felling	A kind of felling intended for general harvesting of wood performed in one or several attempts after final felling has reached definite age or diameter
Forest area (FAO)	Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ. Includes also temporarily unstocked forests (e.g. following a clear-cut or a natural damage), as well as small gaps and forest roads.
Forest cover	The share (%) of land currently covered by forest.
Harvesting residues	Harvesting residues consist of small trees, branches, tops and other non-commercial wood left in the forest after the cleaning, thinning or final felling of forest stands.
Improvement felling	A type of felling intended to remove the unproductive forest stands seamlessly or selectively.
MAI	Mean Annual Increment. The volume of wood growing on one hectare of a forest during one year on average since the forest has been established (m^3/ha/year).

Word	Definition
Maximum sustainable harvest	A level defined by the Latvian Ministry of Agriculture, Forest Department. It is based on annual increment data, but is ultimately a political decision and may not exactly reflect the actual, ecological maximum sustainable harvest.
Other felling	A type of felling intended for the maintenance of forest infrastructure, landscape forming, collecting of dangerous trees, felling of dead trees, as well as for the preservation of nature values.
Pre-commercial thinning	A forest management practice, which does not result in marketable wood. The aim is to reduce the number of seedlings per hectare to improve the growth of remaining seedlings.
Reforestation	The natural or intentional restocking of existing forests and woodlands that have been depleted, usually through deforestation.
Sanitary clear-felling, Sanitary selection felling	Sanitary clear-felling is a type of felling with the help of which the stands, which have lost the growing ability due to diseases, pests, wild animals, or abiotic factors (water, fire, wind etc.), are removed. Sanitary selection felling is a type of felling with the help of which forest stand is cleared from trees overturned and broken down by wind, damaged by diseases, pests, animals or injured otherwise, and which have lost their ability to grow.
Selective cutting	The cutting down of selected trees in a forest so that growth of other trees is not affected. This is done according to criteria regarding minimum tree size for harvesting, specifications of the number, spacing and size classes of residual trees per area, and allowable cut. The cutting out of trees that are mature or defective, or of inferior kinds to encourage the growth of the remaining trees in a forest or wood. Selective cutting can also refer to a forest management system that does not include clear-cuts. In forests where selective cutting is applied, typically both young and mature trees are grown in the same stand.
Sowing	Planting seeds by scattering them in or on the soil.
Tending (of forests)	Hypernym encompassing improvement cutting, selective cutting and regulation of the water and nutrition regime of forest soil. In Latvian context also weeding, respacing, clearing understory; measures to improve the daylight and nutritional conditions of the principal tree species of a stand and shaping the composition of the forest.
Thinning	A type of felling intended for improving the stand composition, growth conditions for the remaining stand.
Uneven-aged forest management, Continuous cover forestry	Uneven-aged or continuous cover forestry essentially differs from even-aged management in that they avoid clear felling and planting by utilizing thinnings from above and by promoting natural regeneration.
Working forests	Forests which are used for wood production.

Word	Definition
Wood processing residues	Wood processing residues mainly consist of black liquor, sawdust and bark.

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