PÖYRY

THE RISK OF INDIRECT WOOD USE CHANGE

FINAL REPORT

prepared for
Energie Nederland
July 2014

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ABBREVIATIONS

AAC	Annual Allowable Cut
BEL	Belgium
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CHP	Combined Heat and Power
DEN	Denmark
EN	Energie Nederland
GBR	Great Britain
IWUC	Indirect Wood Use Change
JAP	Japan
Mt	Million tonnes
Mtpa	Million tonnes per annum
NET	The Netherlands
odt	Oven dry tonne
OSB	Oriented Strand Board
PJ	Petajoule
PPC	Pellet Paying Capability
SKO	South Korea
tpa	Tonnes per annum
USD	US Dollar
USD/odt	US Dollars per oven dry tonne
USDA	US Department of Agriculture
WPC	Wood Paying Capability

1. INTRODUCTION

The demand for wood pellets for electricity generation in the Netherlands and in other European countries is expected to increase as a consequence of financial incentive schemes being offered to increase the share of renewables in the energy mix. While these incentives can help to reduce the level of GHG emissions, there are concerns that such incentives might have unwanted effects on existing wood consuming industry sectors that compete for the same raw material, such as pulp & paper and wood panel producers.

Concerns about potential shifts in wood use are an element of the discussions in the Netherlands to formulate a set of sustainability criteria for the use of biomass for energy. To facilitate this discussion Energie Nederland[1] (EN) has asked Pöyry Management Consulting (Pöyry) to provide an understanding of the risk of Indirect Wood Use Change (IWUC). For the purpose of this study, IWUC has been defined as the risk that an increasing pellet production for large scale electricity and heat generation will result in raw material shortages and price increases in producing regions. The key concern is that other users of the same wood raw material could not afford risking price levels and would e pushed out of the market by the developing pellet sector.

This study focuses on three major supply regions for industrial pellets, namely the US Southeast (coastal states ranging from Texas to Virginia), Western Canada (British Columbia), and North West Russia.

Specific questions that EN has been seeking answers for are as follows:

- What is the projected global industrial pellet demand for 2014, 2020 and 2025?
- What are the main industries in the region using forest wood in each region in scope?
- What is the supply and demand balance of the various wood assortments today, and how is the supply and demand situation expected to develop towards 2020 and 2025?
- What are the main drivers for these expected supply & demand developments?
- What is the wood paying capability (WPC) of each of the key biomass consuming industries today? How are these expected to develop towards 2020 and 2025 and what are the main drivers for these developments?
- What is the WPC of industrial wood pellet producers today? How are these expected to develop with the anticipated growth in demand out to 2020 and 2025 and what are the main market characteristics and drivers behind these developments?
- How do the WPCs of industrial wood pellet production compare to the WPCs of other wood using industries in the same region?
- Based on the above, what is the risk that the anticipated growing demand for industrial wood pellets for large scale energy generation will lead to a situation

[1] This study was commissioned by Energie-Nederland on behalf of the joint working group of environmental NGOs, energy companies and government, which works to agree on a set of sustainability criteria for the use of biomass for energy following the National Energy Agreement.

where industrial wood pellet producers will push other users of the same material out of the market?

2. THE RISK OF INDIRECT WOOD USE CHANGE

2.1 Definition

For the purpose of this study, the risk of IWUC was defined as the risk that demand for biomass for pellet production will push other users of the same raw material out of the market, which might have unwanted indirect effects. Pöyry distinguishes between two different degrees of indirect wood use change – Strong IWUC and Weak IWUC. While the strong IWUC can be observed and measured, the weak IWUC is not directly quantifiable.

Strong IWUC - The risk that the growing biomass demand for pellet production will push other existing users of the same raw material out of the market. The strong IWUC is triggered when new pellet mill investments (in combination with a falling biomass surplus) push the biomass price up above what other end users in the market can pay and force them to exit the market.

Weak IWUC - The risk that the growth in biomass demand for pellet production will limit planned future demand increases by other users of the same material, since increased uncertainty and short term mobilisation constraints cause price spikes that deter investments. The weak IWUC is caused by market imperfections. When new pellet mills enter the market, the lack of market transparency and short term difficulties to mobilise new supply result in temporary supply shortages and significant price fluctuations that defer new investments by other end users, despite a long term biomass supply surplus and the comparatively low paying capability of the pellets sector.

2.2 Conclusions

The study could not find strong evidence for increasing risk of IWUC in the US Southeast and North West Russia due to the existing and persisting favourable biomass surplus situation that offers sufficient supply potential for the existing industry sectors and the projected developing pellet demand volumes. The comparatively low Wood Paying Capability (WPC) of pellet producers in the US Southeast and the projected decline in demand from the pulp & paper sector further support the finding of a low risk of IWUC in this region.

However, the study has identified an increasing risk of IWUC in Western Canada. By 2025, some pulp mills (especially mechanical pulp producers) are likely to have been forced to leave the market as they will not be able to afford to compete for biomass. At the same time pellet production in the region is expected to have doubled compared to 2014 levels.

The main reasons for the increased risk of IWUC in Western Canada are:

- A fall in the biomass supply potential by more than 30% between 2014 and 2025
- Growth in Asian (Japan and Korea) pellet demand
- Falling demand and end-product prices in the mechanical pulp and printing & writing paper sector

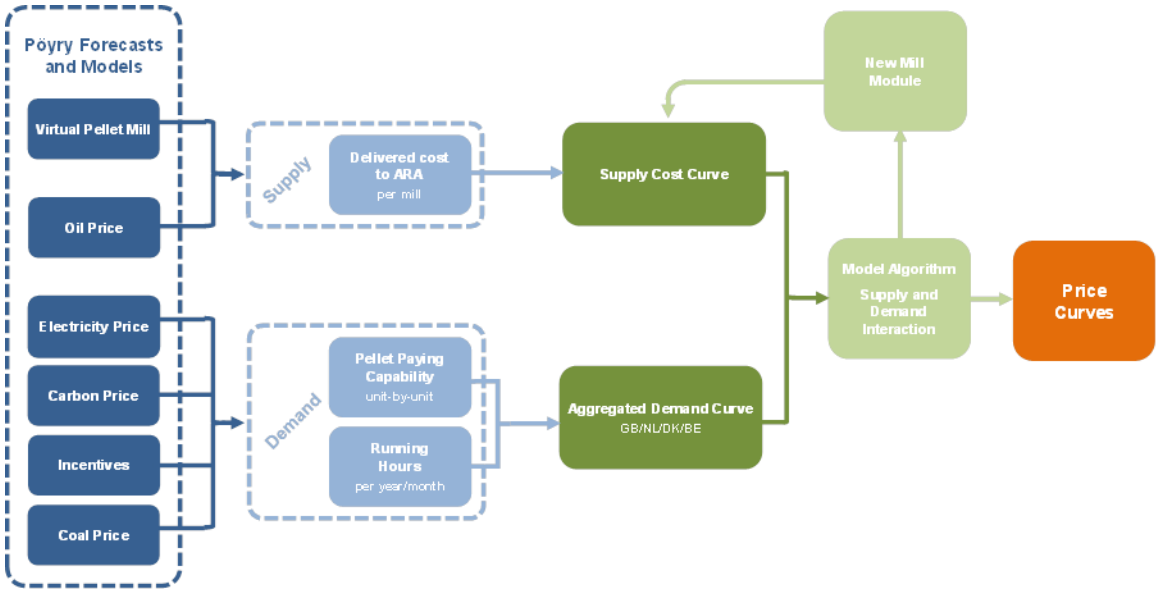
It has to be noted that these factors are mainly outside of the control of European pellet buyers.

3. METHODOLOGY AND APPROACH

3.1 Pöyry's Industrial Pellet Market Model

This section briefly outlines the underlying methodology for Pöyry's Pellet Market Modelling. The basis of the modelling is generating aggregated demand curves and supply cost curves for the pellet market, with the interaction between these two depicting how pellet prices can be expected to develop over time, as shown in Figure 1.

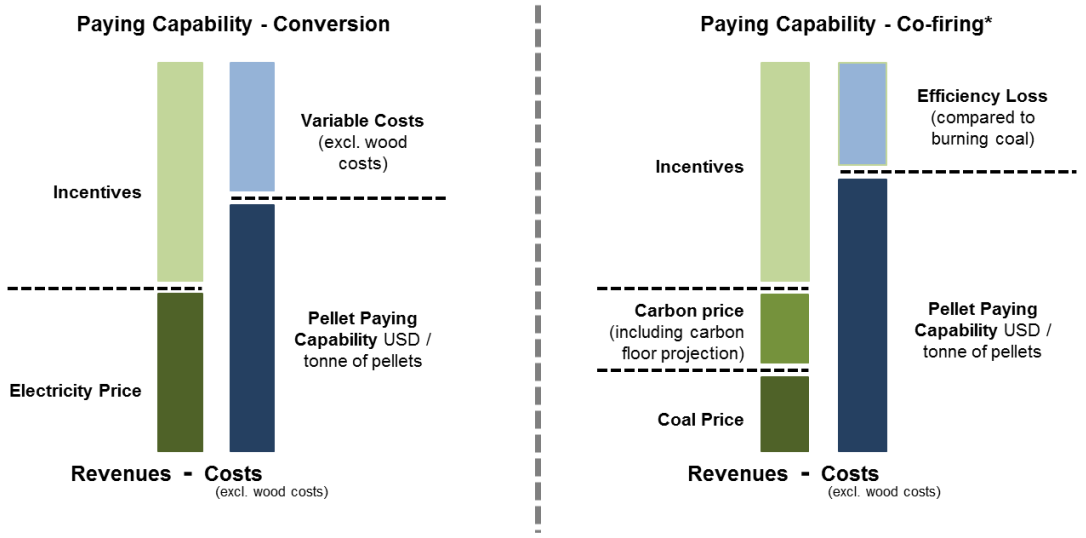
Figure 1 – Pellet market modelling overview



Pellet demand curves are derived from Pöyry's European Power System modelling (BiD3). The basis of each scenario is a view of the economic climate. Three scenarios have been developed: High, Central and Low, with strong, moderate, and restricted economic growth respectively. For example, in the High scenario, strong economic growth leads to high commodity prices (fuel) and high power demand.

Pellet demand curves are calculated for each individual unit of each power plant in each year. These are based on Pöyry's projections of monthly peak and off-peak power prices, biomass incentives, gas/coal/carbon costs, and specific plant parameters. Using these inputs, the Pellet Paying Capability (PPC) is calculated for each unit, based on their profitability in each operating period, along with total potential pellet demand for each period. Figure 2 shows a high level overview of how the PPC is calculated for coal to biomass conversion plants and biomass co-firing plants. Following this the demand and PPC of each unit in each period is aggregated into yearly demand curves, giving an overview of total industry pellet demand and PPC in any one year.

Figure 2 – Pellet Paying Capability (PPC) calculations



Once all PPCs and aggregated demand curves have been calculated, they must be combined with pellet supply cost curves, to determine long-term pellet price scenarios. The supply curves are determined by the production costs in each of the regions that are currently supplying the market or will do so in the future.

The first production cost factor that needs to be accounted for is total regional biomass supply for pellet production. If in any one year the existing pellet supply is not enough to fully satisfy all pellet demand with a sufficient PPC, new 'model built' mills are placed into the market in the most economically attractive region that still has an available biomass surplus that can be used.

In all regions, only the biomass surplus is assumed to be available for incremental pellet production. The biomass surplus in each region has been assessed and was split into six zones defined by their distance to the cost. This surplus has been taken into account when the model is considering where to construct new pellet mills, if they are required beyond already announced capacity developments in order to meet increasing demand volumes.

Following this resource availability analysis, Pöyry's Virtual Pellet Mill is used to calculate the delivered cost of pellets. This tool calculates indicative pelleting and delivery costs for a pellet mill from any one global region to the off-taker. The supply costs for each individual existing, planned, and model constructed mill are then aggregated to give an overview of the range of supply cots from different regions. These are then aggregated into a total supply cost curve for any given year.

These aggregated supply and demand curves are then interacted to analyse how the market can be expected to develop. The model has been built to maximise meeting demand, while minimising supply cost, and hence pellet market prices.

This process is calculated on a yearly basis, with the main result being trend wood pellet price projections and supply and demand curves for any year and scenario of the projection.

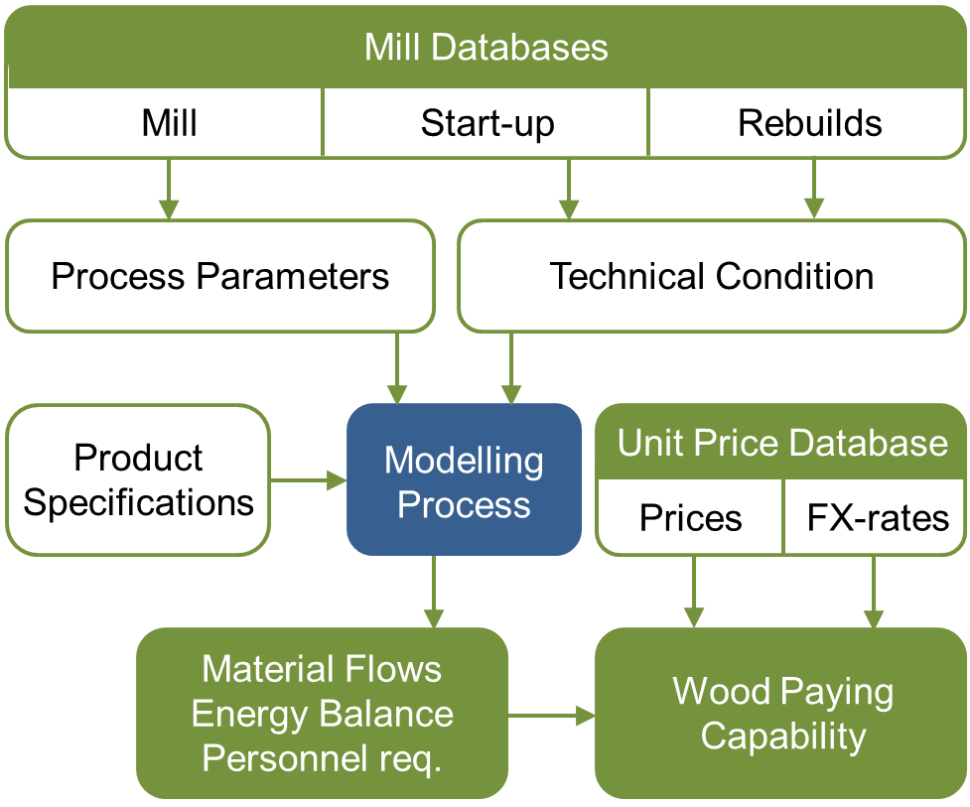
3.2 Calculating the Wood Paying Capability (WPC)

The wood paying capability of all wood processing and consuming mills was calculated using cost estimation models developed by Pöyry. The models serve as a tool for determining the cost structures of all pulp, wood based panels, and pellet mills utilising the following information:

- overall asset quality: capacity and technical age of the production facilities
- general process information including energy concept
- raw material base
- regional average unit prices and exchange rates
- location relative to markets

The costs are estimated for continuous production of the analysed product grades and are based on an average operating performance. The costs are divided into variable and fixed manufacturing costs, as well as into distribution costs.

Figure 3 – WPC calculation overview



The wood paying capability (WPC) was calculated as the difference between the selling price and all manufacturing costs (excl. wood).

The WPC was calculated on a positive cash basis with no return requirement for existing end users, assuming that existing mills will keep running as long as they contribute a positive cashflow to their owners.

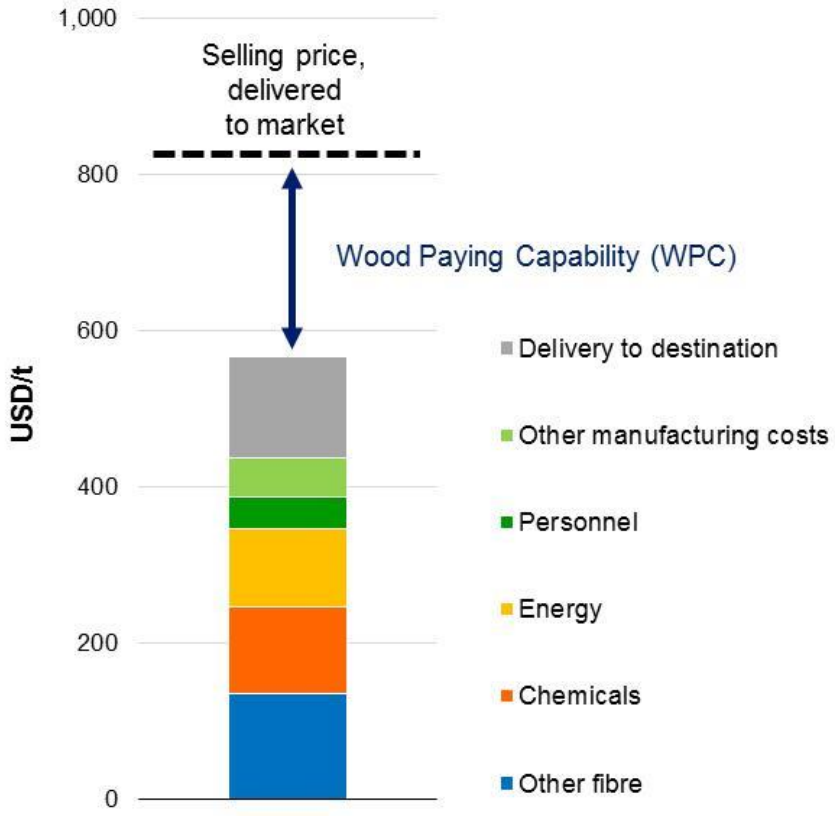
An industry specific return requirement was added to the cost structure when calculating the WPC for new capacity.

Integrated pulp mills (mills that produce pulp and use the pulp internally for paper production) were assumed to sell pulp internally at market prices.

Pöyry tracks the price of all major end products produced using biomass as a raw material globally and is therefore able to assess the WPC of all different industry sectors.

In this engagement the WPC of typical mills in each end use segment in each region has been calculated to determine the WPC range by industry sector and region.

Figure 4 – Illustrative WPC calculation



4. INDUSTRIAL PELLET DEMAND AND SUPPLY SCENARIOS

4.1 The European Market

4.1.1 Market development scenarios for Europe

The European market for industrial pellets is expected to grow materially over the coming years, driven by developments in Great Britain, Denmark, Belgium and the Netherlands. Besides these four countries, no other European country offers relevant financial incentives supporting the utilisation of imported pellets in large industrial facilities, or they only import marginal volumes (such as Sweden).

Great Britain is set to become the largest end user of industrial pellets in the European market with demand volumes potentially reaching up to 16 Mt per year in Pöyry's High Demand Scenario. However, there is still a considerable level of uncertainty regarding the total capacity of coal to biomass conversion projects going forward. A number of large coal power stations are currently looking to convert either their full capacity or only some of their units to biomass. For the central scenario it has been assumed that the majority of demand comes from the full conversion of three units at Drax and two units at Eggborough, as well as the conversion of Lynemouth. Under the high scenario it has been assumed that Eggborough convert an additional unit and Rugeley is also converted. In the low scenario it has been assumed that there is no further conversion of biomass capacity beyond capacity that has already converted or is in the middle of converting. As such, Drax convert two units and Ironbridge stays in the market as a conversion project until 2015.

Denmark has the potential to be the second largest end user of wood pellets in Europe, although this depends on the development of Danish electricity and heat prices and hence plant revenues. Demand for industrial pellets in Denmark will be driven by the continual increase in conversion of CHP capacity from a fossil fuel mix to biomass as fuel. In total seven CHP plants are expected to convert to biomass by 2025, as well as a gas fired power station. The development plans of the plant operators are fairly well defined in Denmark and have been kept constant across all three scenarios. Demand from the CHP facilities is closely linked to their obligation to provide a minimum level of heat in the winter and some CHP plants can only afford to operate when they are also supplying heat and so actual demand from this market may be lower than the total theoretical demand

Total biomass based electricity generation from cofiring in coal plants, and hence demand for industrial pellets, in the Netherlands cannot exceed 25 PJ, as per the recently announced Energieakkoord. Although it is now clear how much electricity generation will be based on biomass in the Netherlands, it is still not yet clear exactly how this capacity will be reached. As some coal capacity is set to close around 2017, Pöyry have assumed that all coal capacity that remains operational co-fires at the same rate to meet this generation limit. The generation limit of 25 PJ would allow for a pellet demand of ~3.8 million tonnes per annum (although this may be different depending on plant efficiency assumptions), which would equate to a co-firing rate of ~19% at the five coal units that are assumed to remain operational after 2017. As it is still uncertain how biomass power generation will be supported, demand has been kept consistent across all scenarios.

Industrial pellet demand in Belgium will make up the smallest portion of demand in Europe, as many coal power stations in this region are expected to close before 2020. There is currently one co-firing unit in Belgium (Ruien) and two plants that have fully

converted to biomass (Rodenhuize and Awirs). These three plants are all expected to have closed by 2020. The demand for pellets seen in 2020 in both the central and high scenarios comes from the full conversion of the Langerlo-Genk plant in 2016. This plant is also currently co-firing. In the low scenario it has been assumed that the Langerlo-Genk plant does not convert and also closes before 2020, hence why no pellet demand is seen in Belgium from 2020 onwards in the low scenario.

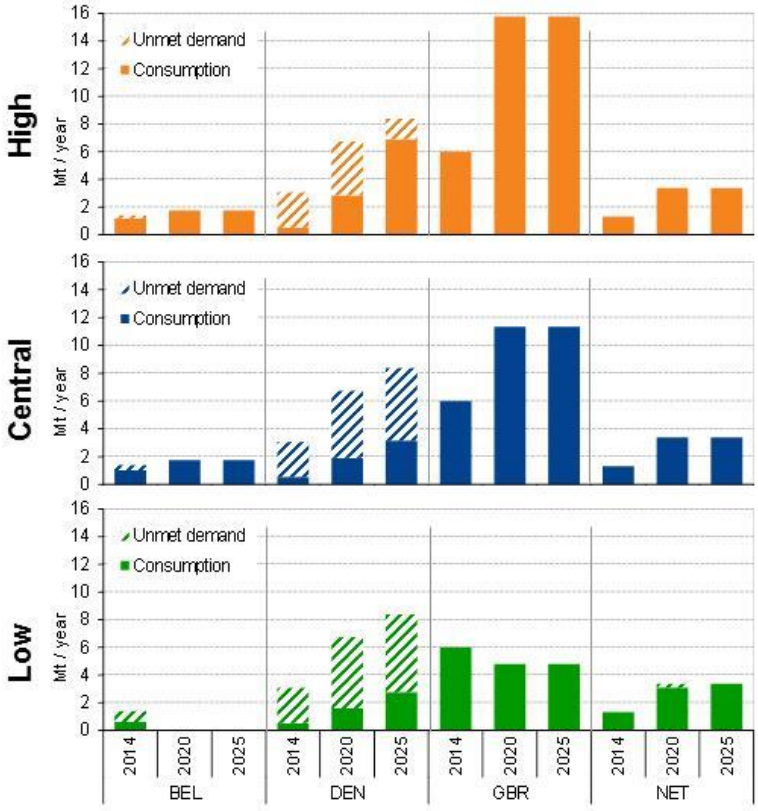
The amount of demand in Europe that can be satisfied depends on the PPC of each of these power stations. Not all plants will be able to afford pellets all year round limiting the actual pellet demand that can be expected, as shown in Figure 5. The PPC is calculated on a monthly basis for both peak and off-peak electricity prices. In Great Britain the PPC of end users is high enough that players can afford to source all the pellets they require in all three scenarios.

Since there is still some unclarity surrounding how biomass based generation will be incentivised in the Netherlands it has been assumed that biomass co-firing up to the targeted level will have a high enough PPC to be able to afford pellets in the market.

In Demark end users only utilise pellets when they operate to fulfil their heat requirement. During other periods of the year they do not operate since the electricity price alone would not be high enough to enable them to afford pellets.

In Belgium biomass co-firing is incentivised through green certificates. However, carbon and coal prices are currently not high enough to make co-firing an attractive option at all times. As these increase going forward (under the assumptions for each scenario) the paying capability of these players increases and they are able fulfil their entire pellet demand in all scenarios.

Figure 5 – Met and unmet market demand by scenario for Europe



4.1.2 Pellet Supply Scenarios for Europe

The total production capacity of all existing and planned pellet mills supplying into the Atlantic Basin would be sufficient to meet the future industrial pellet demand in Europe in both, Pöyry's Low and Central Demand Scenarios.

The US Southeast already holds a pellet production capacity of ~6.2 Mtpa that is or could supply into the industrial pellet market. Additionally, this region shows a significant pipeline of planned pellet mill capacity in various stages of development, making this region the current and future main supplier of industrial pellets into Europe.

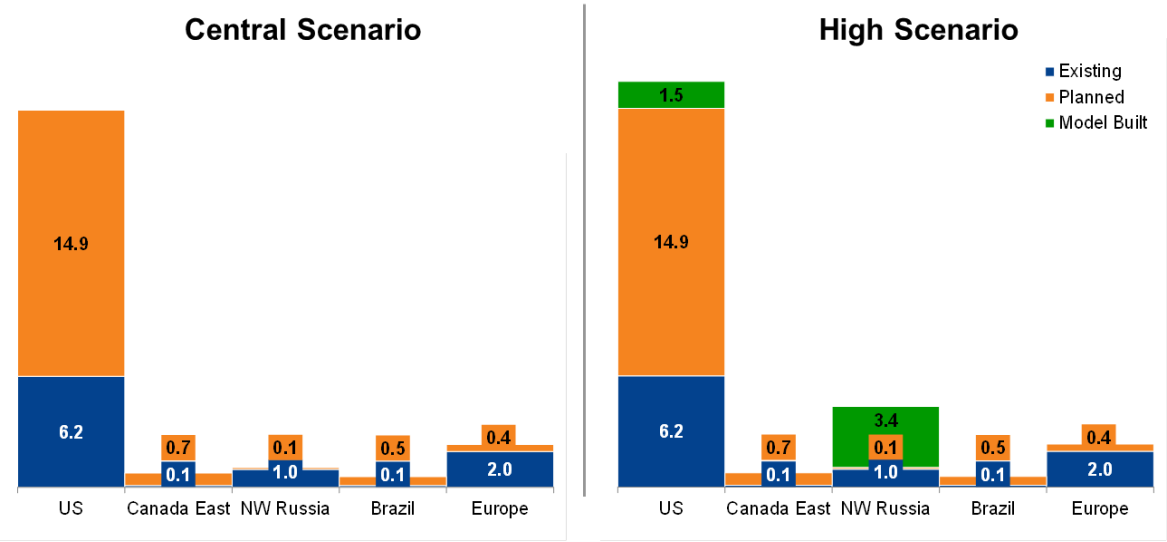
Although most pellet producers in Western Canada are currently supplying into the European market, production capacity from Western Canada is not shown in Figure 6. As demand for pellets in the Asia Pacific region grows it is expected that producers in Western Canada will divert their volumes and switch to supplying the Asian market instead.

Under the high scenario the significant increase in industrial pellet demand from Great Britain will require the development of additional pellet mill capacity beyond already announced production capacity in order to fully satisfy expected demand. In Pöyry's pellet market modelling additional mill capacity is deployed in the most economical region as long as this region still holds a positive biomass surplus, in order to meet any excess demand.

The lowest cost regions for new capacity under the high scenario are North West Russia and the US Southeast, with 3.4 million tpa of capacity and 1.5 million tpa of capacity

constructed in each region, respectively (see Figure 6). Initially the coastal regions of North West Russia are the most economically attractive, however, after the available biomass surplus in this region is utilised the US Southeast becomes the most attractive region to fill the remaining demand.

Figure 6 – Industrial pellet supply development for Europe (million tpa)



4.2 Asia Pacific

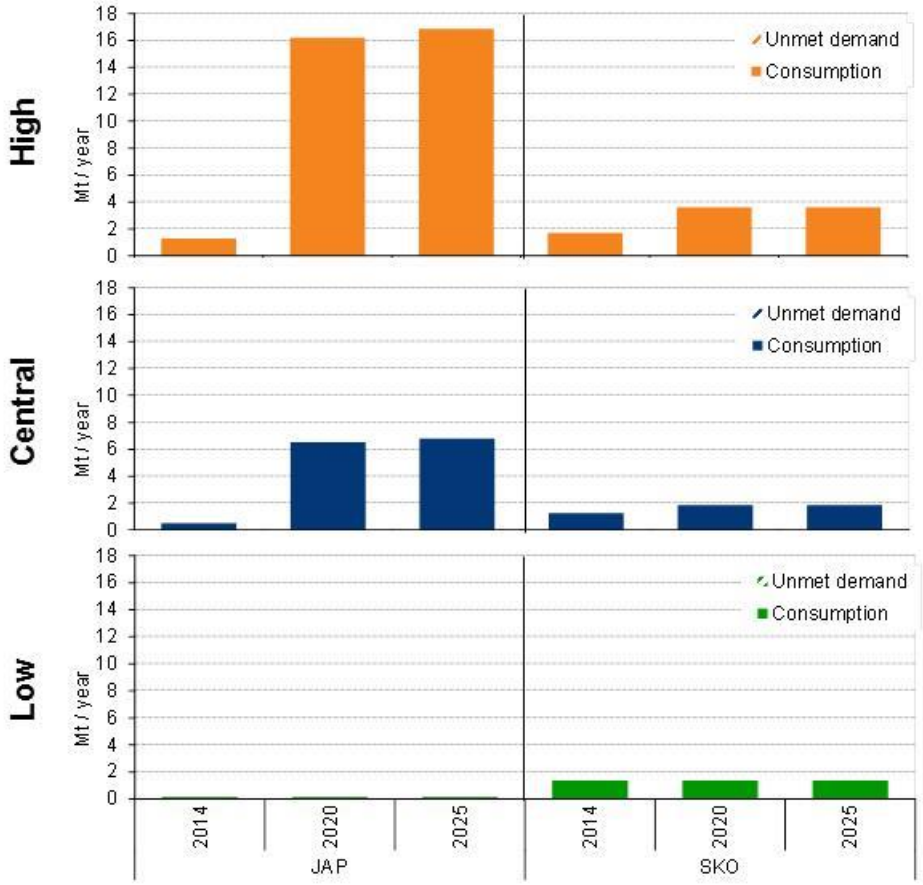
4.2.1 Market development scenarios for Asia Pacific

There is still a considerable amount of uncertainty around how demand for imported biomass will develop in Japan, if at all, hence there is a wide range of demand in the scenarios for this country. Japan is still in the process of developing its energy strategy after the Fukushima nuclear disaster. Three of the scenarios within the Japanese Strategic Energy Plan have been used for the development of the high, central, and low pellet demand scenarios. In the low scenario Japan uses all of its nuclear capacity again, and so has no need for biomass based generation. In the central scenario the nuclear capacity is not used, and more renewable capacity is required, with biomass making up 3% of Japan's total energy mix. In the high scenario the Japanese government tries to reach an even higher share of renewable energy generation. As part of this biomass makes up 5% of the total generation mix. It is assumed that Japan's full surplus of domestic biomass is used as a first priority, with the demand levels shown for each scenario representing the imported biomass that would be needed to reach these targets.

South Korea has defined its renewable energy targets, with an aim for biomass to make up 7% of all renewable energy generation by 2020. The currently planned bioenergy developments within South Korea would result in biomass making up more than 7% of the renewable electricity generation target. In the low scenario operators therefore only continue to develop biomass based projects that are already under construction, as these projects are past the 'point of no return'. In the central scenario all currently planned bioenergy investments continue to go forward, and biomass makes up a larger share of South Korea's renewable energy mix. In the high scenario the operators see the biomass feed-in-tariff as attractive, and as a result develop even more biomass based capacity with bioenergy making up 25% of total renewable energy generation in South Korea.

Both Japan and South Korea have attractive bioenergy incentive schemes in place, which will give all biomass based capacity that is expected to go forward a high enough PPC to allow them to source all the pellet volumes they require in each scenario. It is important to note that the feed-in-tariffs offered in Japan are reviewed and changed on a yearly basis. For this analysis it has been assumed that the tariff levels remain at their current level, however, if the government believes this is too attractive then this could be lowered and a scenario could be seen where not all demand would be satisfied.

Figure 7 – Met and unmet market demand by scenario for Asia Pacific



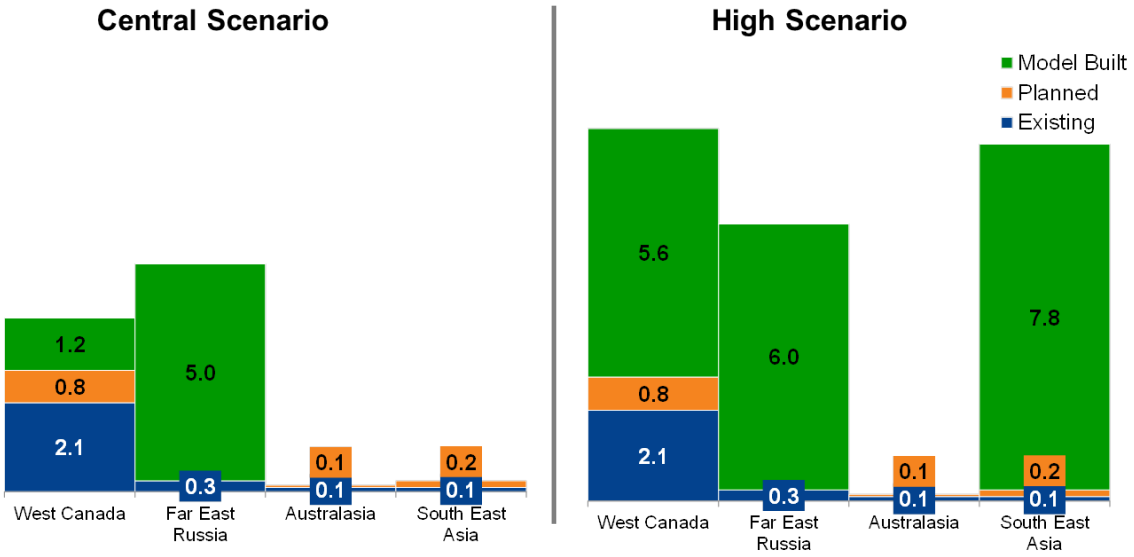
4.2.2 Pellet Supply Scenarios for Asia Pacific

With the exception of plants in Western Canada, there is not much capacity in the Asia Pacific region that could satisfy the demand development that is expected for the central scenario. As a result a considerable amount of new capacity will be required, with new mills being placed in the lowest cost regions that could supply this market. For the central scenario the majority of this capacity is assumed to be built in Far East Russia, which is an area with a currently largely untapped forest resource base. It is important to note that the actual deployment of this capacity is still uncertain, as it will require the development of a considerable amount of infrastructure to access the biomass material, and the business environment in this part of Russia could prove difficult.

With higher levels of demand expected in the high scenario from both South Korea and Japan, there will need to be considerable pellet mill investments in the Asia Pacific market to satisfy all of this demand. Only 6 million tpa of capacity is expected to be constructed in

Far East Russia under this scenario, before going further inland would become too expensive and increasing capacity in Western Canada and South East Asia would offer an economically attractive option. As a result 5.6 million tpa of capacity can be expected to be constructed in Western Canada and a further 7.8 million tpa of capacity can be expected to be constructed in South East Asia.

Figure 8 – Industrial pellet supply development for Asia Pacific (million tpa)



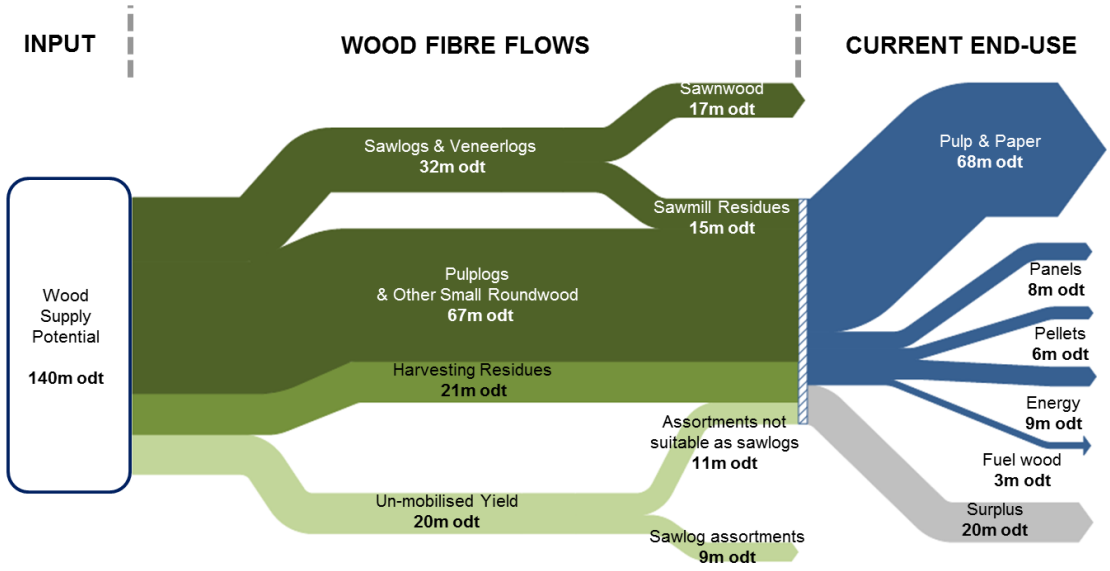
5. BIOMASS SUPPLY, DEMAND, AND COMPETITIVENESS

5.1 US Southeast

Pulplogs currently make up the majority of the biomass supply in the US Southeast accounting for almost 50% of the total wood supply potential. There is also the potential to source an additional 11 million odt of pulpwood grade material from volumes that are not currently harvested but could be mobilised if demand increases.

The pulp & paper industry is currently the largest end user, accounting for over 70% of all market demand, while the wood pellet industry is currently the smallest end-user, utilising just 6 million odt of feedstock and accounting for just 6% of total demand. After accounting for all demand there is a surplus of ~20 million odt (excl. sawlogs). However, as noted ~11 million odt is currently unmobilised pulpwood supply, with the remainder being comprised mostly of harvesting residues.

Figure 9 – Wood biomass flows in the US Southeast in 2014[2]



The wood paying capabilities in the pulp and panel industries are significantly higher than in the emerging pellet sector. For the pulp sector this is due to the high value of the end products. The variance in paying capabilities shown in Figure 10 is mainly a result of differences in production capacity, with the columns showing the indicative top and bottom of the WPC range in each industry. For wood based panels the variance is also a direct result of panel grade produced, with OSB producers being afforded the highest paying capabilities and particleboard producers the lowest.

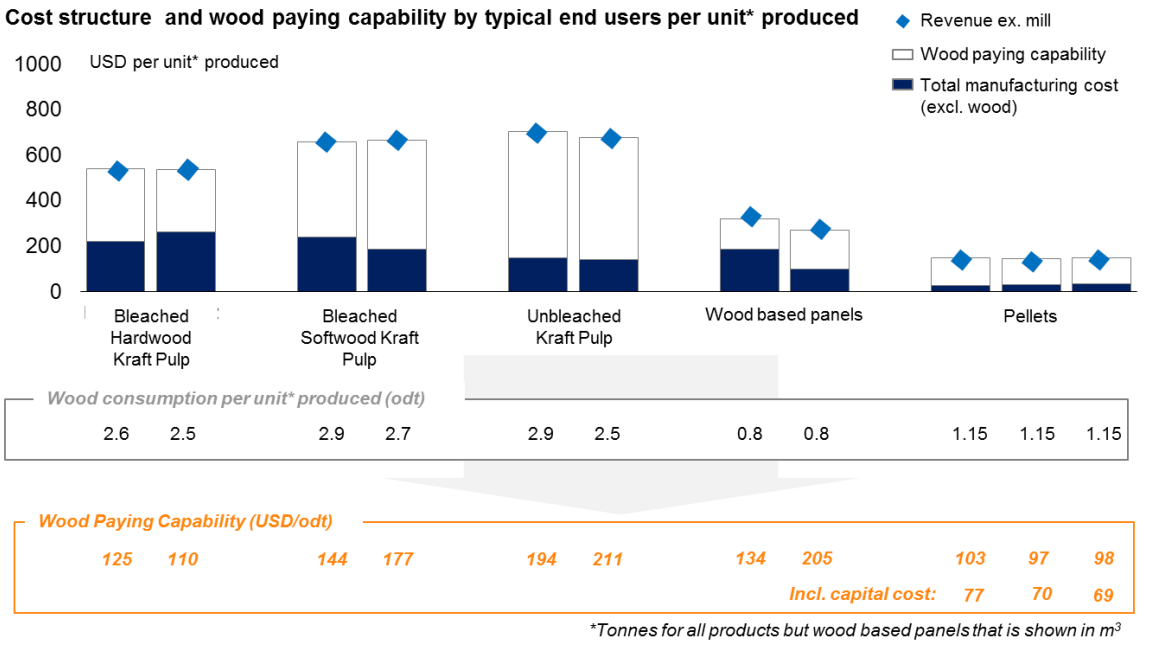
Wood pellet producers supply to a market where the paying capability of their customers is defined and limited by the subsidies they receive, as energy generation from wood pellets is typically not economical on its own. As a result wood pellet producers have little room to increase their end product sales price if their production costs increase as a

[2] 'Energy' refers to wood used for heat and power generation in industrial scale production facilities supplying a national grid network. 'Fuel wood' refers to wood used for heat and power generation in small scale applications.

result of rising feedstock prices. Pulp and wood based panel producers supply into mature markets where increases in production cost can be more easily passed on to the end consumer, to an extent, allowing them to carry the effects of feedstock price increases more easily. This further underlines the strong position held by these players when comparing WPCs.

Overall, the WPCs of wood pellet producers in the US Southeast are the lowest in the market, and these decrease further still when including any CAPEX repayments that may need to be made for a new mill. This highlights the limited impact an increase in pellet mill capacity in this region can have on existing biomass end users. If an increase in pellet mill capacity were to increase biomass feedstock prices, pellet mills would have to outcompete each other for feedstock while the traditional biomass end users could continue to afford to operate.

Figure 10 – WPC for key wood consuming industry sectors in the US Southeast in 2013



*Tonnes for all products but wood based panels that is shown in m^3

In July 2012 the USDA commissioned a study to assess the expected development of US forest inventory and growth rates across the entire US out to 2050[3], based on both historic data and growth rate modelling. This data showed that in the US Southeast, between 2014 and 20205, it is expected that available softwood volumes will increase by ~11%. Hardwood volumes are assumed to remain stable over the same period. As a result of this, the total wood supply potential in the US Southeast can be expected to increase by 10 million odt, reaching 150 million odt by 2025.

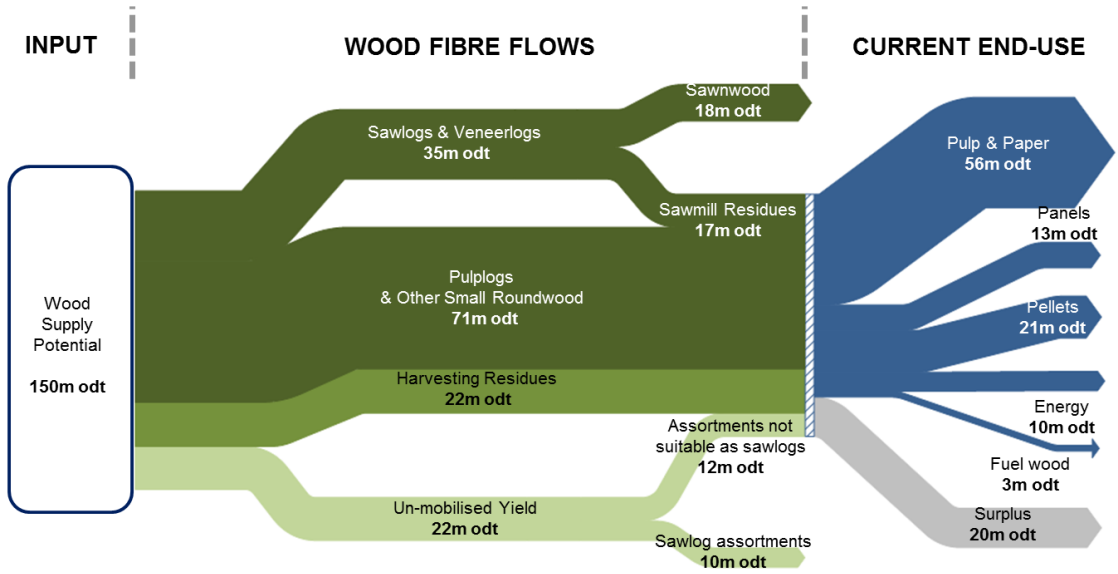
There is also expected to be a significant change in demand in this region. The pulp and paper sector is likely to see a decline in demand, due to a fall in demand for writing and newsprint papers which make up the large majority of production in this region. Balancing out this fall in demand are anticipated increases in demand from the wood based panels

[3] USDA published study entitled "Developing Inventory Projection Models Using Empirical Net Forest Growth and Growth-Stock Density Relationships Across UU Regions and Species Groups"

and wood pellets industries. The wood based panels industry is estiamted to grow with a CAGR of 5% out to 2020, but slowing down to only 1% CAGR by 2025. The wood pellet industry will also see a significant growth in demand of 15 million odt, with new pellet mill capacity being built to meet the increasing demand coming from Europe.

Overall, due to the increase in supply and decrease in demand from the pulp and paper industry, there will continue to be a surplus of material in the US Southeast totalling 20 million odt. 12 million odt of this surplus will be from un-mobilised material, with the remainder mostly consisting of harvesting residues.

Figure 11 – Wood biomass flows in the US Southeast in 2025

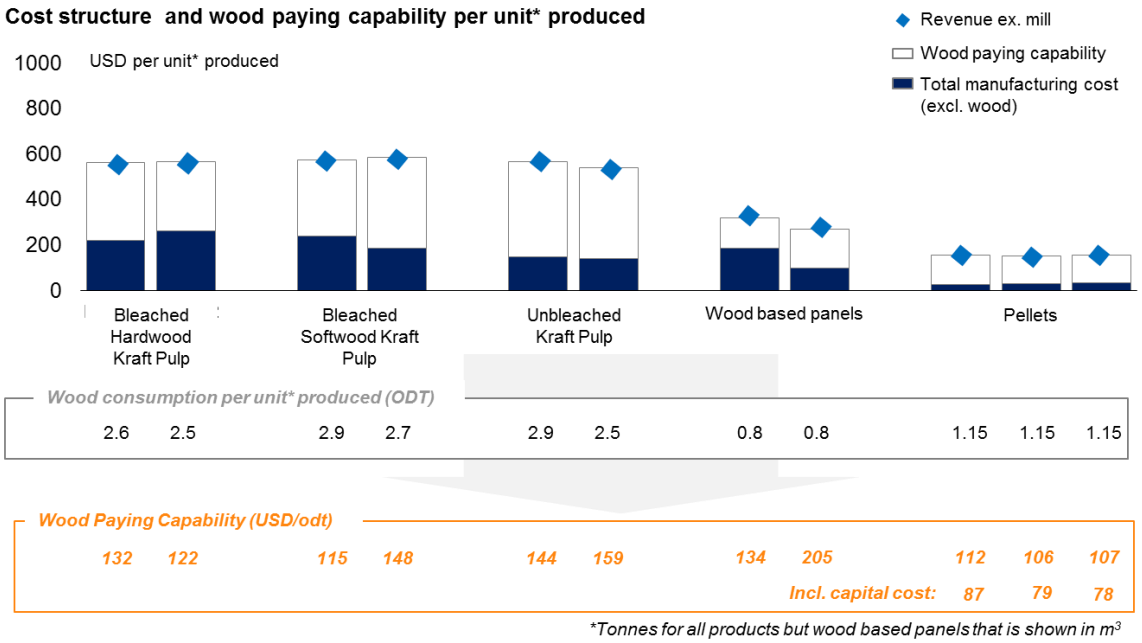


End product prices are projected to fall by 2025 in the pulp and paper sector, however, this sector can still be expected to have the highest WPCs in the US Southeast market. End product prices in the wood based panels sector are expected to remain stable(in real terms) out to 2025, keeping the WPCs of players in this industry constant. As demand for wood pellets in Europe increases and supply becomes tight prices can be expected to increase, as a result the WPCs of wood pellet producers can be expected to increase slightly, however, they will still have the lowest WPCs of all wood consumers in this region and would not be able to outcompete most other forest industry participants.

Conclusion

From this analysis Pöyry conclude that there is no strong evidence for an increasing risk of IWUC in the US Southeast, due to the existing and persisting favourable biomass surplus situation that offers sufficient supply potential for the existing industry sectors and the projected developing pellet demand volumes. The comparatively low Wood Paying Capability (WPC) of pellet producers in the US Southeast and the projected decline in demand from the pulp & paper sector further support the finding of a low risk of IWUC in this region.

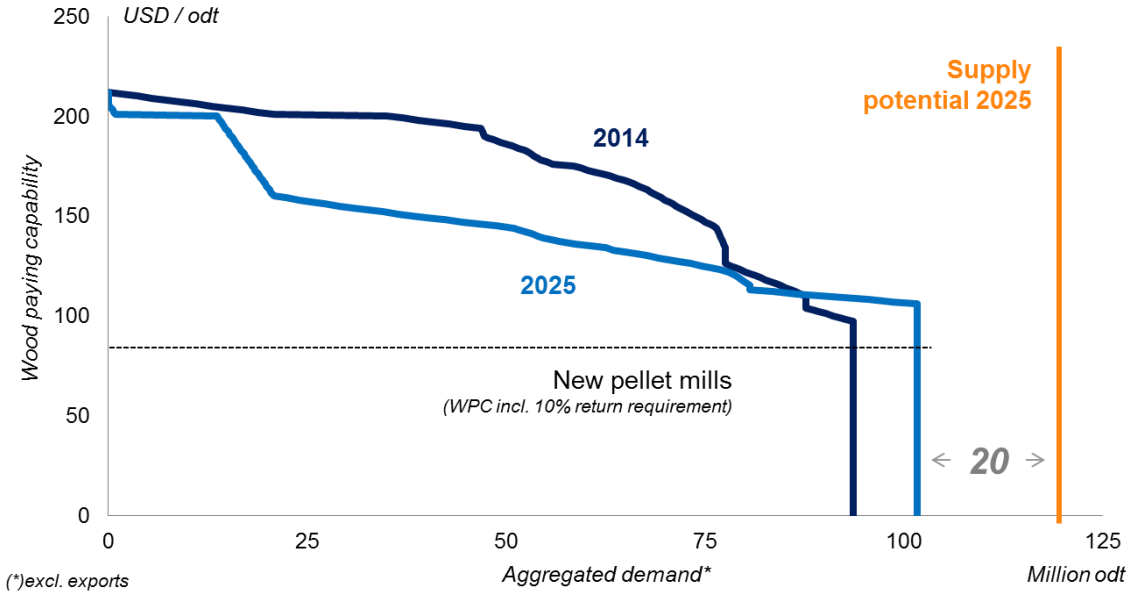
Figure 12 – WPC for key wood consuming industry sectors in the US Southeast in 2025



*Tonnes for all products but wood based panels that is shown in m^3

Figure 13 shows the aggregated demand curves for all wood consumers in the US Southeast in 2014 and 2025, depicting the biomass surplus that can be expected remain within the market. The expected WPC of a new pellet mill will remain below the WPC of the marginal end-user in 2025. This in combination with the stable biomass supply surplus lead to a low pressure on wood prices.

Figure 13 – Aggregated demand curves for the US Southeast in 2014 and 2025

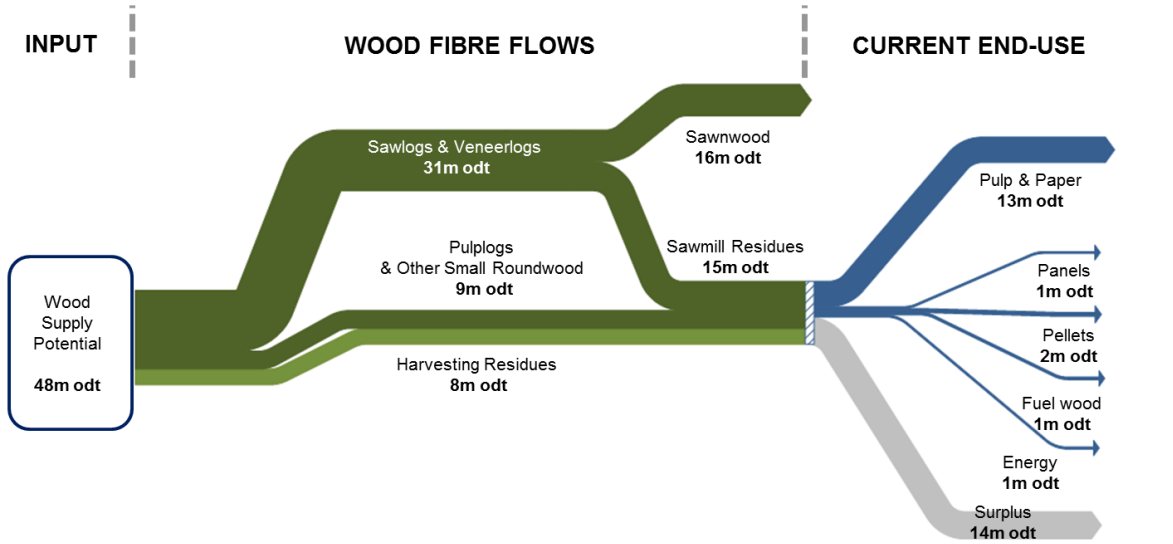


5.2 Western Canada

The government owns the vast majority of forest land (Crown Land) and regulates biomass supply through Annual Allowable Cuts (AACs). The total wood supply potential in this region is currently still higher than normal, due to the government increasing AACs in order to combat the mountain pine beetle infestation by increasing harvesting activities in regions that have been affected in an attempt to prevent the further spread of the infestation. As a result, the total AAC is higher than total demand, leaving a surplus of ~14 million odt in the market, although ~8 million odt of this is harvesting residues, which remain almost entirely untilised. Forest land in this region is also characterised by a high sawlog share, with the pulp and paper industry using almost exclusively sawmill woodchips for pulp production.

The pulp and paper industry is also currently the largest end user of biomass in Western Canada, and while the wood pellets industry is the second largest end user total demand from this sector is still relatively small at just 2 million odt.

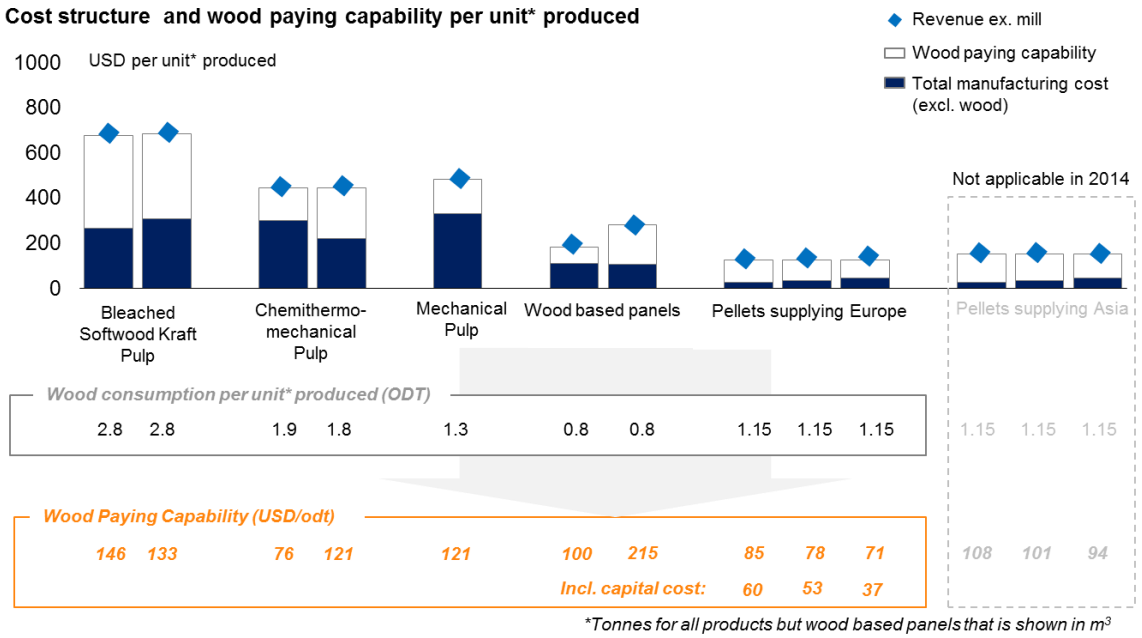
Figure 14 – Wood biomass flows in Western Canada in 2014



Although the WPC of some chemithermomechnical pulp mills can be low, on the whole the pulp and paper industry has higher WPCs than the wood pellet industry. The wood based panels industry also has considerably higher WPCs than the pellet industry, with OSB mills having the highest WPCs of all wood consumers in the market.

The wood pellet industry has the lowest WPCs in this region, due largely to the increased shipping cost as a result of long shipping distances to Europe, making pellets supplied from this region less competitive than those from regions such as the US Southeast.

Figure 15 – WPC for key wood consuming industry sectors in Western Canada in 2014

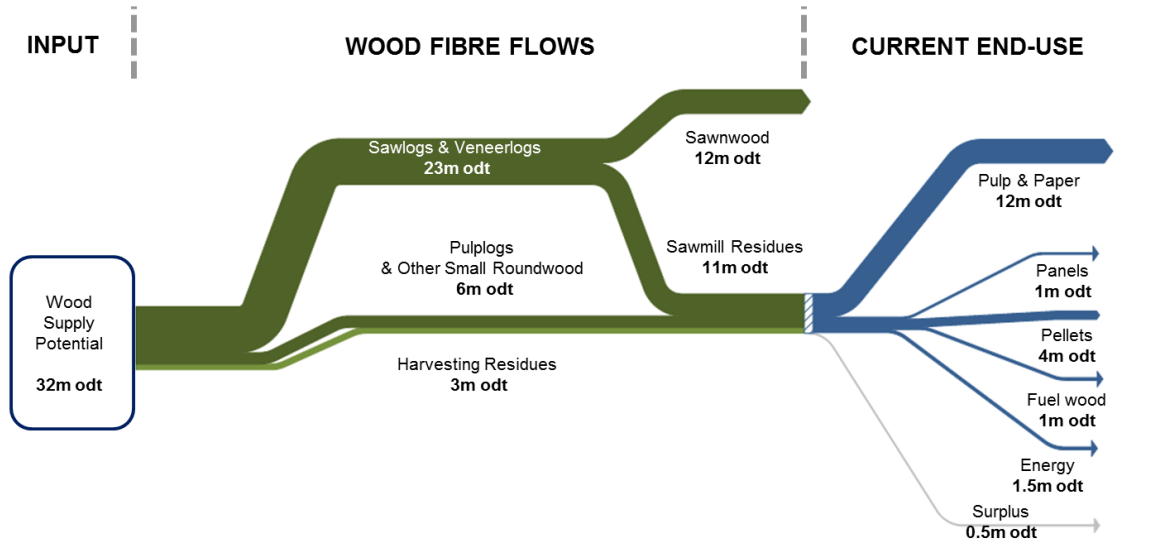


As the mountain pine beetle infestation slowly comes to an end, AACs in Western Canada are expected to fall dramatically. As a result the biomass surplus is expected to fall from 14 million odt currently to just 0.5 million odt in 2025. There is, therefore, an apparent risk that some biomass end-users will not be able to satisfy their demand by 2025.

The pulp and paper industry is expected to see some reduction in capacity (and hence biomass demand), due to a decline in demand for writing and newsprint paper grades, which make up a significant portion of the production in this region. Meanwhile demand from the wood based panels industry is expected to remain stable.

Demand from the wood pellet industry is projected to double, however, this is on the basis of demand from the Asia Pacific market developing as shown in the central scenario demand projections presented in section 4.2.1. If demand does not develop as assumed, or if agricultural pellets make up a high portion of the total supply in the Asia Pacific market then less capacity development will be required in this region, limiting the impact that this sector can be expected to have on the biomass surplus, and hence biomass prices.

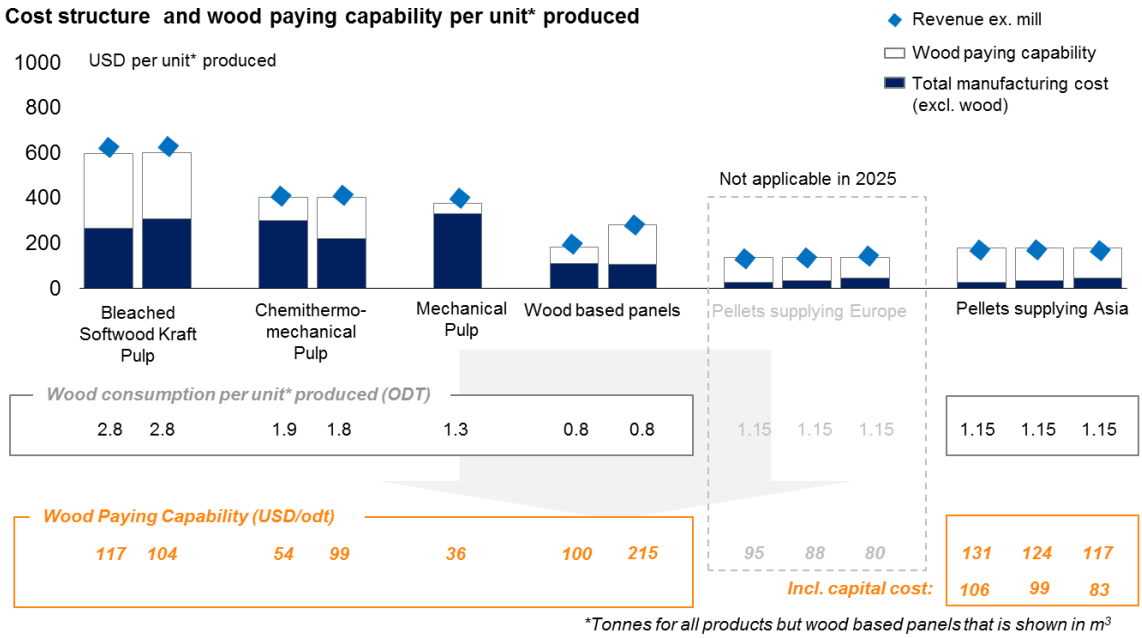
Figure 16 – Wood biomass flows in Western Canada in 2025



As noted, the development of a pellet market in Asia (Korea and Japan) would increase the overall demand for pellets from Western Canada, but it would also increase the WPC of the pellets sector in the region. When selling to the future Asian pellet market, mills in Western Canada can be expected to improve their WPC by 20-25 USD / odt compared to when selling to the European market, due to the higher PPC of energy generators in Asia Pacific and the shorter shipping distances to this off-take market.

A higher WPC for pellet mills in combination with a falling demand and lower end-product prices in the pulp and paper sector improve the competitive position of pellet mills in the biomass market in Western Canada. The modelled WPC of a new pellet mill exceeds that of many existing pulp mills by 2025.

Figure 17 – WPC for key wood consuming industry sectors in Western Canada in 2025



Falling biomass supply, increased pellet production and a relative improvement of the WPC of pellet mills result in an increased risk that some pulp and/or panel mills that have a lower paying capability might have to exit the market unless they manage to pass on raw material price increases to their end customers at least to some extent.

However, without the possibility to sell to the Asian pellet market, no expansion of the pellet industry in Western Canada is expected and the impact of the pellet industry on the other biomass consuming sectors in the region will be limited.

Conclusion

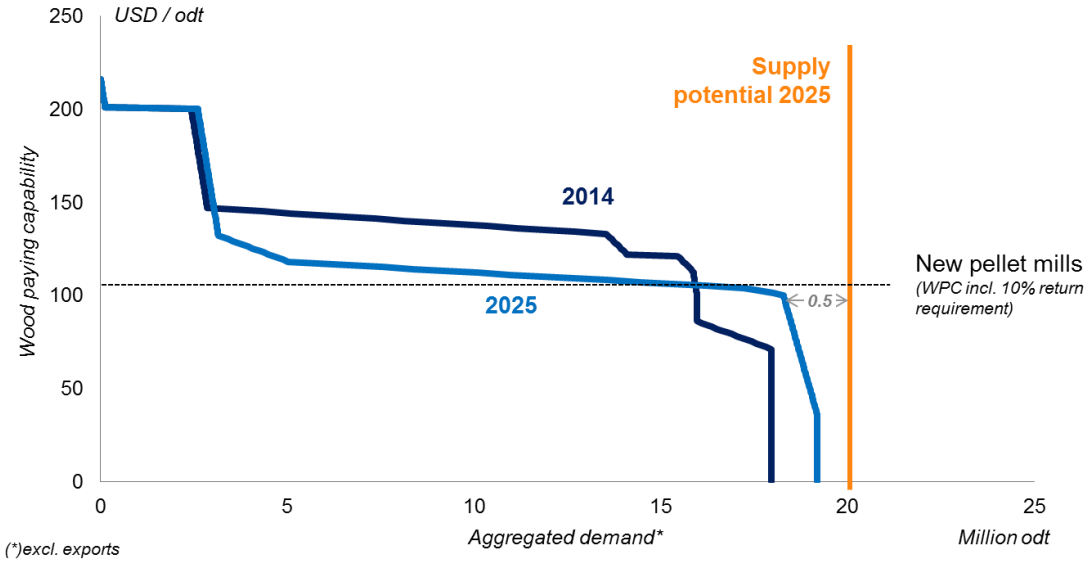
The Pöyry analysis identifies an increasing risk of IWUC in Western Canada. By 2025, some pulp mills (especially mechanical pulp producers) are likely to have been forced to leave the market as they will not be able to afford to compete for biomass. At the same time pellet production in the region is expected to have doubled compared to 2014 levels.

The main reasons for the increased risk of IWUC in Western Canada are:

- A fall in the biomass supply potential by more than 30% between 2014 and 2025
- Growth in Asian (Japan and Korea) pellet demand
- Falling demand and end-product prices in the mechanical pulp and printing & writing paper sector

It has to be noted that these factors are mainly outside of the control of European pellet buyers.

Figure 18 – Aggregated demand curves for Western Canada in 2014 and 2025

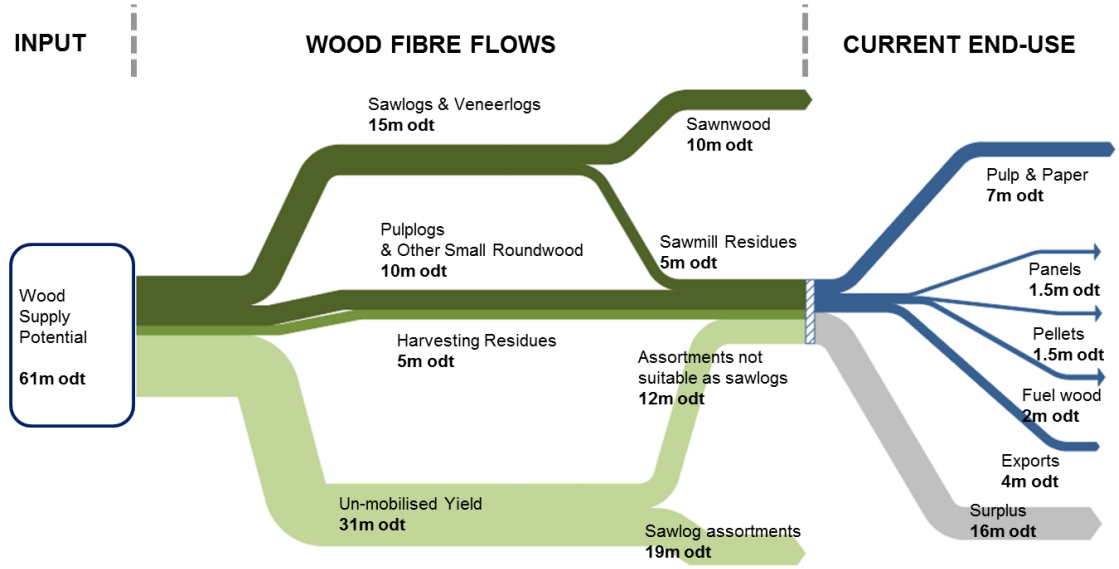


5.3 North West Russia

As in Western Canada, forest land in North West Russia is owned by the state, with the government distributing harvesting licenses and controlling annual harvest levels to prevent overharvesting. North West Russia is heavily forested, however, infrastructure in much of this region is poor, leaving many forest stands un-managed. As a result there is a significant un-mobilised yield that could add an additional 12 million odt of biomass supply to the market.

The pulp and paper industry is currently the largest end user of biomass in the region, followed by the export sector. Demand from the wood pellet industry is small by comparison, currently totalling just 1.5 million odt.

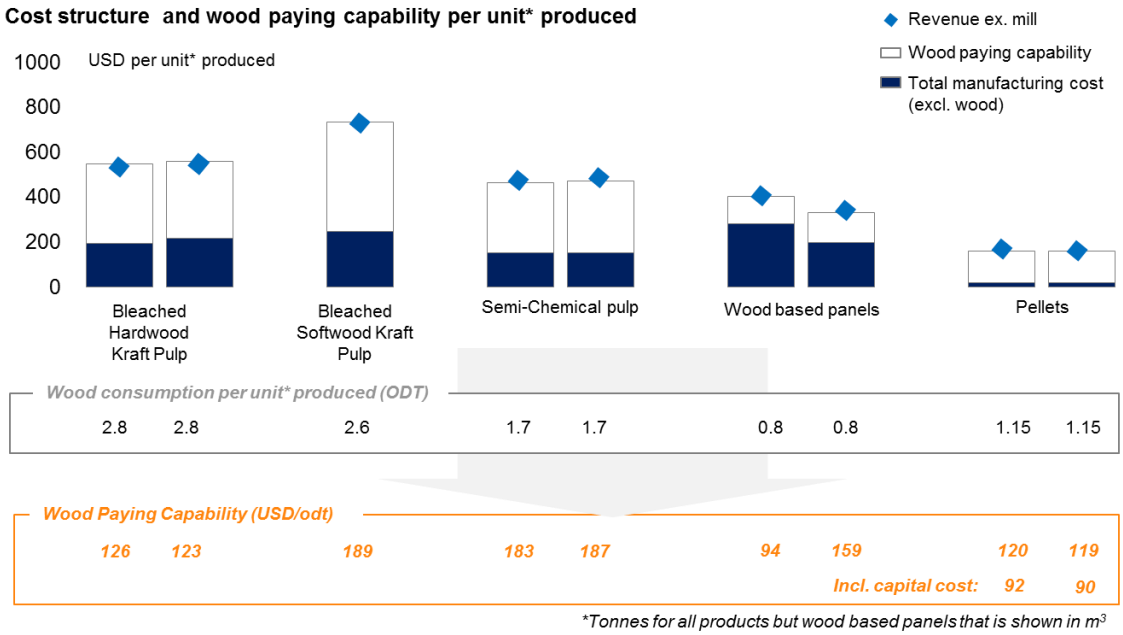
Figure 19 – Wood biomass flows in North West Russia in 2014



The pellet industry is modelled to have a relatively low WPC compared to other biomass consuming sectors in North West Russia. This means that an expansion of the sector would only have a limited impact on medium to long term biomass price developments should the biomass supply and demand situation tighten in the future.

The WPC of a wood pellet mill could be higher than that of some wood based panels mills, but only when assuming all CAPEX costs have been covered and do not have to be repaid. When including CAPEX costs pellet mills have the lowest WPCs. Players in the pulp and paper sector have, for the most part, the highest WPCs due to the high end value of the product that they produce.

Figure 20 – WPC for key wood consuming industry sectors in North West Russia in 2014



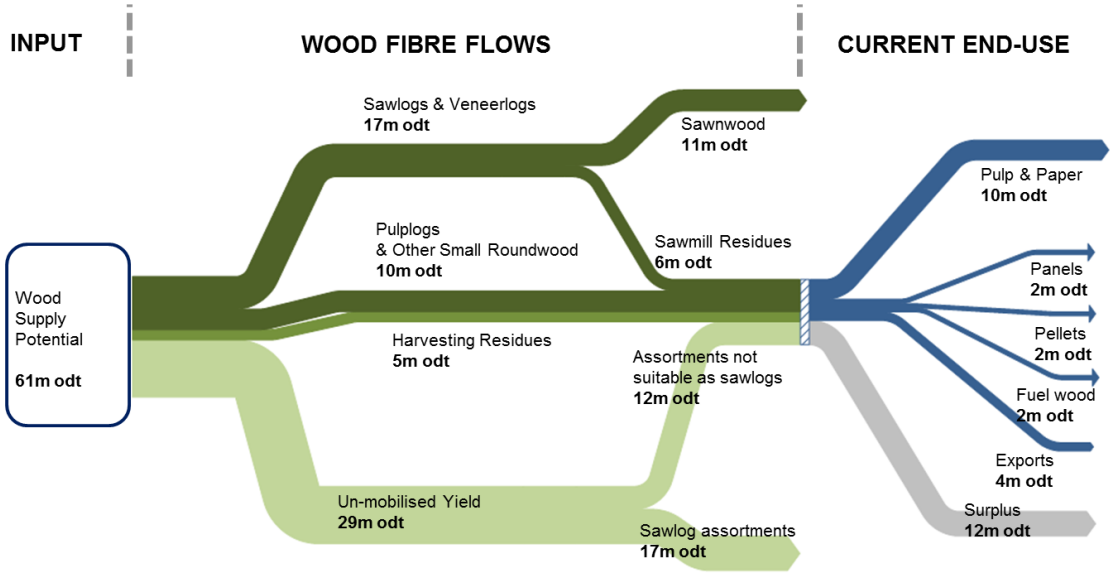
*Tonnes for all products but wood based panels that is shown in m^3

A significant biomass surplus of 12 million odt is expected to remain in North West Russia out to 2025, due to a limited growth in demand and a stable supply outlook. Hence, there is little need to mobilise additional biomass supply.

The pulp and paper industry is expected to see the most significant growth in demand out to 2025, from 7 million odt to 10 million odt. Demand growth from the wood based panels sectors will be limited, although there will be some capacity expansions as new capacity in North West Russia can outcompete existing capacity in Eastern Europe.

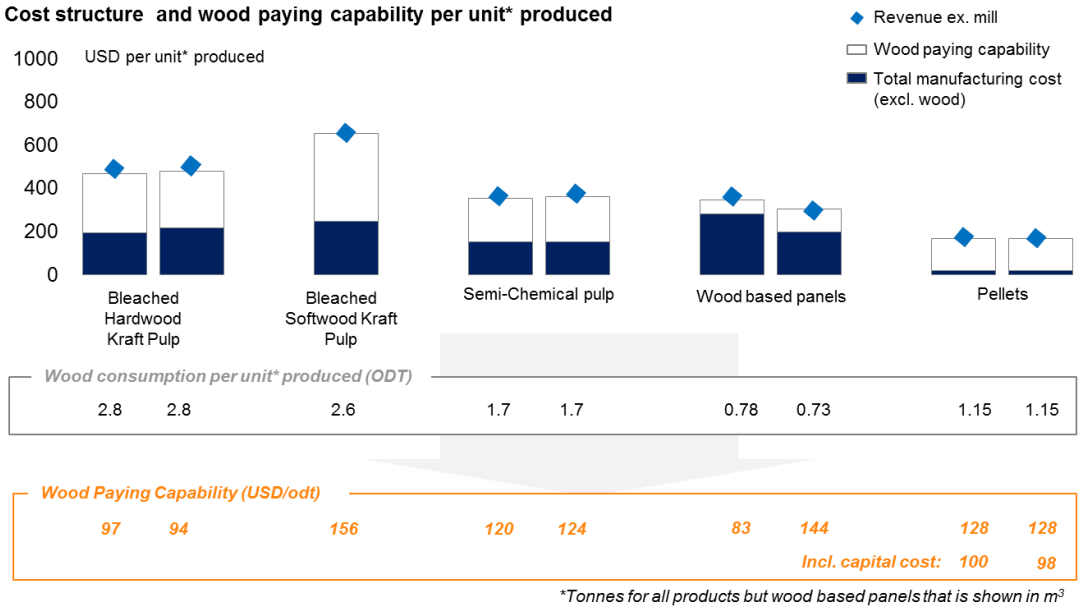
Growth in the pellet sector will be small, as pellet demand in Europe is focused mainly around increasing volumes supplied by the US Southeast since this region offers a higher level of investment security, better infrastructure and easier business access.

Figure 21 – Wood biomass flows in North West Russia in 2025



Falling pulp and paper prices mean that the WPC of some pulp mills, specifically Bleached Hardwood Kraft pulp mills, will be lower than the WPC of the pellet industry, even when accounting for the CAPEX investment cost of these pellet mills. The paying capability of some wood based panels players will also fall below that of the pellet industry, again due to falling end product prices.

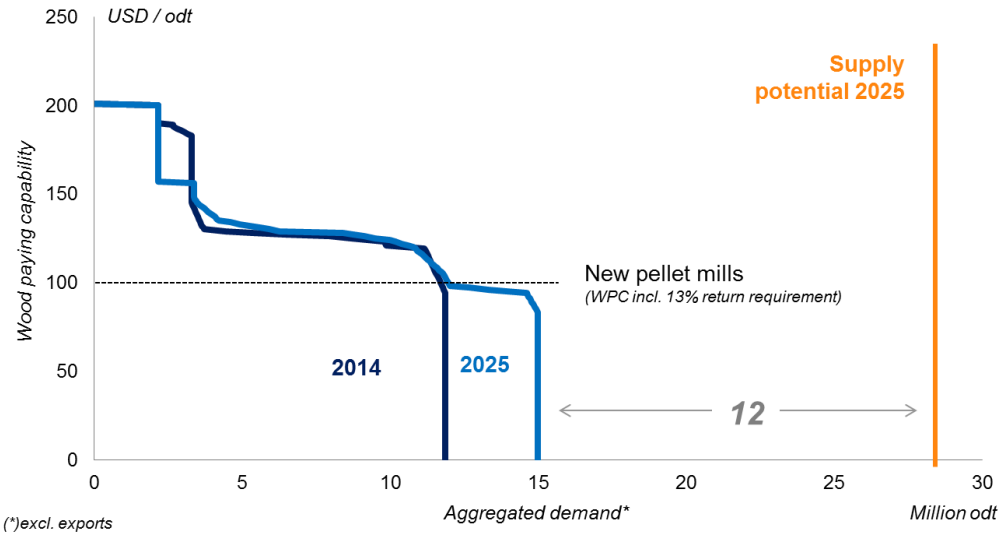
Figure 22 – WPC for key wood consuming industry sectors in North West Russia in 2025



The relative WPC of the pellet sector is expected to improve by 2025, due to increasing pellet prices and falling end product prices in the panel and pulp & paper sector which

negatively affects the WPC of these sectors. However, the significant biomass surplus is expected to limit competition for biomass and on a macro level it can be considered as unlikely that any existing wood consumers will have to exit the market.

Figure 23 – Aggregated demand curves for North West Russia for 2014 and 2025



Conclusion

From this analysis Pöyry conclude that there is no strong evidence for an increasing risk of IWUC in Northwest Russia, due to the existing and persisting favourable biomass surplus situation that offers sufficient supply potential for the existing industry sectors and the projected developing pellet demand volumes.

6. ANNEX

6.1 Conversion Factors

Conversion factors of 0.5 odt per m^3 for mixed assortments and 0.47 for softwoods have been assumed.

The wood demand factors for the different industry sectors were assumed:

- Panel grades: 0.7 odt/m^3 for Particleboard, 0.78 odt/m^3 for OSB and MDF.
- Pellet mills: 1.147 odt/tonne of pellets
- The demand factor differs for pulp depending on the grade produced, as follows:
- BSKP: 2.65 odt/tonne of pulp
- BHKP: 1.95 odt/tonne of pulp
- USKP: 2.45 odt/tonne of pulp
- SI pulp: 2.5 odt/tonne of pulp
- Mechanical pulp: 1.4 odt/tonne of pulp
- Semi-chemical pulp: 1.4 odt/tonne of pulp
- Dissolving pulp: 2.8 odt/tonne of pulp
- Fluffpulp: 1.3 odt/tonne of pulp

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