



SUSTAINING
ECOSYSTEMS
THROUGH
RESPONSIBLE
BUSINESS PRACTICES



TECHNICAL
REPORT

INT

2016

MAPPING STUDY ON

CASCADING USE OF WOOD PRODUCTS

ABOUT WWF

WWF is one of the world's largest and most experienced independent conservation organisations, with over 5 million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

ABOUT MONDI

Mondi is an international packaging and paper Group, with production operations across 30 countries. The Group's key operations are located in central Europe, Russia, the Americas and South Africa.

Mondi Group is fully integrated across the packaging and paper value chain, from the growing of wood and the production of pulp and paper (packaging paper and uncoated fine paper), to the conversion of packaging paper into corrugated packaging, industrial bags, extrusion coatings and release liner. Mondi is also a supplier of innovative consumer packaging solutions, advanced films and hygiene products components.

Mondi aims to create long-term value for their stakeholders by transforming responsibly sourced raw materials into innovative product solutions that meet customer needs in a responsible, cost-effective and sustainable way.

ABOUT THE WWF-MONDI GLOBAL PARTNERSHIP

Mondi Group and WWF are working together in a strategic partnership that focuses on promoting environmental stewardship in the packaging and paper sectors.

The work of the partnership focuses on minimising the impacts of Mondi's operations on forests, climate and water, sharing our initiatives and encouraging sustainable practices in the industry.

The three year partnership, which was launched in February 2014, aims to demonstrate that environmental stewardship and responsible business practice can, and need to go hand in hand. It also hopes to catalyse widespread positive change in the global packaging and paper sector and beyond.

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EXECUTIVE SUMMARY

Wood is used as a raw material to produce a wide range of products in the pulp and paper industry (paper, cardboard, etc.), the woodworking sector (furniture, panels, fibre boards, etc.) as well as in the new bio-based economy (e.g. wood-plastic-composites, biopolymers). Furthermore, wood, wood products and by-products are used for energy purposes as fuels (e.g. logs, pellets, bioethanol). Recent studies suggest that

a growing demand for materials and energy could lead to a supply deficit of wood in the coming decade. The more resource efficient use of wood offers the potential to overcome the supply deficit and increase the availability of wood and a prominent approach is to adopt the ‘cascading use’ of wood.

Cascading use is a strategy to use raw materials such as wood, or other biomass, in chronologically sequential steps as long, often and efficiently as possible for materials and only to recover energy from them at the end of the product life cycle. It is the intention that the increased cascading use of wood will contribute to more resource efficiency and consequently reduce pressure on the environment.

**“CASCADING USE
OF BIOMASS AS
WELL AS COMBINED
HEAT AND POWER
PRODUCTION NEED
TO BE INCENTIVISED
WHERE
APPROPRIATE”**

(WWF 2012)

WWF and Mondi are in a partnership to promote resilient landscape and responsible products manufacturing and consumption. As part of their work programme, the partners want to share a common understanding on the most efficient use of wood. WWF has published a position paper, which states that “Cascading use of biomass as well as combined heat and power production need to be incentivised where appropriate” (WWF 2012). Mondi has a similar position, aligned to the one of CEPI, which is to “Place the cascading use principle at the core of its climate and energy policy, with a view to ensure the most efficient use of the available biomass, in particular to contribute to the EU growth and jobs objectives”.

Even if cascading use is often referred to in the public and political debate, a common understanding of the term and a consensus on where and how cascading use of wood should be implemented is missing. Furthermore, the integration of cascading use into existing policy frameworks differs to a large extent from country to country. This status leads to confusion and misinterpretations by stakeholders. This is why WWF and Mondi set up a project to provide fact based information on the state of policy relating to cascading use of wood and to raise public awareness of its value.

Nova-Institute and IEEP were asked to undertake a mapping study to understand and interpret concepts of cascading use and investigate the policy framework in different countries. The objective of the study is to identify regulations that either hinder or promote the cascading use of wood. The geographical scope covers five European countries (Finland, Germany, Poland, Spain, United Kingdom) and the US. The policy frameworks of the European countries have been analysed in detail whereas the US has been limited to one policy example, the BioPreferred Program. The research was carried out through desk research and interviews with relevant experts (including industry and NGO representatives and policy makers) in the respective countries from March to September 2015.

The content of the project has been defined to focus exclusively on the analysis of existing policy frameworks favouring the sequential use of wood. Therefore, policy frameworks on other environmental impacts (soil fertility, biodiversity, greenhouse gas emissions), the technical implementation (co-production, carbon sequestration) or other aspects are not covered within this study.

For the purpose of this study, the following concept was used as basis: Cascading use of biomass takes place when biomass is processed into a bio-based final product and this final product is utilised at least once more either for material use or energy. Furthermore, the study differentiates between single stage cascades (when biomass is used once as a final product and then used for energy) and multi-stage cascades (if biomass is subsequently used for several material applications before it is used for energy).

The results of the study reveal that none of the investigated countries have dedicated policies for cascading use of wood. However, a multitude of policies and legislative measures influence cascading use and the wood sector in general, e.g. bioeconomy strategies, forestry management, waste policy, bioenergy policy, building regulations, etc.

These policy fields should all be taken into account when considering how best to promote the cascading use of wood. There is a need for policy harmonisation across these sectors in order to build a consistent framework for the resource efficient management of wood and to support the cascading use of wood. From the analysis it has become clear that each country analysed is in a unique situation concerning wood availability and utilisation. These circumstances need to be taken into consideration in order to find the best solutions to increase resource efficiency. The ideal way would be that the European Commission provide guidance to Member States on how to take the Cascading Use of Wood principle – and in general material applications of biomass – into account when designing their bioenergy support schemes, in particular those related to European Renewable Energy policy and activities related to the Circular Economy package. This guidance also needs to take into consideration that there are different types of wood resources suitable for different kinds of applications and that the nature of this resource will vary between countries and regions.

Generally, the establishment of cascades is decided by economic factors, but economics are influenced both by commercial imperatives as well as policy support (such as incentives). Usually, producers of high value applications can pay a higher price for raw materials, which means that in a standard case, a resource for which there is competition, goes to the higher value-creating application. These are usually bio-based products in material applications, so that in a free market, high-value resources would usually at least enter a single-stage cascade (if the product enters a waste management system at the end of its first life cycle). The ability of different actors to pay for the wood resource, however, is currently influenced by subsidies that are paid to support renewable heat and power generation. At present, certain biomass for energy uses are able to receive this support and as a result may be able to pay higher prices for resources than would have been the case based purely on market forces. This has the potential to distort whether wood, wood products and by-products are used for material uses, cascaded and/or used directly or indirectly for energy production and poses a significant barrier to even single-stage cascades.

For multi-stage cascades, the challenges and interactions that determine whether cascading occurs and the balance between material and energy use become more complex. First of all, local heat generation from post-consumer wood (in private households) or by-products (in commercial facilities) is a traditional source of energy in many countries, and might make a lot of sense in terms of local and economic energy production. But this material is lost for cascading use. Secondly, an effective establishment of multi-stage cascades requires a comprehensive system of waste collection, preparation and recycling. These structures need time to build. Moreover, an abundance of wood resources in countries such as Poland makes recycling less attractive, since using fresh resources is more economically feasible than setting up a whole recycling system. Finland is in a similar situation in terms of wood availability. While Finland has a strong paper recycling policy, policy for the recycling of other wood materials is not yet strongly established.

The following key messages can be extracted from the analysis:

- There is a strong need for a commonly agreed and accepted concept of “cascading use” among policy makers, researchers and industry.
- Cascades are only established if they make sense economically, but economics are influenced both by commercial factors and by public support (such as through policy incentives). The ability to establish cascading in Europe is impacted by two economic trends: that fresh wood is not necessarily more expensive than the use of recycled wood; that subsidies received for the production of bioenergy mean that energy users can potentially pay higher prices for woody material than would otherwise be the case. There is a strong impression that as long as bioenergy is heavily subsidized, it is highly unlikely that more effective cascades will be established or improved throughout Europe.
- When considering cascading use, it is extremely important to look at a very wide sweep of policies that historically have been developed in isolation. Interlinkages between waste collection and management policies, sequestration measures, management strategies in the forest, resource efficiency strategies and energy policies are intricate and influence each other. Therefore, the implementation of cascading use of wood is not a one-dimensional debate but a whole set of wider complex policy interactions and nuances that dictate the most effective outcomes of the whole resource system.
- Policy harmonisation still needs to allow room for each unique country situation in terms of wood availability and utilisation. It is recommended that the European Commission provide guidance to Member States on how to take the Cascading Use of Wood principle – and in general material applications of biomass – into account when designing their bioenergy support schemes, in particular those related to European Renewable Energy policy and activities related to the Circular Economy package. Such guidance would also need to take into consideration that there are different types of wood resources suitable for different applications.

- Biomass, including wood and wood products, has been chosen as one of the primary means to deliver Member State renewable energy targets. This poses a potential barrier to the evolution and further establishment of cascades for woody biomass, as the first use (material or energy) determines the final material flows.
- The effective national implementation of the European waste hierarchy is crucial for the establishment of multi-stage cascades. Reliable classification and sorting systems of post-consumer wood are extremely important for functional recycling systems. However, even they cannot be a guarantee for a cascade to take place, if the resources are not used as material in their first application.
- Positive examples of established cascading and recycling systems show that public awareness and acceptance is key. This should be supported throughout Europe.

Six selected countries were analysed in more detail in order to highlight especially relevant legislation and their impacts on the cascading use of wood. The main results of the case studies are as follows:

Finland – A rich tradition in efficient wood use

Finland is rich in wood resources and has a very strong forest industry that accounts for 18% of the national industrial output. A total of 59Mm³ of wood are used annually by the domestic industry. Estimations about potential future increases in consumptions differ, however. The availability of raw material and an established wood processing industry are strong enabling factors for the cascading use of wood, since the production of bio-based products is a prerequisite for cascading use. However, Finland relies heavily on wood as a solid biofuel for renewable energy generation. The support systems in place for bioenergy create market distortions that constitute strong barriers for an effective cascading system, since a lot of wood is directly allocated to energy and never enters a cascading stream.

In general it needs to be stressed that Finland has a rich history of wood utilisation and has developed systems apart from cascading use to optimise resource efficiency, e.g. through streamlined processes and utilisation of co-products. The interviews with experts from the forestry and wood products sectors showed a general hesitancy towards a binding cascading regulation, since the free utilisation of wood resources is regarded as a major factor for economic growth and prosperity. Awareness of the importance of the cascading issue is growing, though.

Germany – Best practice for post-consumer wood collection and sorting

Wood is a very important resource in Germany in terms of value creation and employment. However, the provision of wood resources is close to the maximum capacity.

6
NUMBER OF COUNTRIES ANALYSED FOR THIS STUDY
THESE ARE: FINLAND, GERMANY, POLAND, SPAIN, UK AND THE US

In Germany recycling of wood and paper has been established for more than two decades and is widely accepted in the society. EU regulations on waste management are transposed into national law and find strong institutions to ensure collection and recovery of wood, which also means that public awareness of wood recycling is quite high. Strengths are a comprehensive regulatory framework, which organises collection, separation and use of waste wood. They furthermore secure the separation in different qualities of waste wood in combination with specific recovery options. Weaknesses are the practical implementation of the separation process of waste wood (which is still quite elaborated in the European comparison) and a strong competition with energetic use caused by the national implementation of the renewable energy targets.

Germany has formulated many political strategies, action plans and programmes addressing biomass utilisation, bioeconomy and recycling. However, cascades currently only work in those areas that already have a long tradition in recycling, e.g. paper and particle boards.



**POLAND
IS RICH IN
FOREST
RESOURCES
THE MAJORITY OF
THE FOREST AREA
IS ECONOMICALLY
EXPLOITED**

Poland – Abundance of resources counteracts cascading use

Poland is rich in forest resources, with the majority of the forest area being economically exploited. In 2009, the volume of timber removals amounted to approximately 34 million m³ with an additional 1.93 million m³ slash being removed. This makes Poland attractive as a location for wood-based industries, but gives little incentive for a repeated use of the resource, i.e. through increasing the cascading use. Furthermore, Poland relies heavily on co-firing of wood resources in coal plants for reaching its renewable energy targets, creating a strong market distortion allocating wood to the energy sector. This means that even the first stage of a cascade is never reached for a significant amount of wood materials. It should be noted that high-grade wood is excluded from the co-firing (under criminal liability) except for small-scale installations, which is positive in terms of cascading use. The verification of the grade of wood resources proves quite difficult in Poland, though.

In terms of recycling, the data basis is quite weak. Vague estimations for a recycling quota of wood products range between zero and 10%. However, the transposition of the EU Waste Framework Directive has only recently taken place, establishing a collection system for solid wastes only in 2013. Attitude and perception towards recycling is slowly changing as a result, and research is done by different actors. This might constitute a promoting factor for increased cascading use of wood, but effects need to be seen and there seems to be a lack of political will to establish cascades.

Spain – Advanced policy measures but poor integration

Spain is a country of relatively low wood resources and is at a relatively early stage in the development of cascading use of wood. Some opportunities are provided by the waste management legislation, which establishes the basis to further recycle waste wood in potential multi-stage cascades. There is also evidence of proactive action at the regional level that is significantly improving the collection and hence availability of waste woods. From a longer-term perspective, the discussion on a 2030 bioeconomy strategy and the research agendas looking at research and development

(R&D) may enable further developments with regard to cascading use of wood.

Challenges to cascading use in Spain are identified in the national policies promoting the use of wood for energy production. Although increased demand of wood for energy purposes may stimulate larger mobilisation of wood resources, in principle it limits the availability of wood to be further cascaded.

The objectives and needs from the wood and forestry sector are not sufficiently integrated within Spanish policy. It is not clear how policies that are quite advanced e.g. for separate collection of wood, landfill taxes and the promotion of recycling/reuse interact with the wider priorities of the bioeconomy, renewable energy use and broader climate goals such as sequestration. All these factors could be brought together to develop sustainable outcomes that deliver cascading material uses, energy and effective forest management; however, as yet such coordination is not being undertaken.

UK – Transitioning from wood incineration to a waste based bioeconomy?

The recognition of the potential inherent in the utilisation of waste resources has stimulated policy interest in the UK. The ambition to realise a long-term plan, such as a road map or guiding strategy document, has been hampered initially through uncertainty in the government's future at the time the report was being compiled¹. However, this is due to be revisited. The precise ambition for waste wood within this agenda is not so clear. On the one hand the role of wood waste is particularly important in the UK given the relatively small area of domestic wood production. However, wood waste represents only a relatively small share (4%) of overall waste resources.

What the review of waste resources and use in the UK has highlighted, are the range of sectors and actions needed in order to transform the view of wastes from something that needs to be disposed of, to something that is considered as a valuable resource and input feedstock for a whole range of existing and emerging sectors. These range from funding initiatives; development of coherent policies across various thematic areas; improved coordination activities; planning developments; education and outreach activities; etc.

US – Strengthening innovative wood products through the BioPreferred Program

The US is the biggest producer and exporter of wood and forest products in the world. According to experts in the field, however, the term “cascading use” is not very well established or known by industry players and policy makers in the US and Canada. The topic is slowly gaining some prominence, but is not very high on the agenda. The BioPreferred Program has potential to strengthen the market uptake of wood-based products, therefore enabling cascading use to take place. Unfortunately, the inclusion of wood products in the program has taken place so recently that there is no reliable data on market impacts up to today.

¹ In the run up to the UK General election in 2015.

1 INTRODUCTION

Wood is used as a raw material to produce a wide range of products in the pulp and paper industry (paper, cardboard, etc.), the woodworking sector (furniture, panels, fibre boards, etc.) as well as in the new bio-based economy (e.g. wood-plastic-composites, biopolymers). Furthermore, wood, wood products and by-products are used for energy purposes as fuels (e.g. logs, pellets, bioethanol). Recent studies suggest that a growing demand for materials and energy could lead to a supply deficit of wood in the coming decade. The more resource efficient use of wood offers the potential to overcome the supply deficit and increase the availability of wood and a prominent approach is to adopt the ‘cascading use’ of wood.

Cascading use is a strategy to use raw materials such as wood or other biomass, in chronologically sequential steps as long, often and efficiently as possible for materials and only to recover energy from them at the end of the product life cycle.

It is the intention that the cascading use of wood will contribute to increased resource efficiency and consequently reduce pressure on the environment.

WWF and Mondi are in a partnership to promote resilient landscape and responsible products manufacturing and consumption. As part of their work programme, the partners want to share a common understanding on the most efficient use of wood. WWF has published a position paper, which states that “Cascading use of biomass as well as combined heat and power production need to be incentivised where appropriate.” Mondi has a similar position, aligned to the one of CEPI, which is to “Place the cascading use principle at the core of its climate and energy policy, with a view to ensure the most efficient use of the available biomass, in particular to contribute to the EU growth and jobs objectives”.

Even if cascading use is often referred to in the public and political debate, a common understanding of the term and a consensus on where and how cascading use of wood should be implemented is missing. Furthermore, the integration of cascading use into existing policy frameworks differs to a large extent from country to country. This status leads to confusion and misinterpretations by stakeholders. This is why WWF and Mondi set up a project to provide fact based information on the state of policy relating to cascading use of wood and to raise public awareness of its value.

Nova-Institute and IEEP were asked to undertake a mapping study to understand and interpret concepts of cascading use and investigate the policy framework in different countries. The objective of the study is to identify regulations that either hinder or promote the cascading use of wood. The geographical scope covers five European countries (Finland, Germany, Poland, Spain, United Kingdom) and the

US. The policy frameworks of the European countries have been analysed in detail whereas the US has been limited to one policy example, the BioPreferred Program. The research was carried out through desk research and interviews with relevant experts (including industry and NGO representatives and policy makers) in the respective countries from March to September 2015.

The content of the project has been defined to focus exclusively on the analysis of existing policy frameworks. Therefore, environmental impacts (soil fertility, biodiversity, greenhouse gas emissions), the technical implementation (co-production, carbon sequestration) or other aspects are not covered within this study.

As there is no official or commonly agreed upon definition of “cascading use”, the first step consisted of a review of the most prominent concepts and definitions of the term. The key findings are shown in Chapter 2.

Parallel to the work on the definition, a preparatory screening of the policy environment in 20 different countries was carried out (19 European countries and the US) with a view on finding laws and regulations that either hinder or promote the cascading use of wood. It must be noted that none of the countries that were object of the analysis have dedicated legislation pertaining to “cascading use”. Therefore, a more indirect approach was taken to tackle the issue, focusing on different policy areas that are relevant to the use of resources in general, and the use of wood specifically². These are:

- **Waste management:** Waste hierarchies prioritise re-use and recycling of waste. More specifically, it was investigated what the concrete measures in place are, mostly relating to the sorting of waste wood and classification of secondary resources.
- **Circular economy:** This concept is based on a shift from ‘waste’ to ‘resource’, with a view to re-structure the economy on the reusability of products and raw materials. The implementation of the cascading principle would be a cornerstone of the creation of a circular economy in the bio-based sector. However, the development towards such a circular economy is at the very beginning in all countries.
- **Bioeconomy:** Bioeconomies or bio-based economies aim at the sustainable exploitation of natural resources, including the use of biomass raw materials for high-quality products. Increasing the material use of wood through the cascading principle – creating more value-added from the same amount of biomass – would contribute to the efficiency and the sustainability of bioeconomies. The EU, several member states and the US have acknowledged the need to move towards a stronger bioeconomy, but most measures are still in the form of roadmaps – outlining broad plans instead of concrete action – and research agendas.
- **Resource efficiency:** One of the aims of resource efficiency policies is to improve economic performance while reducing pressures on natural resources, to which the



**THE OBJECTIVE
OF THE STUDY
IS TO IDENTIFY
REGULATIONS THAT
EITHER HINDER
OR PROMOTE
THE CASCADING
USE OF WOOD**

² The selection of the policy areas was based on previous research of nova-Institute for the German Environmental Agency (publication forthcoming) and on the analysis proposed in BTG (2014).

implementation of the cascading principle could greatly contribute.

- **Renewable energy:** Renewable energy targets are key to decrease GHG emissions and increase the share of renewables in the energy mix, having caused strong policy measures incentivising the use of wood for energy. These market interventions have strong impacts on the overall use of wood for all applications.

The screening focusing on these policy areas concluded that:

- None of the investigated countries has dedicated legislation pertaining to cascading use of wood.
- All EU Member States are obligated to implement the EU waste hierarchy in national legislation (and among those that have done so are Sweden, France, Germany, Austria, Czech Republic, Spain, Romania, Norway, the UK, Portugal, and Italy); however, this is done with a varying degree of specificity and with varying levels of relevance for the wood sector.
- All countries in the focus of the analysis have bioenergy targets in place. All EU Member States are bound to the targets set out in the Renewable Energy Directive (RED) and the US has a volume-based target for biofuels in place.
- A limited number of countries have or are planning to establish measures on the circular economy (i.e. Sweden, France and Portugal).
- A limited number of countries have or are planning to establish bioeconomy strategies (i.e. Sweden, Germany, Finland, the UK and the US).

x3
**THE AMOUNT
OF WOOD
WE TAKE FROM
FORESTS AND
PLANTATIONS EACH
YEAR MAY NEED TO
TRIPLE BY 2050**

A review of the screening findings led to a selection of six case studies that were investigated in more detail. Four of the case studies (Finland, Germany, Poland and Spain) investigated the comprehensive country situation, while the two remaining case studies focused specifically on one policy area in the respective country: For the UK, that was the shift towards a waste-based bioeconomy and for the US it was the inclusion of innovative wood products in the BioPreferred Program under the last revision of the farm bill. The work was carried out by desk research and through multiple interviews with experts from the wood sectors in the respective countries. The results are presented in Chapter 3. Since the overarching EU policy framework is key to understand national legislation in some instances, a short overview of the most relevant EU Directives is given as an introduction to the case studies.

2 CONCEPTS OF “CASCADING USE”

There are many articulations of cascading use based on different conceptions of what cascading means (Keegan *et al.* 2013; Dornburg 2004; Fraanje 1997). Along with repairable products and second-hand products, these concepts also include complex combinations of main and by-products in so-called primary and secondary cascades (Sirkin & ten Houten 1994). The concept of cascading use overlaps with other topics such as the circular economy and recycling.

The analysis of ca. 40 definitions and concepts has shown that there is no agreed definition of “cascading use”, although there are common elements in the different conceptual understanding of cascading. Existing concepts differ with regard to which kinds of biomass are included, whether they are strictly descriptive or encompass a strategic perspective, whether they consider the value of products and also in terms of whether they are quantifiable. Our assessment of the main differences in the different definitions and concepts, and the potential misunderstandings or unwanted implications for implementation have led to the formulation of the following criteria on which to base a comprehensive concept of cascading use:

1. The concept should be applicable to all biomass sources, whether they are from forestry, agriculture, marine environments, or different waste streams or by-products.
2. The concept should focus on the multiple sequential material use of biomass.
3. Cascading should aim at maximising the value of products in order to achieve the highest resource efficiency.
4. The concept should be in line with existing European waste legislation, and the (future) European strategy on the Circular Economy.
5. The concept should not consider direct energy use of virgin biomass as a cascading use, because energy use implies the automatic end of any life cycle and the leakage of the resource from the system. If the first use of biomass is energy, a cascade cannot start.
6. The concept should be applicable at the product level (e.g. the life cycle of a product) as well as at the sector level (including the allocation of a specific resource to different products).
7. Cascading should be quantifiable in order to measure its contribution to resource efficiency of the cascaded resource and to compare the results of different policy actions.

The only concept that combines all these aspects is the definition published by Carus *et al.* 2014 and Essel & Carus 2014 within a project on cascading use for the German Environmental Agency. This concept is still being discussed with scientific, political and industrial stakeholders and is not officially endorsed. However, since this

definition comes closest to covering the criteria set out above, it is proposed here as a “working definition” that is open for further discussions. In this concept “biomass” means all types of biomass, including primary biomass, by-products as well as residues.

Cascading Use

“Cascading use of biomass takes place when biomass is processed into a bio-based final product and this final product is utilised at least once more either for material use or energy.”

Single-stage cascade

“Cascading use of biomass is described as single-stage, when the bio-based final product is directly used for energy.”

Multi-stage cascade

“Cascading use of biomass is described as multi-stage when biomass is processed into a bio-based final product and this final product is used at least once more as a material. This means that in order to be counted as a multi-stage cascade, at least two material uses need to have occurred before the energy use.”

“Final product” is defined as a product at the end of a processing chain, which is traded and used by the industry and/or consumer for its material or product properties.

“Process intermediates” or “semi-finished” are not considered as final products. If intermediates counted, almost every process chain of a bio-based product would be considered a cascade.

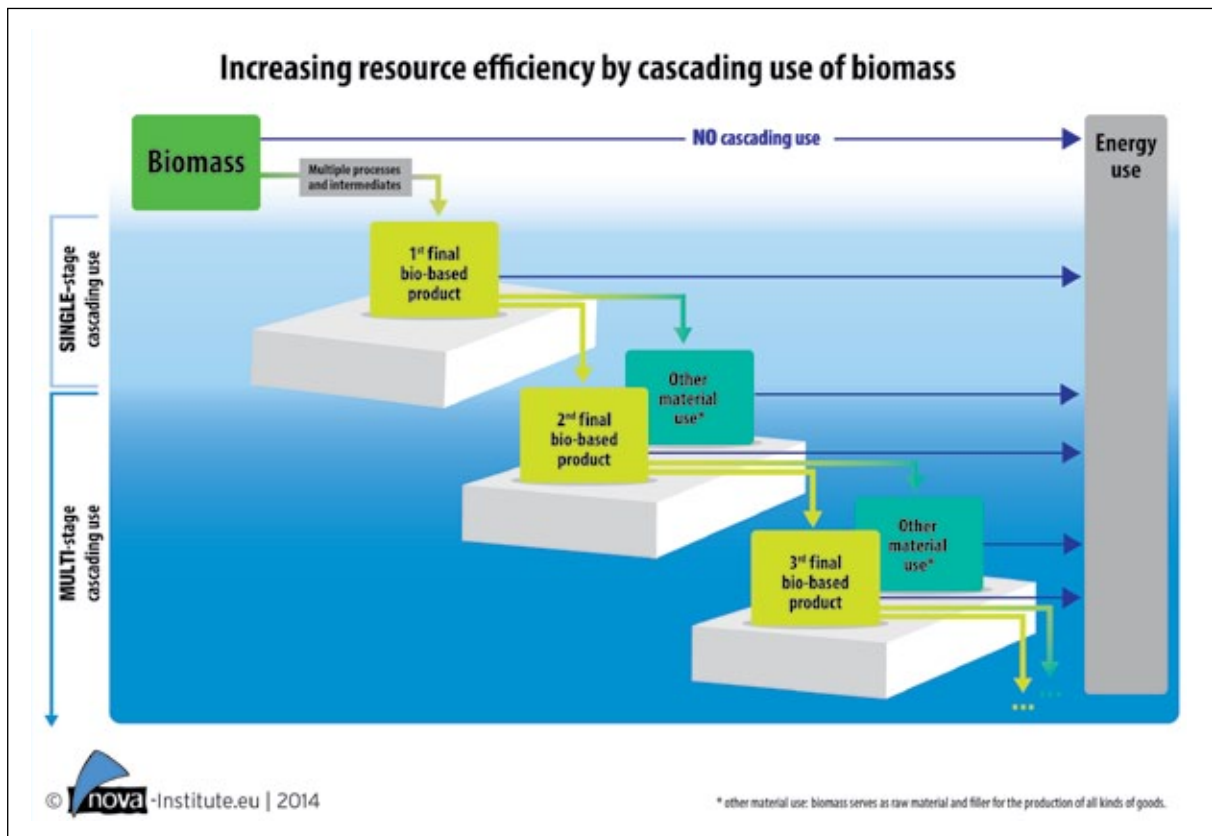
However, the existence of a final product is only required for the first stage of the cascade; in any subsequent stages, products can be final products or alternatively any kind of material (e.g. fillers).

Energy carriers such as wood pellets, biodiesel or bioethanol are not considered “final products” in this context.

“Mega products” such as houses and cars are not treated as final products; they are combinations of several final products. For example insulation material is used by the industry as a final product for its properties in house construction.

The terms “bio-based product” and “bio-based content” or “bio-based carbon content” should be used in line with CEN/TC 411 – EN 16575 “Bio-based products – Vocabulary.”

Figure 1: Increasing resource efficiency by cascading use of biomass (nova 2014)



In the context of this definition, it should be stressed that cascading use and resource efficiency are not the same. Resource efficiency is an overarching concept whereas cascading use is one approach to achieve resource efficiency by increasing the utility of biomass through different material chains. The efficiency of using one resource can also be increased through optimised use of by-products and residues, but this is – strictly speaking – not a cascade per se. For example, if round wood is used for making wooden furniture, and the wood chips resulting as by-products are incinerated for energy, this use of a by-product is not part of the cascade, since the biomass is used directly as energy. However, if the wood chips are turned into particle boards they function as the starting point of a cascade themselves.

The direct use of by-products for other applications (food/feed, energy, return to the biosphere) is called “co-production” and is not the same as a cascade. Based on the above definition, also a quantification system has been (and is further being) developed, the so-called Biomass Utilisation Factor (BUF). This quantification system takes into account how often (= cascading use) and to what extent (= co-production) a resource is utilised.

3 POLICY CASE STUDIES

3.1 FINLAND – A RICH TRADITION IN EFFICIENT WOOD USE

3.1.1 Synopsis

Finland is rich in wood resources and has a very strong forest industry that accounts for 18% of the national industrial output. A total of 59 Mm³ of wood are used annually by the domestic industry. However, estimations about potential future increases in consumption differ. While the Finnish forest industry predicts that sustainable harvesting of 70% of the total forest area would easily allow for an even larger consumption (FFF 2015), other voices raise concerns about environmental impacts and severe losses of biodiversity, stating that there is very limited potential to increase harvests (WWF Finland 2015). The availability of raw material and an established wood processing industry are strong enabling factors for the cascading use of wood, since the production of a bio-based products is a prerequisite for cascading use. However, Finland relies heavily on wood as a biofuel for renewable energy generation. The support systems in place for bioenergy create market distortions that constitute strong barriers for an effective cascading system, since a lot of wood is directly allocated to energy and never enters a cascading stream.

In general it needs to be stressed that Finland has a rich history of wood utilisation and has developed systems apart from cascading use to optimise resource efficiency, e.g. through streamlined processes and utilisation of co-products. The interviews with experts from the forestry and wood products sectors showed a general hesitancy towards a binding cascading regulation, since the free utilisation of wood resources is regarded as a major factor for economic growth and prosperity. Awareness of the importance of the cascading issue is growing, though.

3.1.2 Wood mobilisation and utilisation – facts and figures

The added value of the Finnish bioeconomy has been growing for 10 years and amounted to approximately 60 billion Euros in 2013. The pulp and paper industry created the biggest share (22%), followed by construction (14%), wood products (10%) and forestry (7%) as well as renewable energy (7%) (MEE 2015). The classic forestry sector employed one third of the total 283,000 persons in the Finnish bioeconomy in 2013, making it the most important sector of the bioeconomy in terms of employment.

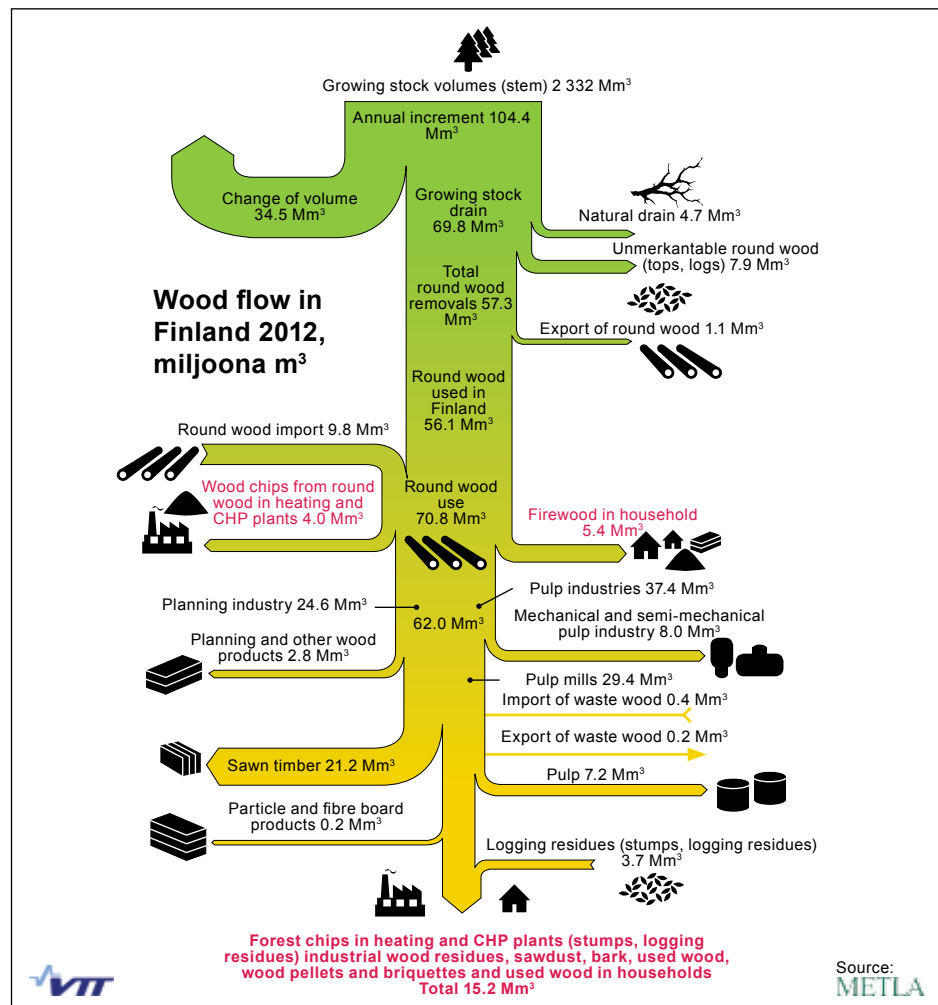
The Finnish forest industry accounts for approximately 18% of Finland's industrial output value and for around 15% of Finland's industrial jobs (Statistics Finland 2013). In 2012, the value of the forest industry production in Finland totalled approximately 19.4 billion Euros, which was divided between the wood products industry³ (6.8 billion Euros) as well as the pulp and paper industry (12.6 billion Euros).

³ Figure also includes the furniture industry.

In Finland, the forest industry is mainly an export industry; the raw materials used are mainly local resources such as domestic wood. The growth of trees per year in Finland stands at 104 million m³ in 2013. 59 million m³ are used annually by the domestic industry. Imported wood amounts to 10 million m³ per year (FFF 2015). The production of e.g. wood-based boards is very small. The sawmilling industry and pulp and paper industries mainly use virgin raw materials. The sawmilling industry has side streams that can be used and are used for e.g. high-value composites, this development has already started and can be further developed (UPM-Kymmene Oyi 2015, Lunacomp oy 2015).

The Finnish forest industry uses the raw material wood very efficiently. Co-products resulting from the sawing such as wood chips are used as materials for making pulp and particle boards, although this use could be enhanced. The forest industry processes have been optimised in order to generate more finished products from less raw materials and to reduce environmental impacts. Thus the efficiency of virgin wood utilisation is maximised. That means that in Finland the “paper and pulp production material efficiency” is reaching its theoretical maximum (Salmi *et al.* 2014). The process flows in the Finnish forestry and wood products sector are shown in the following graph:

Figure 2: Wood flow in Finland 2012, in million m³
(Source: Sokka *et al.* 2015)



3.1.3 Understanding policy in Finland

3.1.3.1 Waste policy – Disposal and recycling of wood products

In terms of recycling of paper, Finland is ahead of European targets with a recycling quota of 71%. Thirty nine per cent of recovered paper used by the Finnish industry go to packaging uses and the remaining 61% are used for paper and other applications (FFF 2015). Over 90 per cent of the paper produced in Finland is exported, which means the paper is recovered mostly in Central Europe, which is the Finnish forest industry's biggest market area. Importing recovered paper to Finland is not economically viable due to, for example, the high costs caused by long transport distances (FFF 2015).

The legal basis for recycling is the packaging and packaging waste directive. It covers all bags, cans, glass and metal packaging and places the responsibility of dealing with the waste with the producers. From 1st January 2016 on, packaging producer organisations will also be responsible for the whole packaging waste collection points network throughout the country. This means that producer organisations will also be responsible of receiving and delivering the further processing of all the separately collected packaging material.

The EU waste directive sets the target that 70% of municipal waste should be recycled by 2030 (today in Finland 34%). The recycling target of waste from fibre-based packaging (paper and wood fibre) aims at 80% (today in Finland 60%), and the recycling target for wooden packaging is 50% by 2020 and up to 80% by 2030. The recycling rate of wooden packaging amounts to only 15% in Finland today.

The Ministry of Employment and the Economy is preparing a study for the cascading use of wood, which demonstrates the topicality of this issue in Finland. In the interview with VTT (Koljonen 2015) who are conducting the study, the different positions of European countries on the timber market were voiced as one main concern. Countries such as Finland or Sweden are timber producers, while others are strong consumers, like Germany. Any European regulation on cascading use needs to take these differences into consideration, but an overarching framework could also provide better solutions for the cascading use instead of individual country regulations.

3.1.3.2 Bioenergy

Finland is one of the world's leading users of renewable sources of energy, especially bioenergy. The strategy of the current government aims at an increase of the renewable energy share to more than 55% of total energy sources in the 2020ies. In 2013, the share of renewable energies of total energy consumption was 36.8% at 115 TWh. The lion's share of this is bioenergy, with 88% of renewable energy being generated from biomass and renewable waste. Eighty two per cent of renewable energies come from solid biofuels, i.e. wood, which is 30% of total energy consumption (Eurostat 2015).

This means that significant amounts of wood are used for energy purposes in Finland. In 2012, they amounted to as much as 34 Mm³. Of these, 24.5 Mm³ were

80%
TARGET OF
WASTE FROM
FIBRE-BASED
PACKAGING
(PAPER AND WOOD
FIBRE) RECYCLED
BY 2030

side streams of the forest industry that went into energy production in the mills, 4.1 Mm³ wood go to bioplants for heating or combined heating and power (CHP) and 5.4 Mm³ were used in private residential household for heating. 0.3 Mm³ of waste wood are exported (Koljonen 2015).

The use of wood fuels has steadily increased in Finland since the beginning of the 2000s. The use of wood chips for energy production has increased tenfold in the 2000s, for example. The use of forest chips target for 2020 is set at 25 TWh, which corresponds to about 13 Mm³ of wood chips per year. In 2013, 8.7 Mm³ wood chips were used to generate 17.4 TWh, of which the biggest share (8 Mm³) went to thermal power stations, generating approximately 16 TWh (FFF 2015).

The Act on Production Subsidy for Electricity Produced from Renewable Energy Sources (1396/2010) lays down provisions on a feed-in tariff system for which power plants fuelled with wind, biogas, forest chips and wood-based fuels meeting the prescribed preconditions could be approved (MEE 2015c). In the feed-in tariff system, an electricity producer whose power plant is approved in the system will receive a subsidy (fixed feed-in tariff) for a maximum of 12 years. The subsidy varies on the basis of a three-month electricity market price or the market price of emission allowances (MEE 2015c).

The UPM Lapeenranta Biorefinery went on-stream in Finland in March 2015. The feedstock for producing renewable diesel in this new biorefinery is crude tall oil (CTO), a by-product of pulp processing from softwood, most often pine trees. UPM uses the available feedstock from its pulp mills located in Finland. This works without increased wood harvesting required for the refinery, but has strong impacts on wood-based resource availability nonetheless. In fact, this example shows the consequences of the subsidies for the energy use of by-products in Finland. Crude tall oil is classified as a waste in Finland, making it eligible for double counting in the biofuels quota and exempting it from almost all sustainability requirements. This makes it extremely attractive for UPM to produce biodiesel from its own processing by-products. However, the classification as waste or residue (as opposed to a by-product) is highly controversial and the suddenly increased demand for CTO for energy purposes leads to a shortage of this valuable feedstock, which has been used by the pine chemicals industry for centuries (Arizona Chemical 2015). This is a very concrete example of lost cascading potential when the resource is used for energy first.

The Ministry of Employment and the Economy has assembled a funding group representing public entities to coordinate and help proposals obtain public funding for biorefineries. The support is set up in the form of a competition and the winner gets a prize of EUR 100,000. Spinnova Ltd. wood fibre yarn project won this biorefinery competition in 2015. This is a good example also of how material applications of wood can generate value in biorefineries. Biorefineries that make other products than biofuels does not have much tradition in Finland and one of the biggest hurdles is the huge investments required as politics are not interested in small business units in this area (Kantola 2015).

The Finnish state also provides funding for research and investment projects that are related to environmentally friendly energy production.

3.1.3.3 Bioeconomy and others

Finland has a dedicated bioeconomy strategy that was adopted in 2014 and the recently announced government programme stressed that one of the main goals of the new government will be enforcing the bioeconomy. Finland is aware of the huge economic importance of its renewable resources, and the implementation of a bioeconomy is planned to be done through energy production, but also through an increased use of wood in construction and through new products from the forest. Some environmentalists, though, raise concerns about whether the plans of the government will have negative impacts on ecosystems.

If all planned investments are going to be actually made, the use of wood in the construction sector will increase to 10 million m³. Political measures enabling this development are planned and consist especially of the removal of building regulations, which prevent the use of wood in construction. The current change will consider e.g. the procurement law that will give municipal communities the possibility to choose wooden construction instead of the cheapest alternative (Karjalainen 2015). Finland has the second highest proportion of multi-storey buildings in Europe, right after Spain. Multi-story wooden construction reached 4% in 2014 and according to the Ministry of Employment and Economy, the share will rise up to 10% already in 2015. This development was not based on subsidies but on a “National wood construction programme 2011–2015” (Karjalainen 2015) that included an information campaign and road shows especially in the area of procurement as well as further education of architects and designers in wood construction. New targets for wood construction have constantly been pursued in the name of the programme, in collaboration with Finland’s most important builders, construction companies, and municipal decision makers and zoning authorities of growth centres.

Development efforts in area of building regulations can serve as “best practise” for other European countries. Measures have focused particularly on large-scale wood construction and on enhancing buildings’ energy-efficiency. Finnish fire-safety regulations were changed 1st September 1997 to allow the use of wood in building frames and façades for buildings of up to four storeys. Fire codes were changed again in 2011, to allow for the use of wood also in residential and office buildings of 5–8 storeys with a wooden frame and façade. In addition, the possibilities for using wood were extended to cover repairs of and extensions to concrete suburban buildings (Karjalainen 2015). A programme for the support for export of lumber products is included in the first steps of the bioeconomy strategy, especially for the wooden construction materials.

3.1.4 Conclusions

Although there is no actual and direct regulation related to cascading use of wood in Finland, several strategies and framework conditions have an impact on the cascading use of wood in this country. Recycling policies are ambitious and can provide opportunities for the repeated use of biomass resources if implemented for wood-based materials. Also the revisions of wood construction regulations can

serve as positive examples for policies promoting the material use of wood, therefore promoting the first stage of a cascade.

In general it needs to be stressed that Finland has a rich history of wood utilisation and has developed systems apart from cascading use to optimise resource efficiency. The interviews with experts from the forestry and wood products sectors showed a general hesitancy towards a binding cascading regulation, since the free utilisation of wood resources constitutes a major economic factor.

Accordingly, the current market for wood is nominally free, which means wood is sold to whoever pays most. In practice, producers further down the processing chain tend to pay more for the raw material wood, since their products achieve higher prices. This means that, at least in principle, a single-stage cascade is realised for high-grade wood through market dynamics. Subsidies for bioenergy corrupt this principle, however, although the system is being modified towards a model in which support for small wood residues is greater than that for larger timber. Finland is currently in a critical period in the sense that the new government programme has only just been announced, and the impacts are not yet known.

3.2 GERMANY - BEST PRACTICE FOR POST-CONSUMER WOOD COLLECTION AND SORTING

3.2.1 Synopsis

Wood is a very important resource in Germany in terms of value creation and employment. However, the provision of wood resources is close to the maximum capacity.

In Germany recycling of wood and paper has been established for more than two decades and is widely accepted in the society. EU regulations on waste management are transposed into national law and find strong institutions to ensure collection and recovery of wood, which also means that public awareness of wood recycling is

Table 1: German wood balance in Mm³ of 2012 and 2013 (Weimer 2014)

SOURCES	2012	2013 ¹⁾	USES	2012	2013 ¹⁾
logging	52,3	53,2	Stocks		
Recycling paper			increase	0	1
National sources	44,4	44,7			
Waste wood			Export	123,8	119,6
National sources	10,7	10,7 ²⁾			
Import	125,8	124,2	National Utilisation	111,6	112,3
Stocks					
decrease	2,3	0			
Total Sources	235,4	232,8	Total Uses	235,4	232,8

¹⁾ estimated value; ²⁾ extrapolated

quite high. Strengths are a comprehensive regulatory framework, which organises collection, separation and use of waste wood. They furthermore secure the separation in different qualities of waste wood in combination with specific recovery options. Weaknesses are the practical implementation of the separation process of waste wood (which is still quite elaborated in the European comparison) and a strong competition with energetic use caused by the national implementation of the renewable energy targets.

Germany has formulated many political strategies, action plans and programmes addressing biomass utilisation, bioeconomy and recycling. However, cascades currently only work in those areas that already have a long tradition in recycling, e.g. paper and particle boards.

3.2.2 Wood mobilisation and utilisation – facts and figures

In Germany around 11.4 million ha are covered with forests corresponding to about one third of the total area. Around 75% of the forest area are certified by PEFC™ or FSC® which is close to the national target of 80% certified wood (UBA 2015). This target was defined in the German National Strategy on Biodiversity (BMU 2007).

In 2014 the total logging amounted to about 54 million m³ wood without bark with 74% softwood and 26% hardwood (DESTATIS 2014). The logging of spruce increased slightly by 5,8% while the logging of pine, beech and oak declined. Forty four per cent of the logging was done on private property, around one third in state forest and 23% in corporate forests (ibid.). 11,2 million m³ of the total harvest was used for energy (an increase by 87% compared to 5.9 million m³ in 2005) (DESTATIS 2014).

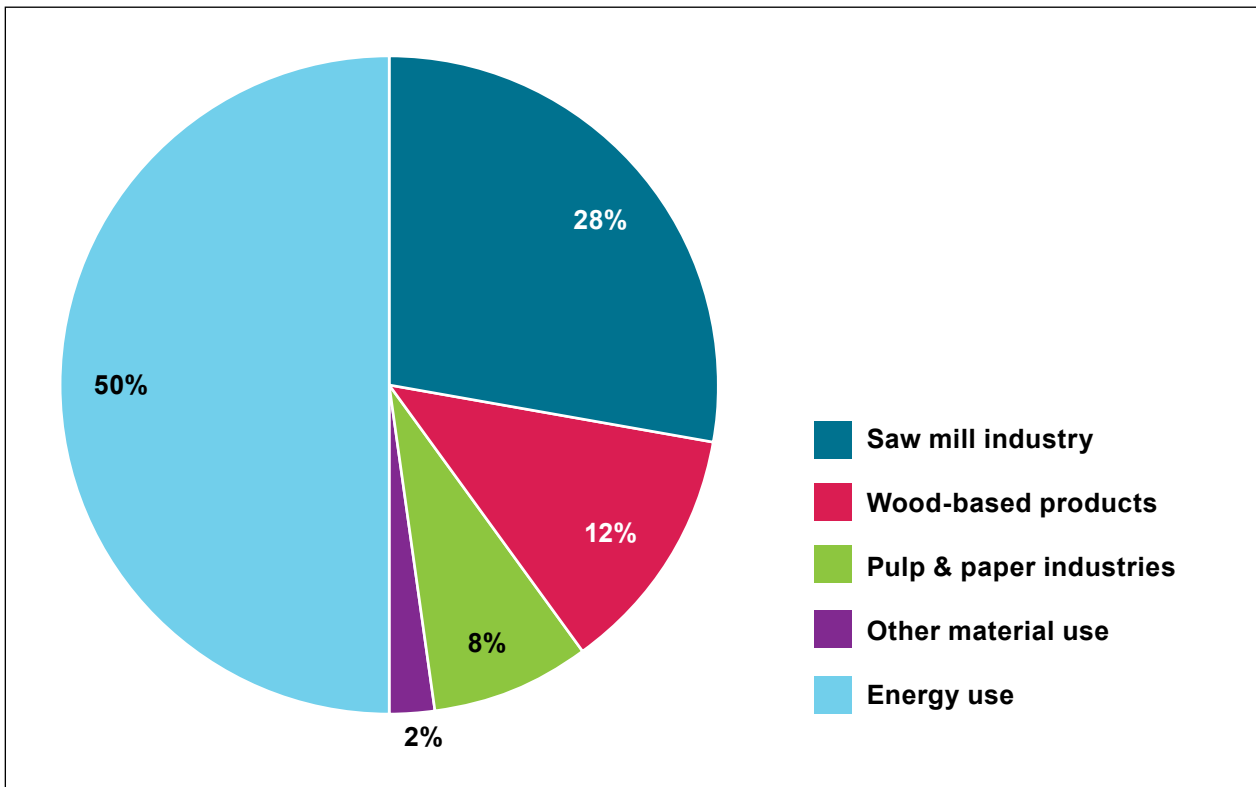
Over the past years there was a slightly increase in hardwood and a decrease in softwood production. The tendency to increase the share of hardwood might be a barrier for cascading use as there are hardly applications besides pellets and fuel in general. Germany is a net exporter of hardwood and net importer of softwood. Key trade partners of hard wood are Austria, Finland, Sweden, the Czech Republic and Belgium (BMEL 2015).

Around 82% of the annual increment is utilised each year (UBA 2015). This means that there is not much room for any further mobilisation. Due to extreme weather events already in the past the harvest exceeded the annual increment e.g. in the year 2010.

This means that an increasing demand of wood can only be satisfied by imports, cascading use or the expansion of the overall forest area, not by mobilisation of wood resources.

According to Mantau (2012) 50% of the total wood resources was used for energetic purpose in the year 2010. This means that these wood resources are not available for any cascading use. The share of wood utilised in the saw-mill industries is about 28%. Twelve per cent is utilised in wood-based products and 8% in the pulp & paper industries (Figure 3).

Figure 3: Utilisation of resources (virgin and waste wood) in Germany (based on Mantau 2012)



3.2.3 Understanding relevant policy in Germany

3.2.3.1 Wood production and forest management

Forest Management is regulated by the Act of Forests (Bundeswaldgesetz, BWaldG) from 02 May 1975. The particular purpose of this law is to preserve the forest, if necessary to increase wood availability and to ensure its sustainable management. It furthermore promotes forestry and balances public interests with the interests from forest owners. The BWaldG acknowledges the particular importance of forests based for the economy (Utility function) as well as its particular importance for the climate, water balance, air pollution control as well as protective and recreational functions for the general public.

The BWaldG is the umbrella act for the federal states. Specific regulations on forest management are transposed to federal state law. It regulates comprehensively all aspects of forest management including institutions, monitoring and bureaucracy.

Core strategies influencing wood availability on national level are the National Strategy on Biological Diversity and the forest strategy 2020 (BMELV 2007). However, each of the 16 Federal States implements its own strategy. The strategies focus on sustainable forest management rather than the mobilisation of wood. The details are out of the scope of the study and are not crucial, because as the exploitation of forest is already close to the yearly increment, the impact is more of indirect nature.

3.2.3.2 Waste policy – Disposal and recycling of wood products

Paper recycling is very much advanced in Germany. In average the utilisation rate is 74% with a recovered paper return rate of 74% (EU av. 72%). CEPI (2011) assumes the theoretical maximum of paper recovery about 78%. The total volume of recycling paper is about 15 million tons. The highest share of recovered paper is in newsprint paper and packaging materials. Paper recycling is often regarded as the prime example of recycling or cascading use.

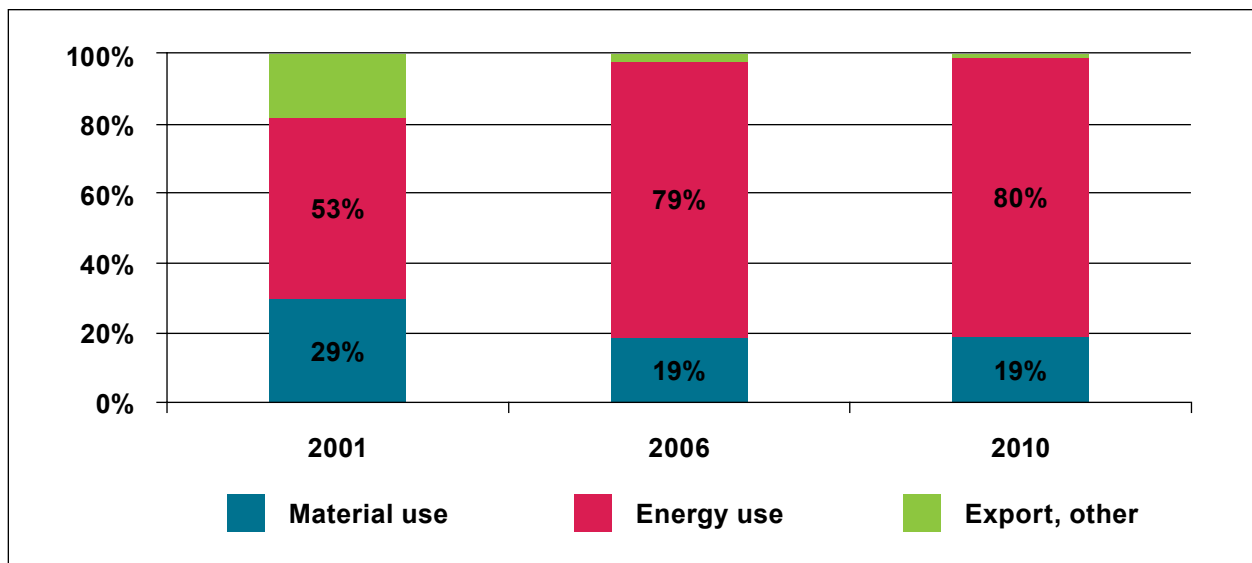
Recycling and waste management have been established in Germany for more than two decades. From 1994 to 2012 the Act to Promote the Circular Economy (Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Beseitigung von Abfällen) set the framework and regulations for waste management and recycling in Germany. In 2012 the Waste Management and Product Recycling Act (Kreislaufwirtschaftsgesetz KrwG) replaced the existing framework. Cornerstones of the amendment were the implementation of the waste hierarchy, the regulation of collection and recycling as well as the monitoring and bureaucratic procedures of waste management. In general, the KrwG standardises and regulates the framework for the whole recycling sector.

Collection is organised by a bring-and-collection system. In the case of wood, the collection is performed by public services. They decide about the separation in the waste wood categories and consequently about the further utilisation of the collected material. Industrial waste is organised by a cost-by-cause system that means the business unit is self-responsible for the disposal system. On the one hand, the dual, communal system is very much established and accepted in the society, on the other hand often local incineration plants are also in communal hand leading to a mid- or long term lock-in effect for the usage of waste as feedstock for the incineration plants.

The separation is described in the Waste Wood Ordinance (Altholzverordnung, AltholzV) from the year 2002. The AltholzV regulates recycling, energy recovery and disposal of waste wood. The central element is the classification in waste wood classes I-IV and corresponding utilisation. Only wood of the classes I and II can be reused in materials. The allocation is made by visual inspection and subsequent sorting. The sorting is done at the municipal collection centres. However, the visual analysis of contamination and pollutant concentration such as arsenic, lead or cadmium is problematic. In order to avoid subsequent pollution, wood that could actually be used for material recycling is allocated to a higher class with poorer wood qualities which are only suitable for energy recovery. On the one hand it is a standardised procedure with a clear framework, on the other hand, the system tends to produce more low quality waste wood which can only be used energetically. In general, the AltholzV promotes cascading by securing a safe and sound recycling of waste wood. However, adjustments in the classification system may support material recycling.

The utilisation of waste wood changed significantly over the past years. The share of energy use increased from 53% in 2001 to 80% in 2010. Furthermore the export of waste wood is non-existent anymore. Material recovery decreased by 10% from 29% in 2001 to 19% in 2010 (Mantau *et al* 2012).

Figure 4: Utilisation of waste wood over time (Mantau *et al.* 2012)



Besides the described policies there are some other regulation with only minor effects on cascading use such as the Abfallverbringungsgesetz (AbfVerbrG) regulating international transfer of waste materials or the Federal Emissions Protection Act (Bundesimmissions-schutz-gesetz, BImSchG) regulating certain aspects of the energy use of wood.

In general, all waste directives which are in force in the EU are reflected in German law, e.g. through the Act on Waste (KrWG), the Act on Packaging and Packaging Waste (VerpackV) and the Act on the obligations of entrepreneurs in the field of management of certain waste (Gewerbeabfallverordnung, GewAbfV).

3.2.3.3 Bioenergy

The biggest impact on the allocation of raw material is the German Renewable Energy Act (Erneuerbare Energien Gesetz, EEG). The rationale for the EEG was to promote energy from renewables to reach the targets of 40-45% renewables in the energy mix by 2025 and 55-60% by 2035 in Germany.

The EEG hinders the development of material use by providing comprehensive support to energetic uses of biomass that is not balanced by comparable incentives for the material use. The impact is unfair competition for biomass as pressure on established biomass uses in the material sector and significant potentials for innovation, value creation, and climate protection that remain untapped. The EEG results in three types of market distortions all with negative impact on cascading use:

- Cultivation areas – increasing land prices; this is especially a problem for industrial niche crops (fibre, dye, pharmaceutical).
- Increasing prices for biomass – too expensive for bio-based chemicals and materials to compete with petrochemical products.

- Residues and waste – strong incentives for biofuels, which is lost for many industrial material uses.
- Output focus of biorefineries: Because of the existing incentives, biorefineries produce almost only biofuels. From an economic point of view, almost no biofuels should be produced, but high-value chemicals. And because of this incorrect focus, the operations depend heavily on incentives. (Piotrowski *et al.* 2014).

The problematic competition between material and energy use has been recognized in politics for more than five years. As an example the national biomass action plan for Germany (BMELV 2010) addresses the problem and pleads for a level playing field, however up to now the awareness did not find its way into action.



**FIREWOOD IS
AVAILABLE
UNDER THE
REDUCED VAT RATE
OF 7% IN GERMANY**

A further problematic incentive system is the so called “Market Support Programme” (Marktanreizprogramm MAP) incentivising wood based firing in households. The strong subsidies have led to a significant increase in wood-based heating from 100 000 ovens in 2007 up to 400 000 (estimate) in 2015 (Deutsches Pelletinstitut based on biomassatlas.de, HKI, ZIV 2015). As a consequence, the demand for pellets increased significantly in the past years and lead to a shortage of wood for material use und functioning as a price driver for wooden resources.

Wood based heating systems are very attractive in Germany as in contrast to oil or gas, wood pellets and firewood are available under the reduced value added tax (VAT) rate of 7%. The VAT rate in general is 19%. Both, the MAP and this tax incentive, influence cascading by triggering the competition between energetic and material use of wood and heat up the market for wood.

3.2.3.4 Bioeconomy and others

In 2013, Germany launched the “Politikstrategie Bioökonomie” (National Policy Strategy on Bioeconomy, BMELV 2013), which assumes that cascading use is one means to defuse the conflict of utilisation competitions for biomass, land and resources in general. Also biorefineries are one of the future options for a better resource use. The Roadmap Biorefineries (BMELV, BMBF, BMU, BMWi 2012) highlights the necessity for integrated concepts for an optimised and sustainable raw material supply.

Currently one focus of research and innovation policies lies in the development of new production technologies and new products which may affect cascading in two ways: new alternative uses for waste wood, and increase in the cascading potential of new products in future recycling loops. The awareness that product design today influences the raw material supply in future within the scope of the circular economy is well established, however specific research on recycling is scarce.

To achieve this, the Federal Ministry of Education and Research (BMBF 2010) launched the “National Research Strategy Bioeconomy 2030 - Our Route towards a bio-based economy”. The strategy says that there is a huge potential of biomass utilisation to contribute. Especially the potential of wood- and straw-containing biomass as well as residues are currently not fully exploited. To achieve this,

integrated systems which include cascading use as well as co-product utilisation (e.g. biorefineries) will contribute on that.

Many strategy papers support cascading use in general however, only few projects specifically deal with the use of recycling material. Example projects are CareWood, ReWoBioref and Demowood. The projects are funded by the EU, but not on national level. Nevertheless in research on material sciences which is one of the core research fields of the German Ministry of Education and Research the recyclability of new materials is a crucial feature of any new material. This applies also for wood-based products.

Other relevant strategies and programs are the German Resource Efficiency Program (ProgRes, BMU 2012) and the national biomass action plan (BMELV, BMU 2010). ProgRes highlights cascading as one core strategy to the circular economy and requests to establish an indicator-based monitoring system for the contribution of cascading to the circular economy. The national biomass action plan highlights that regulatory and support schemes shall not discriminate material use of biomass. However up to now this is not fully implemented.

3.2.4 Conclusions

Cascading use in Germany is basically considered as a resource strategy rather than a strategy to increase sustainability. Cascading use might be a chance to increase wood resources as the exploitation from forests almost reached the maximum. As there are strong incentives for a direct energy use of wood, a shortage of wood resources puts the wood-based industries as well as the forest management under high pressure.

In Germany recycling has a long tradition and is widely accepted in the society. Therefore the willingness to cooperate among the public is high. This means that the collection of wood is well established. However, the use of recovered wood is strongly directed to an energetic utilisation of wood due to the Renewable Energy Directive (EEG).

Standardisation and the general regulatory framework for the use of waste wood is very much advanced in Germany. However, adjustments to more recent developments (e.g. new products, market-oriented supply and demand) in the economy are needed to ensure that wood as a resource is exploited sufficiently by subsequent material uses.

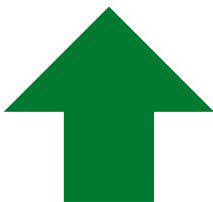
Among politics the willingness to establish and strengthen cascading use is reflected in many strategy papers, however it may still require effort to adjust structures, institutions and laws to establish safe and comprehensive cascading use on the one hand and on the other hand to create a level playing field between energy and material use of wood resources strengthening the material use of wood. As not all wood resources are suitable for a material use it should be acknowledged that both utilisations find the appropriate resources.

3.3 POLAND – ABUNDANCE OF RESOURCE COUNTERACTS CASCADING USE

3.3.1 Synopsis

Poland is rich in forest resources, with the majority of the forest area being economically exploited. In 2009, the volume of timber removals amounted to approximately 34 million m³ with an additional 1.93 million m³ slash being removed. This makes Poland attractive as a location for wood-based industries, but gives little incentive for a repeated use of the resource, i.e. through increasing the cascading use. Furthermore, Poland relies heavily on co-firing of wood resources in coal plants for reaching its renewable energy targets, creating a strong market distortion allocating wood to the energy sector. This means that even the first stage of a cascade is never reached for a significant amount of wood materials. It should be noted that high-grade wood is excluded from the co-firing (under criminal liability) except for small-scale installations, which is positive in terms of cascading use. The verification of the grade of wood resources proves quite difficult in Poland, though.

In terms of recycling, the data basis is quite weak. Vague estimations for a recycling quota of wood products range between zero per cent and 10%. However, the transposition of the EU Waste Framework Directive has only recently taken place, establishing a collection system for solid wastes only in 2013. Attitude and perception towards recycling is slowly changing as a result, and research is done by different actors. This might constitute a promoting factor for increased cascading use of wood, but effects need to be seen and there seems to be a lack of political will to establish cascades.⁴



**THE HIGH RATE
OF WOOD
UTILISATION
MAKES POLAND
A FAVOURABLE
LOCATION FOR
WOOD INDUSTRIES
IN EUROPE**

3.3.2 Wood mobilisation and utilisation – facts and figures

Forest area in Poland covers approximately 9 million ha (Eurostat 2015), of which 100% are state-owned. Forests in Poland mainly occur on the poorest soils, which are reflected in the structure of forest habitat types. Coniferous forest habitats predominate, accounting for 51% of the total forest area, while broadleaved forest habitats account for 49% (The State Forests Information Centre 2014).

The main source of information about the volume of timber resources in Poland is the Large-Scale Forest Inventory. According to the data collected in the years 2009–2013, and based on the forest area as it stood at the end of 2012, the timber resources in the State Forests amounted to 1929 million m³ of gross merchantable timber. Almost half (49.9%) of the timber resources are in stands in the age classes III and IV (41–80 years). The volume of timber resources in the stands over 100 years old, including classes KO, KDO and BP, stands at 18.4%. According to the Large-Scale Forest Inventory 2009–2013, the average standing volume of stands in the State Forests was 272 m³/ha. Pine has the largest share in the volume of timber resources and accounts for 58.7%. There has been a steady growth in timber resources since the first inventory in the State Forests took place in 1967. (The State Forests Information Centre 2014).

⁴ The authors would like to acknowledge Kamila Paquel (IEEP) for her valuable contributions to the Polish case study.

In 2011, 51% of the forest served for economic exploitation. Forecasts for 2020 and 2030 suggest that the area for economic exploitation will increase to 58% and 63% respectively. In 2009, the volume of timber removals amounted to approximately 34 million m³. 8.5% of all timber was classified as fuel wood. In 2009, there were also 1.93 million m³ slash removed, of which 72% served as fuel wood and the remaining 28% were used in industrial applications. (USDA 2011).

According to Mantau 2010, approximately 50 million m³ wood were used in Poland in 2010, of which 48% went to material applications and 52% to energy uses. He forecasts a noticeable increase of the share of energy uses (57% by 2020), which is mostly due to the significantly increasing use of wood by biomass power plants. Currently, households are the biggest consumers of wood with 14.8 million m³, followed by the panel industry with 11.1 million m³ in 2010. In Mantau's scenario, the consumption by biomass power plants is expected to exceed that by private households by 2020.

For material uses, the major customers of wood in Poland are the construction sector, furniture manufacturers and the pulp and paper industry. In spite of Poland's vast wood resources, local demand is greater than local supply by about 3-5 million m³ annually. Major wooden materials that are used for the furniture production are: chipboard, fibreboard and sawn wood. In 2009, there were 3.06 million m³ of chipboard used for furniture production; 89,950 square meters of fibreboard and almost 1 million m³ of sawn wood. According to "World Furniture Outlook 2010", Poland is the fourth major furniture exporting country, after China, Italy and Germany. (USDA 2011).

3.3.3 Understanding relevant policy in Poland

3.3.3.1 Wood production and forest management

The Act on Forests, adopted on 28 September 1991 provides the legal basis for public support measures in forestry. It is a very comprehensive Act addressing all kinds of matters related to forests, and derived legislation regulated the concrete implementation of different topics and measures. The Act is a very central piece of legislation enabling the strong economic exploitation of Poland's wood resources and it establishes the State Forests agency, which is in charge of administering the forest. The high rate of wood utilisation makes Poland a favourable location for wood industries in Europe, but also makes a repeated use of the same resource unnecessary or at least quite unattractive.

3.3.3.2 Waste policy – Disposal and recycling of wood products

In general, it is possible to say that all waste legislation in force in the EU is reflected in Polish law, through the Act on Waste, the Environmental Protection Law, the Act on Packaging and Packaging Waste and the Act on the obligations of entrepreneurs in the field of management of certain waste (Cichy 2015). The revision of the Act on Waste entered into force in 2013 and entailed a multitude of new concepts and terms. Definitions were introduced at that time for such concepts as "bio-waste,"

“re-use,” and “treatment.” The new Act on Waste adds or modifies such key definitions as “waste,” “waste management,” “waste administration,” “waste storage,” “waste broker,” “waste dealer,” and “waste collection” (Kuras 2013).



**BEFORE 2013,
RECYCLING WAS
BASICALLY NON-
EXISTENT IN
POLAND**

Before 2013, recycling was basically non-existent in Poland (Berthold & Meinschmidt 2015). The data basis is quite weak, so it is a challenge to obtain official recycling quotas. Statistics about the production of particle board estimate the share of boards made from recycled wood to be zero percent in Poland (EPF 2015). Particle boards classically being one of the main products made from recycled wood, it seems reasonable to assume that overall recycling quotas are close to zero, too. Experts confirm this assumption, giving a range of recycling from zero percent to maximum 10%. Apparently, almost all post-consumer wood is used a firewood by private households or goes to landfill (Berthold & Meinschmidt 2015).

However, due to the revised Act on Waste and also the new Packaging and Packaging Waste Act, interest in recycling is slowly increasing. The Packaging Act sets specific recycling targets also for wood-based packaging (61% for paper and cardboard packaging, 16% for wood packaging) (Grochowski 2014). As a consequence of the revised pieces of legislation, municipal collection centres were set up that collect also post-consumer wood and make it available for recycling. Some players of the wood industry have already built big plants for sorting and recycling wood, but so far there is almost no supply of post-consumer wood to feed these plants. One weak point still is the classification of different types of wood wastes and corresponding usages. Interestingly, experts stated that even though there is no legally binding or official classification system of post-consumer wood in Poland yet, the industry makes use of the German system set out in the Waste Wood Ordinance (“Altholzverordnung”) (Berthold & Meinschmidt 2015). This system is one of the most advanced in Europe (though there is still room for improvement) and is more detailed than the guidelines set out by the EPF that are used in most European countries. The Waste Wood Ordinance distinguishes waste wood into classes I to IV, based on quality, contamination etc. Only classes I and II can be reused in materials. The allocation is made by visual inspection and subsequent sorting. Those players in Poland starting to recycle wood wastes make use of the system, since it gives a better guarantee of the quality of recycled wood products, but a nationally binding definition and classification system for wood wastes will be crucial in order to give a stable framework to recycling of wood.

3.3.3.3 Bio-energy

Poland has a national target of covering 15% of its energy consumption by renewable energy by 2020. The intermediate goal of 8.8% in 2010 was successfully achieved, with the shares of renewable energy reaching 11.3% in 2013 (Eurostat 2015). By far the largest share of this quota is made up of bioenergy (91%), of which the lion's share is made up of solid biofuels (i.e. wood and other lignocellulosic feedstocks). Of the approximately 100 TWh energy from renewable resources consumed in Poland in 2013, ca. 91 TWh came from solid biofuels – so 91% (Eurostat 2015). This is mostly due to the fact that the Polish renewable energy strategy relies heavily on the co-firing of lignocellulosic feedstocks in coal plants. Aside from imported wood pellets and nutshells this means that mostly domestic lignocellulosic residues

(straw) and by-products of wood processing (wood chips, sawdust), and even timber is incinerated in coal plants (Bacia 2014). In 2013, out of the total of over 6 mio tonnes of biomass co-fired by big utilities, 3.5 mio tonnes came from forest biomass, 1.48 from agricultural waste, 0.35 from energy crops and 0.87 from other sources (Gajewski 2014). According to an expert of the Polish Economic Chamber of the Wood Industry, wood availability is becoming an issue and the branch is losing more and more of the feedstock to the energy sector due to a distorted competition (Gruszczyński 2015).

The Act on Renewable Energy Sources was recently revised and was adopted by the Polish parliament on 20 February 2015. This law introduces a shift away from Green Certificates issued for every MWh produced from renewable energy sources to an auctioning system for whole renewable energy projects (Krasnodebski *et al.* 2015). While the reform also aims at reducing the amount of support given to co-firing of timber with the ratio for calculation of the value of certificates for energy from co-firing going down to 0.5 per 1MWh as of January 2016, the change seems to be more of a cosmetic nature: this reduction applies only to bioenergy that is generated in appliances that are not “dedicated installations of multi-fuel combustion”.

“Hybrid combustion” in dedicated installations is still allowed, which involves burning biomass separately but still connected to a coal or gas-fired boiler (Mills-Davies 2015). This effectively reduces support to woody biomass co-firing after 2016 from the most inefficient plants, but leaves room for the incumbents (including the four big energy players) to profit from the system by investing in the dedicated biomass combustion appliances. Some of them already have installed dedicated furnaces.

There are voices of reliable experts in the sector warning that dedicated co-firing plants will allow their operators to win all of the renewables auctions as of 2017/2018, excluding all smaller players from the competition in the renewable energy sector in Poland. This would mean that the reduction of support to co-firing was only temporary and the new system of support to renewable energy sources in Poland is promoting a monoculture with solid biomass playing an important role. Having said that, it is key to note that ‘high-grade’ wood is and will be excluded from the support (new RES Act, art. 45) and it cannot contribute for the fulfilment of the renewable energy target.

The relevant regulation banned support to bioenergy production from high quality wood and crops as from 2013 and is continued in the new legislation (under criminal liability). Generating power from ‘high-grade’ wood would only be eligible for support if burnt in micro and small installations dedicated to biomass combustion (meaning limited to 200 kW of installed capacity). The modalities of verification of the origin of woody biomass is a matter of concern in Poland, In the end of 2013, Polish energy regulatory authority has initiated a National System of Biomass Authentication [p.l. Krajowy System Uwierzytelniania Biomasy] in order to facilitate and strengthen the verification processes. The new system aims among others at removing biomass market distortions, including administrative burden, that were created by the regulatory restrictions related to use of ‘high grade’ wood for energy purposes. The system is not yet operational however and there is no evidence how

effective is will be in preventing high-grade wood from being directly incinerated (Paquel 2015).

3.3.3.4 Bioeconomy and others

Poland does not have a dedicated bioeconomy strategy. Activities referring to the bioeconomy are mostly limited to research and academia and focus solely on Industrial Biotechnology (EuropaBio 2008, BIO-TIC 2014). As of now, bioeconomy does not seem to be a priority of the Polish government and the classic wood sector – an important and reputable economic sector in Poland – is apparently not considered to be a part of it at all. This means that the strategic deliberations referring to biomass feedstock availability that are often connected to national or regional bioeconomy strategies will probably not have any influence on cascading use of wood in Poland for the time being.

3.3.4 Conclusions

The current policy framework in Poland has some promising aspects for establishing cascading uses of wood, such as the revised regulations on recycling including collection and sorting systems, or the exclusion of high-grade wood from co-firing installations. However, the current practices seem to be quite unfavourable for actually establishing cascades and there is a lack of political will to do this. The wood processing industry seems to optimise processes wherever it is cost-effective. The data basis for all kinds of wood uses is quite weak and it is not clear whether the exclusion of high-grade wood from incineration is actually implemented. The abundant availability of wood resources makes recycling not economically attractive enough, and most post-consumer wood never enters any official streams due to a high usage of waste wood for energy in private households.

3.4 SPAIN – ADVANCED POLICY MEASURES, BUT POOR INTEGRATION

3.4.1 Synopsis

Spain is at a relatively early stage in the development of cascading use of wood. Some opportunities are provided by the waste management legislation, which establishes the basis to further recycle waste wood in potential multi-stage cascades. There is also evidence of proactive action at the regional level that is significantly improving the collection and hence availability of waste woods. From a longer-term perspective, the discussion on a 2030 bioeconomy strategy and the research agendas looking at R&D may enable further developments with regard to cascading use of wood.

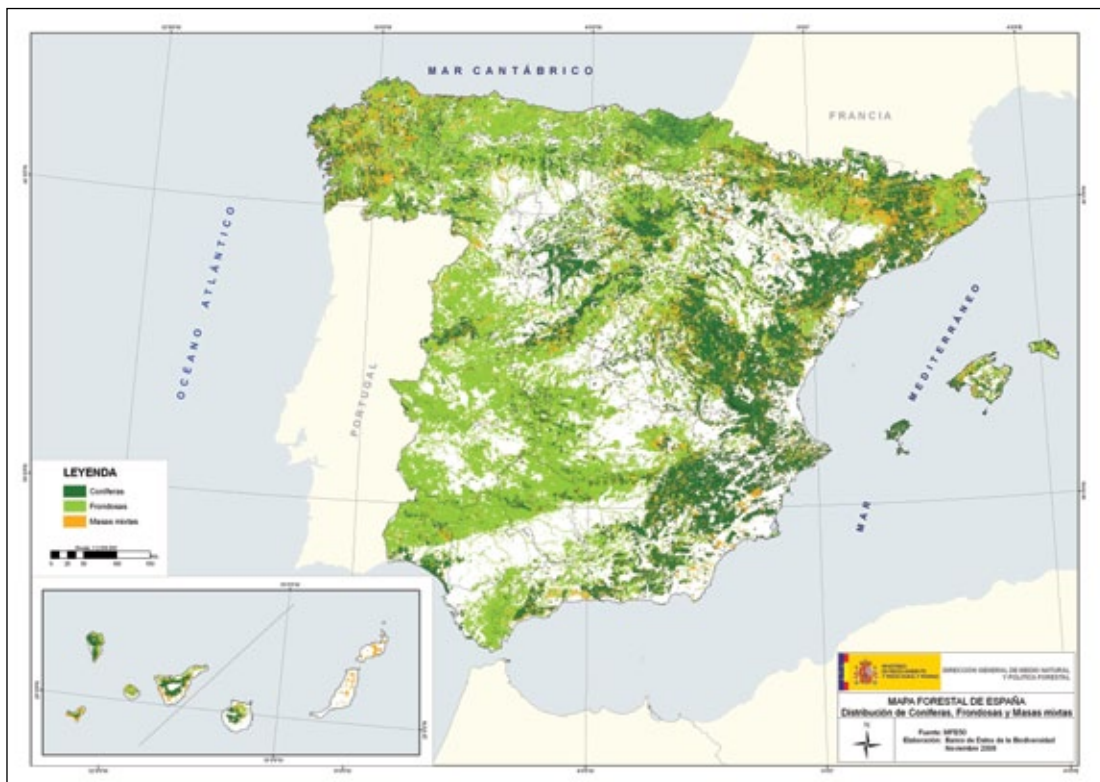
Challenges to cascading use in Spain are identified in the national policies promoting the use of wood for energy production. Although increased demand of wood for energy purposes may stimulate larger mobilisation of wood resources, in principle, it limits the availability of wood to be further cascaded.

The objectives and needs from the wood and forestry sector are not sufficiently integrated within Spanish policy. It is not clear how policies that are quite advanced e.g. for separate collection of wood, landfill taxes and the promotion of recycling/ reuse interact with the wider priorities of the bioeconomy, renewable energy use and broader climate goals such as sequestration. All these factors could be brought together to develop sustainable outcomes that deliver cascading material uses, energy and effective forest management; however, as yet such coordination is not being undertaken.

3.4.2 Wood mobilisation and utilisation - facts and figures

Since the 1990s, the extent of forest land in Spain has increased relatively steadily due to a decrease in land with no vegetation or devoted to agriculture (World Bank 2015). Total forest and woodland in Spain account for 27.5 million hectares (mha) (approximately 55% of total land area). The largest portion of this land, almost 18.5 mha, is covered by vegetation, while the remainder (9 mha) is occupied by shrubs and pastures and has no tree cover (MAFE 2007, Figure 1). Excluding protected areas, the total area of forest available for the supply for wood and firewood is 14.92 mha (MAFE 2012). In terms of composition, coniferous forests account for 37% and deciduous forests for 55%; the remaining 8% are mixed forests. Forests are mainly located in the central-eastern and western part of Spain, and along the north border with France and the Atlantic Ocean. (Figure 2) The Autonomous Community with the largest forest area is Castille and Leon, followed by Andalusia and Castille-La Mancha.

Figure 5: Forest map of Spain (Ministry of Agriculture, Food and the Environment 2010)



As is the case for other Southern European countries, Spanish forests are mostly owned by private individuals (70.9%), followed by local administrations (22.9%) and, to a minor extent, central and regional governments (6.2%). The ownership share, however, varies widely between regions (EFI 2013) and is largely fragmented. The size of privately owned forestland is relatively small – around 2-3 ha – compared to an average of 500 to 600 ha for those publicly owned.

According to the latest national statistics, in 2013 the available growing stock (excluding bark) from the forest area available for the supply of wood and firewood amounted to 799 million cubic meters (m³), with an annual increase of 46.3 million m³ (with bark, MAFE 2015). Nonetheless, estimates of growing stocks vary widely (i.e. between 683 and 993 million m³ including bark), depending on the source (PEFC 2015).

Between 2000 and 2010, average annual logging volume of barked wood was 15.28 m³, of which approximately 60% was softwood (mainly conifer stands) and 40% hardwood. In recent years, the latest available data show that the balance between softwood and hardwood has moved towards higher extraction rates of hardwood. Out of the 14.1 million m³ of non-barked wood harvested in 2012, about 50% was softwood and 45% hardwood. The extraction rate of wood material in Spain is approximately 36%, which is considerably low compared to the EU average of 69% (Council of Ministers 2011).

The wood sector represents an important share of Spain's economy, accounting for 1.76% of GDP (MAFE 2012). According to the latest national statistics (MAFE 2015), 26,188 companies belong to the Spanish wood sector.⁵ From an economic perspective, the largest wood sector is the paper and pulp (11.5 million €), followed by the wood manufacturing sector (e.g. timber-based products) (4.6 million €) and the furniture sector (4.1 million €). The latter is the largest sector in terms of number of companies (51%), however, accounting for a total of 13,302 SMEs, followed by the wood manufacturing sector (42%) with 11,095. The paper and pulp sector is characterised by a fewer number of medium and large companies on the market, for a total of 1,791 (equal to 7%) (MAFE 2015).

In 2012, total annual roundwood consumption in Spain was estimated 24.5 million m³, of which 10.1 million m³ was used by the bioenergy sector; 6.5 million m³ by sawmills; 4 million m³ by the pulp and panel industry and other 3.8 million m³ for the production of wood-based products and exports (MAFE 2012).⁶

A significant proportion of wood entering the Spanish market comes from imports. In 2012, approximately 2.3 million m³ of roundwood were imported in Spain, of which the larger proportion (1.1 million m³) was used by the pulp and paper industry, followed by sawmills and the wood panel industry. A small volume of dedicated wood for energy (8.838 m³) was also imported. Finally, small volumes of



70.9%

SPANISH
FORESTS
ARE MOSTLY
OWNED BY PRIVATE
INDIVIDUALS

⁵ This sector in Spain includes the paper and pulp sector, the furniture sector and the manufacturing sector that excludes furniture and includes industry processing raw wood, and primary and secondary processing industries. The silviculture and forestry exploitations sectors are excluded.

⁶ The companies belong to the furniture, pulp and paper and board sectors. The construction sector is not included in the wood sector.

sawnwood (500.000 m³) and recycled wood (7.700 m³) were imported and directed to the paper and pulp industry and the wood panel industry (MAFE 2012). Although the significant volume of wood imported in Spain, it is important to note that a substantial amount of wood resource is claimed not to be collected and be left in forests. This is mainly attributed to the fact that demand of certain woody materials by traditional industry is met through imports (Council of Ministers 2011).

According to the latest national statistics, the total volume of waste wood separately collected in 2012 was 611.300 tonnes, of which 21.3% (130.500) comes from municipal solid waste and 78,7% from industrial waste (Spanish National Institute of Statistics 2015). No further information on specific categories of waste wood is currently available.

In 2012, about 1.2 million tonnes of waste wood was recycled. Given this quantity exceeds the volume of separately collected waste wood in the same year (611.300 tonnes), it has to be noted that an unclear volume of waste wood may be recorded within the 'mixed waste' category in national statistics. It is estimated that around 666.000 m³ of recovered waste wood were used by the wood panel industry (MAFE 2012).

The main wood-based products generated in Spain in 2011 include: 1.6 million m³ of particle boards and 900.000 m³ of fibre board; 6.2 million tonnes of paper and paperboard and 1.9 million tonne of pulp industry output (PEFC 2015).

3.4.3 Understanding relevant policy in Spain

3.4.3.1 Policies driving or impacting on wood generation

A number of policies in Spain have an impact on wood generation from forests in Spain. National law, including the recently amended Forestry Act (2003), provides high-level direction on forest policy and impacts on forest management and use of wood.

Wider national policies in Spain may influence forest productivity and capacity; hence the extent of forest land. For example, the Climate Change and Clean Energy Strategy (EECCCEL) (2007) promote to boost carbon sequestration capacity of forests and increase forest surface by means of forestation and reforestation of abandoned and degraded farming land. At the same time, it encourages the energy use of solid biomass residues and waste. This is in line with thinking arguing that cascading in the wood sector can help reducing carbon emissions; however, an increased role of forests in climate mitigation through their role as carbon sinks could reduce the availability of wood as a feedstock.

A growing framework on how to process and manage waste (including waste wood in various forms, i.e. as a separate stream or included in 'biodegradable waste') in accordance with the waste hierarchy (including the National Integrated Plan on Waste (2005); the Royal Decree on the production and management of waste from construction and demolition (2008); Law on Waste and Contaminated Soil (2011) reflects changing agendas in Spain towards wood collection and management. Of particular interest, the Royal Decree on waste from construction and demolition



**50% TARGET IS
ESTABLISHED
FOR THE
COLLECTION AND
SEPARATION OF
WOOD WASTE
BY 2016**

establishes a separate collection for wood waste. At regional level, the Plan for the Prevention and Management of Waste of the Basque Country (2015) sets detailed objectives and targets for the prevention, collection and management of a number of waste streams, including waste wood. A 50% target is established for the collection and separation of wood waste by 2016 (increasing to 60% by 2020), as well as a 40% target for reuse and recycling of wood waste by 2016 (increasing to 50% by 2020). These measures provide support to cascading use of wood by stimulating separate collection and thus potentially increasing the availability of waste wood to be cascaded.

An additional push towards the diversion of municipal, industrial and construction waste streams (including non-separately collected wood materials) from landfills has been experienced as a consequence of the establishment of landfill taxes introduced by a number of Autonomous Communities.

3.4.3.2 Policies driving or impacting on material use of wood

Spain has a number of national level policies driving or having an impact on material use of wood and, consequently, on certain stages of the wood cascade. Although policy measures or legislation on resource efficiency and the circular economy are yet to be developed in Spain, strategic initiatives on the bioeconomy, research agendas and funding programmes play an important role in the promotion of material use of wood.

The draft Spanish Strategy for a Bioeconomy (2015) directly promotes the use of residues, (including woody residues) in cascades, as well as the use of biological resources from forests in a range of biotechnological applications (including those for energy production). In addition, although the high-level Strategy for Science, Technology and Innovation 2013 – 2020 (2012) does not specifically reference wood use, it supports sustainable forest management and has the potential to promote research and technological innovation with regard to wood based products or products that have seen initial cascading of wood, or could be further cascaded after use.

Changing attitudes towards material uses of wood in Spain are also reflected in waste management strategies and legislation. As already mentioned, higher recycling rates or measures with the aim to divert waste from landfill may have an impact on waste wood use. The Law on Waste and Contaminated Soil (2011) make this objectives legally binding by promoting the application of the waste hierarchy and the use of waste packaging made from renewable, recyclable and biodegradable materials, including wood, paper and cardboard.

As wood is one of the most used materials for construction, policy developments encouraging wood utilisation in the sector may support the increase of wood availability for cascading. For example, in 2006 Spain approved a renewed Building Code including rules on the structural use of wood within the sector which, given the size of the industrial sector, could help driving up wood availability for further cascading after use.

3.4.3.3 Policies driving or impacting energy use of wood

The Spanish renewable energy policies give indication of the country's efforts to mobilise wood resources for energy purposes. At national level, the Electricity Sector Law (1997) first introduced Spain's renewable energy ambition into national law, establishing a 10% renewable energy target by 2010. The Renewable Energy Plan 2005 – 2010 (2004) confirmed that ambition and set a new target at 29.4% for the production of renewable energy in the gross electricity consumption by 2010. The Renewable Energy Plan for the following period, 2011 – 2020, (2010) introduced in national law a 20% renewable energy target out of gross energy consumption by 2020, as established by the EU Renewable Energy Directive (RED). The vast majority of governments of the Spanish Autonomous Regions, which have responsibility for energy policy, have also established measures to promote renewable energy through their energy plans.

Although the efforts undertaken to mobilise resources for the production of renewable energy, it is reported that a considerable amount of wood is not collected from forests and that those resources could be used to help meeting Spain's ambition on renewable energy. The use of woody biomass for the production of renewable energy is thus perceived as a way to mobilise a resource that would be otherwise left unused. It has been estimated a total volume of 6.6 million tonnes of residual forest biomass available (State Commission for Natural Heritage and Biodiversity 2010). The Spanish Strategy for the development of energy uses of residual forest biomass (2010) furthers this objective by promoting the extraction of residual forest biomass for energy purposes. This is supported by the Renewable Energy Plan 2011 – 2020 (2010) which promote the same direction of travel.

A feed-in tariff supported the use of wood for energy purposes. Decree Law 661/2007 (2007) regulated the production of electricity under a special regime applicable to electricity produced from renewable energy sources, including a feed-in tariff for wood-based power plants, among others. The system guaranteed a tariff for an approved power plant for a maximum of 15 years. This mechanism was suspended in 2013.

Finally, a number of Spanish policies and research programmes with wider application directly or indirectly support energy uses of wood. Among others, the draft Spanish Bioeconomy Strategy (2015) promotes the use of woody materials in a range of biotechnology applications, including those for energy purposes. The Spanish Climate Change and Clean Energy Strategy (2007) encourages the use of waste from forests for the production of energy. The Plan for the Prevention and Management of Waste of the Basque Country (2015) promotes the energy use of those streams of wood waste that have high energy density but that are not recyclable.

The above Spanish policies, driving the use of wood for energy purposes, may be considered as a barrier to the development of cascades as they, in fact, limit the availability of wood for further stages of cascading.

3.5 UK – TRANSITIONING FROM WOOD INCINERATION TO A WASTE BASED BIOECONOMY?

3.5.1 Context

The United Kingdom is a sovereign state comprised of the countries of England, Wales, Scotland and Northern Ireland. Policy control generally resides with the UK government, however there are a series of policies and powers, such as waste policy, that have been devolved to the individual countries, as well as delivery bodies that implement them.

ONLY
13%
OF THE TOTAL
SURFACE AREA
OF THE UK IS
COVERED BY
FOREST

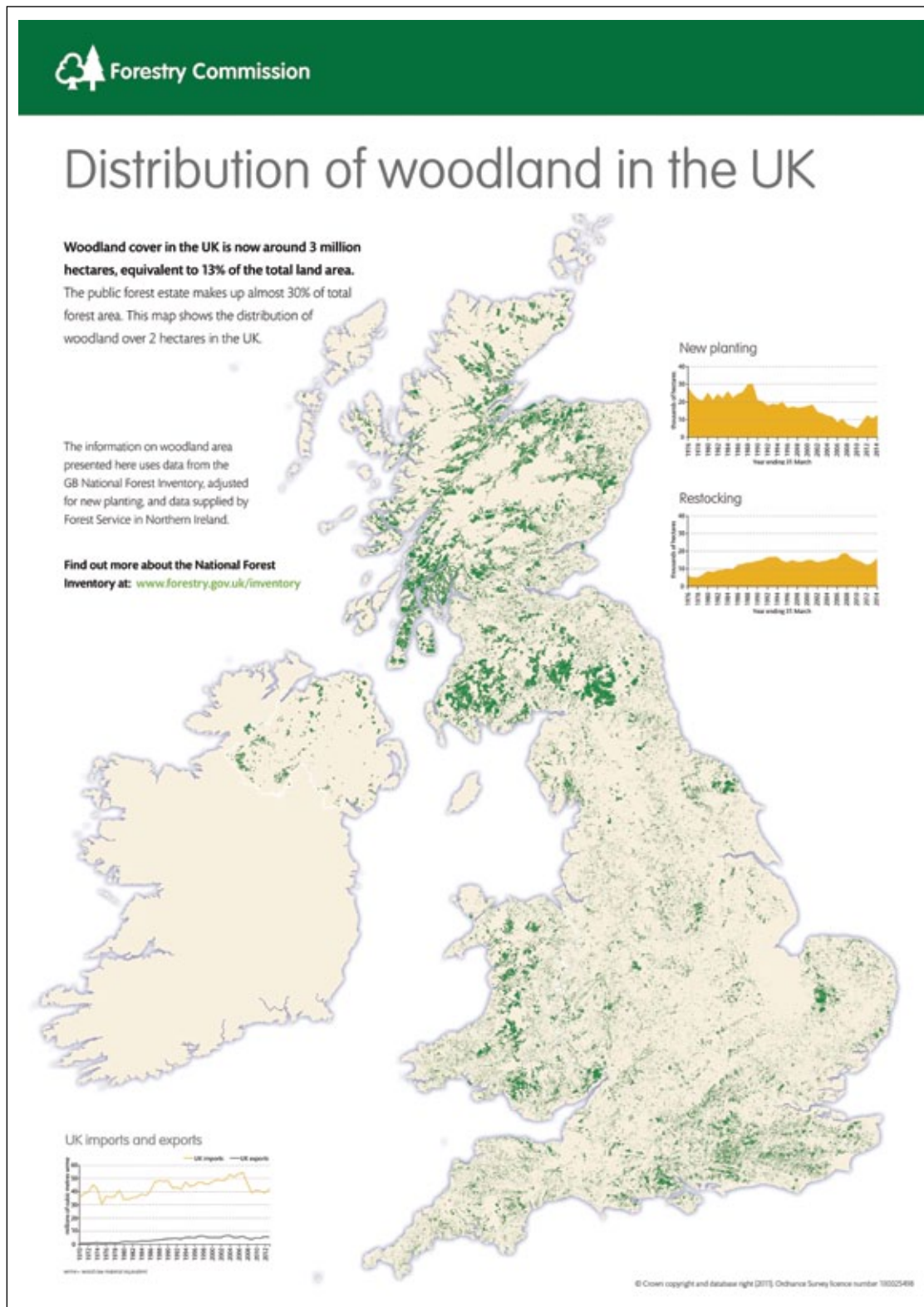
The United Kingdom of Great Britain and Northern Island covers an area of around 24 million hectares (mha) but only 13 per cent (3.1mha) of this is covered by forests. Coniferous forests account for 1.608mha (51%), and deciduous woodlands 1.531mha (49%). The majority of forests in the UK are under private ownership 2.268mha, or 68 per cent of the total resource. Scotland has the largest share of the UK's forests (45%), followed by England (42%), with Wales and Northern Ireland accounting for 10% and 3% respectively (Forestry Commission, 2014a). The UK's woodlands are relatively fragmented, with few exceptions, the largest contiguous areas can be found in the north of England and flanking the mountain ranges in central Scotland (Figure 6).

Based on the latest national statistics on UK wood production and trade (Forestry Commission, 2014) the production and use of wood in the UK has risen since 2013 whilst at the same time, wood exports have declined. In total 12.7 million green tonnes⁷ (mgt) of wood were harvested from UK forests, the majority (90%) of which came from softwood (Forestry Commission, 2015). In total, 11.4mgt of UK roundwood was utilised in sawmills (6.8mgt); wood-based panels (1.3mgt); integrated pulp and paper mills (0.5mgt); and other uses, including round fencing, wood fuel, shavings and exports of roundwood: 2.9 mgt (Forestry Commission, 2015).

The types of basic wood products generated in the UK include: 3.8 million cubic metres of sawnwood; 3.1 million cubic metres of wood-based panels; 4.4 million tonnes of paper and paperboard; and 0.3 million tonnes of wood pellets and briquettes. The UK exports around £1.7bn of wood products, of which £1.5bn comes from pulp and paper (Forestry Commission, 2015).

⁷ One green tonne is equivalent to approximately 0.98 m³ underbark softwood or 0.88 m³ underbark hardwood, and to approximately 1.22 m³ overbark standing softwood or 1.11 m³ overbark standing hardwood.

Figure 6: Distribution of woodland in the UK (Forestry Commission 2014b)



A far greater proportion of the UK's wood use comes from imported timber amounting to 27.7 million green tonnes in the form of: sawnwood (6.4mgt); wood-based panels (3.3mgt); wood pellets (10.7mgt) and pulp and paper (7.3mgt). The total value of wood product imports was £7.2 billion, of which £4.2 billion was pulp and paper (Forestry Commission, 2015). In 2012, the UK was the third largest net importer (imports less exports) of forest products, behind China and Japan (Forestry Commission, 2015).

Wood waste in the UK

Whilst identifying wood production and trade is relatively well accounted for in national statistics, identifying how wood is disposed of in the UK is more challenging. Waste statistics in the UK are relatively comprehensive, but they are collected for a variety of specific reasons, such as reporting requirements, regulatory monitoring and policy development needs (BIS, 2014). The wood waste market report carried out in 2009 and the subsequent update in 2011 for the UK's recovered wood market report (WRAP, 2011) provides one of the more comprehensive assessments of wood waste in the UK⁸. The 2011 report identifies that around 4.1 mt of wood waste is generated in the UK. The construction and demolition sectors account for just over half of this production (25% and 26% respectively) with packaging accounting for another quarter (27%). Industrial wood waste⁹ (9%) and Municipal wood waste (13%) make up the rest of the overall volume (WRAP, 2011).

The wood waste produced in the UK can be further broken down by type that can affect its potential for re-use in future cascades. The quality of the recovered wood in different waste streams varies considerably and the capacity of the various end markets to accept different grades depends on their technical and commercial capabilities (WRAP, 2011)¹⁰. For the 2009 wood waste composition clean solid wood accounted for 31% (1.4Mt) of the waste wood resource, treated solid wood 42% (1.9Mt), particleboard 12% (0.57 Mt), MDF 6% (0.26Mt), Plywood 7% (0.3Mt) and OSB 3% (0.11Mt) (WRAP, 2009).

Uses of wood waste in the UK

There are a variety of markets in the UK that account for the majority of recovered wood consumed in the UK. These include: panelboard manufacture; biomass energy generation; animal bedding; mulches; equine surfaces; pathways and coverings; and industrial and commercial applications (WRAP, 2015).

Some wood waste is re-utilised within the UK wood based sectors. For example, in 2009 the six UK based panel mills used around 3.9 mt¹¹ of woody material, 21% (0.8 mt) of which came from recycled wood fibre (Forestry Commission, 2015).

⁸ It should be noted that in both cases, the authors Pöyry and Oxford Economics recognise the limitations in data availability.

⁹ Largely from the joinery and furniture manufacturing sectors.

¹⁰ The Wood Recyclers Association's (WRA) grading structure aims to categorise various grades of recovered wood based on their quality and forms the starting point for the development of recovered wood standard specifications. Grade A: "Clean" recycled wood - material produced from pallets. Grade B: Industrial feedstock grade - grade A material plus construction and demolition waste. Grade C: Fuel grade - all of the above material plus that from municipal collections and civic amenity sites. Grade D: Hazardous waste - all grades of wood including treated material such as fencing and track work. (WRAP, 2011)

¹¹ The inputs in 2014 comprised 1.3 million tonnes of roundwood (33%), 1.8 million tonnes of sawmill products (46%) and 0.8 million tonnes of recycled wood fibre (21%).

Yet other wood based waste, for example recovered paper, is exported in significant quantities (4.4 mt in 2014), despite the majority of UK paper production relying on recovered waste paper and imported pulp (Forestry Commission, 2015).

In 2010, around 2.25 million tonnes of wood waste was recycled or used in energy recovery in the UK, over 50% of estimated UK wood waste arisings. A further 194,000 tonnes were exported for recycling or recovery. Of the remaining 1.7 million tonnes, it is believed that around 1.2 million tonnes was sent to landfill, with the remainder burned (primarily on-site) or used in land recovery (Table 2).

Table 2: Sectors using wood waste in the UK 2009/2010 (WRAP 2011)

END MARKET SECTOR	WOOD WASTE USE IN 2009/10 (000T)
Panel board	1,119
Animal/poultry bedding	391
Equine surfaces / bedding	77
Mulches, soil conditioners, composting	95
Pathways and coverings	17
Biomass / Energy (UK)	551
Total recovered in UK	2,250
Exports	194
Total recycled / recovered	2,444

3.5.2 Rationale for policy innovation

The UK generates a considerable volume of waste per capita. Around 300 million tonnes of waste are generated annually in the UK. Approximately 100 – 150 million tonnes of this are considered high carbon waste (~3 - 4% of this is waste wood) that could be used to replace fossil alternatives, reducing the countries dependence on imported fossil resources help to deliver carbon targets. The economic potential of this resource was estimated in a recent House of Lord’s enquiry around what this waste might offer as a resource. Estimates of the total value of the economic opportunity for all waste resources generated in the UK fall within the region of £100bn (~€141bn)¹².

This volume of waste resources also presents an environmental challenge, particularly in relation to disposal and management of such large volumes. Storage, disposal (landfilling or incineration), and recovery (recycling or incineration for energy) are the primary ways in which waste resources are managed in the UK currently. In addition to domestic management, a considerable volume of the UK’s waste resources is exported for management or recovery. Not only do these exports represent a missed opportunity for the UK economy, they also serve to export the UK’s environmental impacts to other countries.

¹² Estimates of potential provided by the UK Department for Business Innovation and Skills (BIS), in HoL, 2014. Note: The value of the economic opportunity can only ever be an estimate.

The Lord's Select Committee review (HoL, 2014) and the government's response to the review (BIS, 2015) concur 'that there is an enormous opportunity for growing the bioeconomy using a range of feedstocks, including waste'. It is the bioeconomy that sets the context for the initiative taken in this area, and one where environmental and economic gains are seen to be aligned. The rationale for action in this area is therefore to seize the considerable economic opportunity (including job creation) that could be realised from waste, whilst maintaining and improving commitments to the reduction and utilisation of waste resources in the UK.

Barriers and opportunities

Within the UK there is a considerable amount of activity around the prevention, management and use of waste resources. These range from the implementation of EU level directives, such as the waste framework directive (Directive 2008/98/EC) or the landfill directive (Directive 1999/31/EC), through to activities to promote the generation of bioenergy and biofuels, to industrial and chemical strategies¹³. The majority of these approaches are focussed around the management of wastes rather than valorisation. Overall there remains a lack of activity and investment around the transformation of carbon-containing wastes into higher value products that can benefit the economy and environment alike (HoL, 2014).

In addition to lack of activity in this area, the implementation of policies and activities surrounding waste resources in the UK are divided amongst different government departments. In addition, waste policy is devolved, meaning that each part of the UK is responsible for establishing its own policies. These are set out in Government Review of Waste Policy in England 2011,12 Scotland's Zero Waste Plan, Wales' Towards Zero Waste and Northern Ireland's Delivering Resource Efficiency. All four administrations provide funding to, and work with, the Waste and Resources Action Programme (WRAP)¹⁴ that provides support to the UK governments' policies on waste and resource efficiency to ensure effective delivery. The devolved nature of waste policy and different competencies for different areas of waste management and use can make it difficult for emerging sectors and industries to understand the policy landscape surrounding waste resources. Government departments do work together on waste policy, but the HoL Select Committee identified that there is a far greater need for coordination in this area and made recommendations for this to be rectified (HoL, 2014, para 69 and 71). There are a variety of other technical, economic, logistical and operational barriers that were identified in the House of Lords and Governments review (e.g. BIS, 2015; HoL, 2014) that aim to be addressed by policy.

3.5.3 Review of policy action

The new developments in this area of policy in the UK focus on the development of a more strategic approach to align activities in the bioeconomy in order to maximise the use of waste as a resource as part of a drive to develop the wider bioeconomy in the UK.

¹³ Industrial strategy - <https://www.gov.uk/government/collections/industrial-strategy-government-and-industry-in-partnership>; Chemical strategy - <http://www.cia.org.uk/Portals/0/Documents/Growth%20Strategy%20FINAL.PDF>

¹⁴ WRAP is a not for profit, private company.

Recognising the significant volume of waste generated in the UK and the potential economic and environmental opportunities and synergies in utilising these wastes, the UK's HoL Science and Technology Select Committee launched an enquiry in 2013 entitled 'Waste opportunities: stimulating a bioeconomy'. The findings of this enquiry were published in 2014 alongside a series of recommendations to the government (HoL, 2014). These recommendations sought to address the range of existing barriers to utilising high carbon waste resources (including wood) and included identification of the opportunity, government strategic priorities, research and development, information and availability of waste, and stimulating investment. The UK government responded positively to the enquiry with a series of responses across a variety of areas (Table 3).

Table 3: Challenges and solutions to developing a waste-based bioeconomy in the UK

CHALLENGE	SOLUTIONS
Policy/departmental coherence	Develop a cross-ministerial champion as a central figure promoting the waste-based bioeconomy. Development of a cross Govt steering group with industry and key stakeholders to coordinate the development of the bioeconomy
Review best practice	UK Department for business, innovation and skills undertook a review of best practice examples of waste based bioeconomy activities in the UK; and commissioned a review of international best practice (see Allen <i>et al</i> , 2015)
Coordinated research funding	<ul style="list-style-type: none"> £45 million to R&D in high value products rather than solely on energy projects Maintaining and developing existing research collaborations <ul style="list-style-type: none"> 40 million recent investment in synthetic biology (SynBio) research centres Recognition of small start-ups in commercial activities, such as Biosyntha
Improved information and data	Continued work with WRAP to improve waste collection data, including improved metrics in line with waste hierarchy.
Funding for knowledge transfer and near to market research	Through the UK Catapult network* technology commercialisation has been improved at later technology readiness levels than other existing mechanisms and is being reviewed to ensure its continued utility in this area Increased funding for commercialisation activities and development/ demonstration facilities, including on going support through the Green Investment Bank**.
Coordinated action for the future	The development of a long-term plan to stimulate the more resource efficient and economic use of waste resources. Initial document

Source: BIS, 2015, based on the UK government response to the Lords Enquiry Notes: * Catapults are technology and innovation centres for R&D combining businesses, scientists and engineers; ** The UK Green Investment Bank plc is a funding institution designed to attract private funds for the financing of the private sector's investments related to environmental preservation and improvement

Despite the positive response to many of the recommendations and actions proposed in this area, there were some areas that are proving more difficult to overcome. For example, the Lords recommended a more ambitious approach to waste collection including improved guidance, planning decisions and long-term policy for standardising waste collection with a view to enabling the UK to extract the maximum value from wastes¹⁵. However, the government noted that waste collection in the UK was devolved as a local issue, with a wide variety of collection processes limiting the potential for standardisation and did not take on the recommendation of issuing new guidance.

3.5.4 Conclusions

The recognition of the potential inherent in the utilisation of waste resources has stimulated policy interest. The ambition to realise a long-term plan, such as a road map or guiding strategy document, has been hampered initially through uncertainty in the government's future at the time the report was being compiled¹⁶. However, this is due to be revisited. The precise ambition for waste wood within this agenda is not so clear. On the one hand the role of wood waste is particularly important in the UK given the relatively small area of domestic wood production. However, wood waste represents only a relatively small share (4%) of overall waste resources.

What the review of waste resources and use in the UK has highlighted are the range of sectors and actions needed in order to transform the view of wastes from something that needs to be disposed of, to something that is considered as a valuable resource and input feedstock for a whole range of existing and emerging sectors. These range from funding initiatives; development of coherent policies across various thematic areas; improved coordination activities; planning developments; education and outreach activities; etc.

Recognising the broad range of activities needed in this area, and in particular in the UK with the devolved nature of waste policy and the localised decision making around waste collection and planning, there is a continuing need for organisations, such as WRAP and Zero Waste Scotland, to facilitate the transition to the bioeconomy. Coordinating and implementing organisations such as this play an important role in communicating the potential that improved cascading use of woody biomass can play in the development of bioeconomy ambitions, and coordinating activities across a diverse range of sectors and stakeholders.

¹⁵ Recommendation paragraph 120.

¹⁶ In the run up to the UK General election in 2015.

3.6 US – STRENGTHENING INNOVATIVE WOOD PRODUCTS THROUGH THE BIOPREFERRED PROGRAM

3.6.1 Context

**THE US IS
THE SINGLE
LARGEST
WOOD PELLET
PRODUCER IN THE
WORLD**

The US is the biggest producer and exporter of wood products in the world. The forest products industry accounts for approximately 4 percent of the total US manufacturing GDP, manufactures approximately \$240 billion in products annually, and employs nearly 900,000 men and women. The industry meets a payroll of approximately \$50 billion annually and is among the top 10 manufacturing sector employers in 47 states (AFPA 2015). Forests cover 33.9% of the total land area with an acreage of about 310,000,000 ha. Approximately 210,000,000 ha are timberland, of which roughly two thirds are privately owned (AFPA 2015).

Especially the export of wood pellets has been booming for the last few years, mainly driven by the European renewable energy targets. Dozens of manufacturers, increasingly concentrated in the Southeast, are now approaching production of 10 million annual short tons of wood pellets. Another six million short tons of capacity is now planned or under construction, making the US the single largest wood pellet producer in the world (Zeller 2015). In 2014, almost three-quarters of all US wood pellet exports were delivered to the United Kingdom, mainly for the purpose of generating electricity. Overall, US wood pellet exports increased by nearly 40% between 2013 and 2014, from 3.2 million short tons to 4.4 million short tons, as the United States continues to be also the largest wood pellet exporter in the world (EIA 2015). Some industry speculators estimate that these numbers can still increase tenfold by 2020 (Zeller 2015).

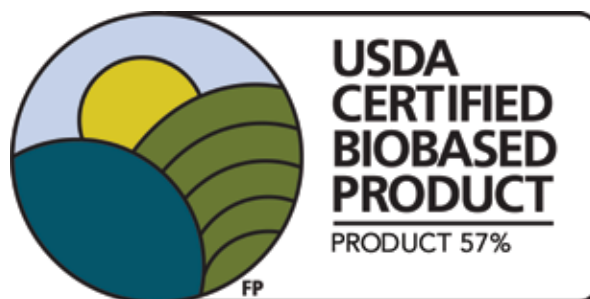
According to experts in the field, the term “cascading use” is not very well established or known by industry players and policy makers in the US and Canada. The topic is slowly gaining some prominence, but is not very high on the agenda (Lavoie 2015). From the previous research of the above case studies, it has crystallised that there are two main factors influencing whether cascading takes place or not: The first factor is the allocation of the woody biomass either to material applications or energy, since the first use determines whether a cascade can take place at all. The second factor is an established system of collecting and sorting post-consumer wood in order to direct the biomass to second, third or further stages of the cascade.

The collection, sorting and recycling of wood waste is highly regionalised in the US and an analysis of these circumstances would go beyond the scope of this case study. Other researchers have looked at the recycling issue (Howe *et al.* 2013, USDA 2002) and have found several weaknesses and potential for improvement. For the purpose of this study, it was therefore decided to focus on the first factor which determines the first application of the woody biomass. For this, the focus will be on the BioPreferred Program, which is a policy instrument intended to strengthen bio-based products on the consumer market. It will be analysed, if and to which extent this policy instrument can contribute to increasing the market share of wood products and therefore enabling cascading use to take place.

3.6.2 Innovative wood products in the BioPreferred Program

The BioPreferred Program was established by the 2002 Farm Bill (USDA 2015). The program aims at strengthening the domestic rural economy by strengthening market access of bio-based products, preferably produced from domestic biomass. It consists of two main components: voluntary labelling (see Figure 7) to declare the bio-based content of a product, which is supposed to improve communication to end consumers who should feel increased confidence about products they buy and what they are made of. The second component is mandatory federal purchasing of bio-based products. This means that all federal agencies are directed to purchase bio-based products in categories identified by the Department of Agriculture (USDA). To date, USDA has identified 97 categories (e.g. cleaners, carpet, lubricants, paints) of bio-based products for which agencies and their contractors have purchasing requirements, which opens up a huge market potential for these products.¹⁷

Figure 7: USDA label for bio-based products



BioPreferred was reauthorized and expanded by the Agricultural Act of 2014. Among others, it included a new provision that made biorefineries producing bio-based chemicals eligible for the same funding as biorefineries producing fuels, and it also removed the previously existing barrier that excluded “mature” products from the labelling and mandatory purchasing program (Buckhalt & Goodman 2014). As a consequence, USDA proposed new actions to include new forest products in the BioPreferred Program. The proposal also included other traditional bio-based products and other mature market products, which have been produced in innovative ways (USDA 2014).

As of now (status 9 July 2015) 36 individual products containing forestry materials have received certification to display the USDA Certified Bio-based Product label. These include paper products, mulch, viscose fibres, construction material etc. (Chu 2015). Unfortunately, there is no secured information about economic impacts this might have. Furthermore, the USDA has not established yet any product categories for forest products that qualify for mandatory federal purchasing. Therefore, there is no information on public procurement being done on wood-based products (Chu 2015).

Potentially, labelling and mandatory federal purchasing of forest products can have positive impacts on the development of (at least single-stage) cascades. It needs to be seen whether these positive effects will be reached after a certain time.

¹⁷ In the EU, the purchasing power of public procurement is given at almost 2,000 billion Euros per year.

4 CONCLUSIONS AND KEY MESSAGES

The presented study is a mapping study with the foremost goal to provide information about the policy context in which cascading use is handled in Europe, with a very limited look at the US. Concrete recommendations on how to support cascading use of wood are out of scope of this exercise, but several general observations can be made to point towards increased cascading use in Europe. Due to the vast and complex structures of wood utilisation in the US it was impossible within the framework of the study to reach sound conclusions, which is why the observations

and recommendations only refer to the European context. One basic lesson of the research on the American market was that “cascading use” per se is almost not discussed at all in the sector.

First of all, the intense review of existing definitions and concepts and of the public debate around it has shown that there is still no commonly agreed concept of what cascading use exactly is. In order to develop a consistent framework, however, it is crucial that a common definition be found as a baseline.

Furthermore, it has been illustrated that none of the investigated countries have dedicated policies for cascading use of wood. However, a multitude of policies and legislations influence cascading use and the wood sector in general, e.g. bioeconomy strategies, forestry management, waste policy, bioenergy policy, building regulations, etc.

These policy fields should all be taken into account when considering how best to promote the cascading use of wood. There is a need for policy harmonisation across these sectors in order to build a consistent framework for the resource efficient management of wood and to support the cascading use of wood. From the analysis it has become clear that each country analysed is in a unique situation concerning wood availability and utilisation. These circumstances need to be taken into consideration in order to find the best solutions to increase resource efficiency. The ideal way would be that the European Commission provide guidance to Member States on how to take the Cascading Use of Wood principle – and in general material applications of biomass – into account when designing their bioenergy support schemes, in particular those related to European Renewable Energy policy and activities related to the Circular Economy package. This guidance also needs to take into consideration that there are different types of wood resources suitable for different kinds of applications and that the nature of this resource will vary between countries and regions.

Generally, the establishment of cascades is decided by economic factors, but economics are influenced both by commercial imperatives as well as policy support (such as incentives). Usually, producers of high value applications can pay a higher price for raw materials, meaning that in a standard case, a resource for which there is competition, goes to the higher value-creating application. These are usually bio-based products in material applications, so that in a free market, high-value resources would usually at least enter a single-stage cascade (if the product enters a waste management system at the end of its first life cycle). The ability of different

actors to pay for the wood resource, however, is currently influenced by subsidies that are paid to support renewable heat and power generation.

At present certain biomass for energy uses are able to receive this support and as a result may be able to pay higher prices for resources than would have been the case based purely on market forces. This has the potential to distort whether wood, wood products and by-products are used for material uses, cascaded and/or used directly or indirectly for energy production and poses a significant barrier to even single-stage cascades.

For multi-stage cascades, the challenges and interactions that determine whether cascading occurs and the balance between material and energy use become more complex. First of all, local heat generation from post-consumer wood (in private households) or by-products (in commercial facilities) is a traditional source of energy in many countries, and might make a lot of sense in terms of local and economic energy production. But this material is lost for cascading use. Secondly, an effective establishment of multi-stage cascades requires a comprehensive system of waste collection, preparation and recycling. These structures need time to build. Moreover, an abundance of wood resources in countries such as Poland makes recycling less attractive, since using fresh resources is more economically feasible than setting up a whole recycling system. Finland is seemingly in a similar situation in terms of wood availability although sustainability of increasing harvest remains a controversial topic. While Finland has a strong paper recycling policy, policy for the recycling of other wood materials is not yet strongly established.

The following key messages can be extracted from the analysis:

- There is a strong need for a commonly agreed and accepted concept of “cascading use” among policy makers, researchers and industry.
- Cascades are only established if they make sense economically, but economics are influenced both by commercial factors and by public support (such as through policy incentives). The ability to establish cascading in Europe is impacted by two economic trends: that fresh wood is not necessarily more expensive than the use of recycled wood; that subsidies received for the production of bioenergy mean that energy users can potentially pay higher prices for woody material than would otherwise be the case. There is a strong impression that as long as bioenergy is heavily subsidized, it is highly unlikely that more effective cascades will be established or improved throughout Europe.
- When considering cascading use, it is extremely important to look at a very wide sweep of policies that historically have been developed in isolation. Interlinkages between waste collection and management policies, sequestration measures, management strategies in the forest, resource efficiency strategies and energy policies are intricate and influence each other. Therefore, the implementation of cascading use of wood is not a

one-dimensional debate but a whole set of wider complex policy interactions and nuances that dictate the most effective outcomes of the whole resource system.

- Policy harmonisation still needs to allow room for each unique country situation in terms of wood availability and utilisation. It is recommended that the European Commission provide guidance to Member States on how to take the Cascading Use of Wood principle – and in general material applications of biomass – into account when designing their bioenergy support schemes, in particular those related to European Renewable Energy policy and activities related to the Circular Economy package. Such guidance would also need to take into consideration that there are different types of wood resources suitable for different applications.
- Biomass, including wood and wood products, has been chosen as one of the primary means to deliver Member State renewable energy targets. This poses a potential barrier to the evolution and further establishment of cascades for woody biomass, as the first use (material or energy) determines the final material flows.
- The effective national implementation of the European waste hierarchy is crucial for the establishment of multi-stage cascades. Reliable classification and sorting systems of post-consumer wood are extremely important for functional recycling systems. However, even they cannot be a guarantee for a cascade to take place, if the resources are not used as material in their first application.
- Positive examples of established cascading and recycling systems show that public awareness and acceptance is key. This should be supported throughout Europe.

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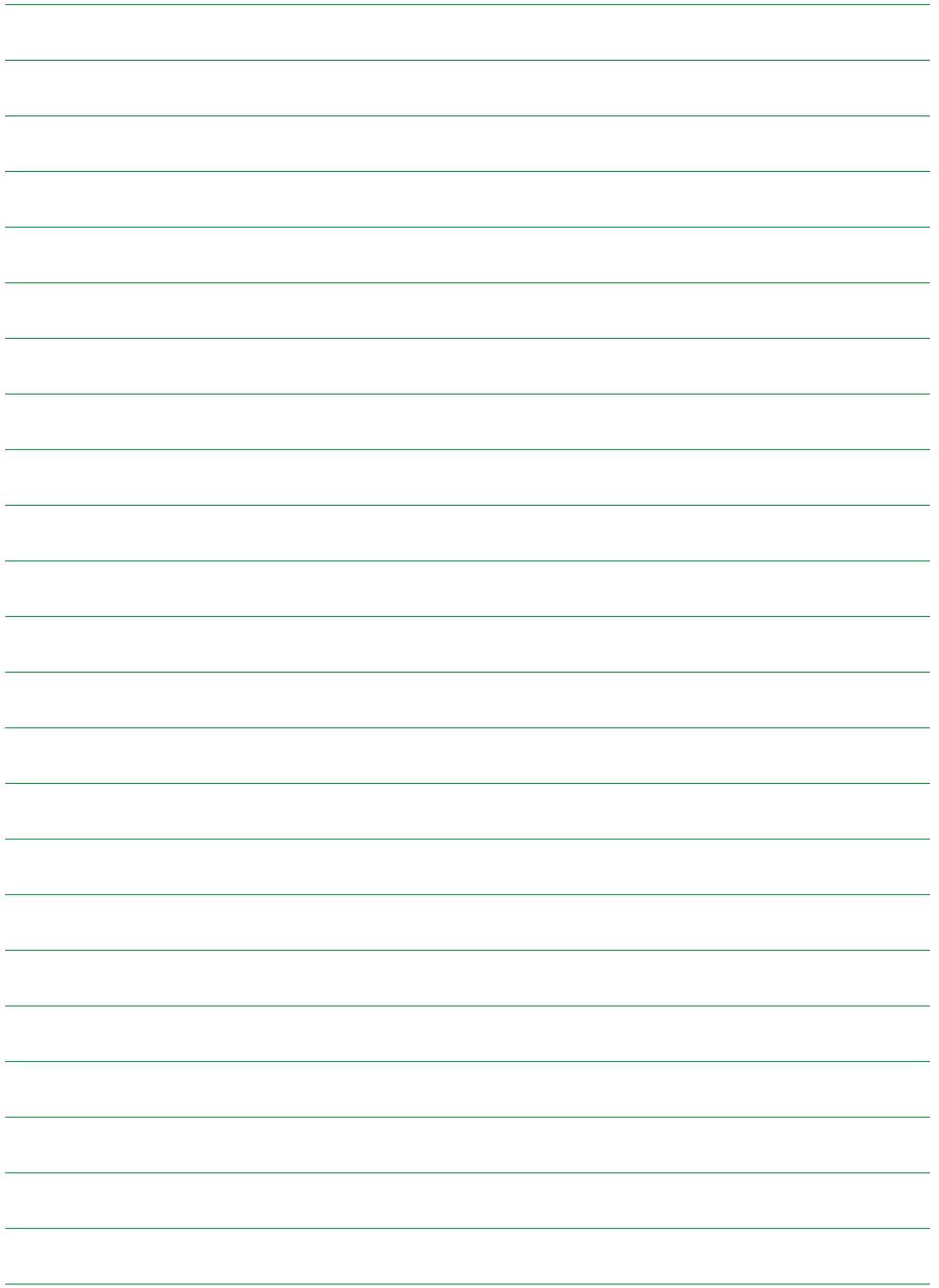
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Cascading use of wood

2050

The amount of wood we take from forests and plantations each year may need to triple by 2050.

6

Number of countries analysed for this study. These are: Finland, Germany, Poland, Spain, UK and the US.



2014


The year that the WWF-Mondi Global Partnership was launched.

10%

Today, 10 per cent of the world's population consumes over 50 per cent of the paper.

50%

In Germany, 50% of the total wood resources was used for energetic purpose in the year 2010.

	<p>Why we are here To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.</p> <p>www.panda.org</p>
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