



‘Absorbing the Potential of Wood Waste in EU Regions and Industrial Bio-based Ecosystems — BioReg’

D1.1 EUROPEAN WOOD WASTE STATISTICS REPORT FOR RECIPIENT AND MODEL REGIONS

To the attention of the Research Executive Agency

Organization	IUNG-PIB
Due date	31.03.2017
Issue date	09.11.2018



Document information

Document title	EUROPEAN WOOD WASTE STATISTICS REPORT FOR RECIPIENT AND MODEL REGIONS
Document file name	BioReg D1.1
Revision number	2
Issued by	Magdalena Borzecka
Issue date	09 November 2018
Status	Final

Nature of the deliverable

R	Report	x
P	Prototype	
D	Demonstrator	
O	Other	

Dissemination Level

PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Document Approval

Name	Role in the project
Dominique Boulday	Coordinator

Document Review

Date	Version	Reviewers
31.03.2017	1	Dominique Boulday CEDEN
23.05.2017	2	Dominique Boulday CEDEN Teodora Marinova EP
09.11.2018	3	Dominique Boulday CEDEN



ACKNOWLEDGEMENT

This report forms part of the deliverables from the project "BioReg" which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 727958. The Community is not responsible for any use that might be made of the content of this publication.

The BioReg project proposes to create a platform of stakeholders who are able to influence and develop their regions towards bio-based industries and products.

The project runs from January 2017 to December 2019, it involves 8 partners and is coordinated by "le CABINET D'ETUDES SUR LES DECHETS ET L'ENERGIE" (CEDEN).

More information on the project can be found at <http://bioreg.eu/project/>.

ABSTRACT

The report presents the European wood waste statistics. The report covers the whole EU plus seven regions of the project interest. It presents data on municipal, commercial and industrial (C&I), construction and demolition (C&I) wood wastes. The statistical data was collected from EUROSTAT, OECD, AEBIOM, EEA, as well as from partners representing regions of interest.

EXECUTIVE SUMMARY

This report presents the analysis of the waste wood statistics in the EU-27 and Switzerland. Estimates were made for the following types of biomass:

- wood waste from municipal waste,
- construction and demolition wood,
- waste wood from industry (by products).

Estimates were made for spatial unit's NUTS-2, which are regions with geocode standard for referencing the subdivisions of countries for statistical purposes. The special interest was set to the regions chosen in the project as the recipient regions (Normandy (FR), Lubelskie (PL), Alentejo and Lisboa (PT) and model regions (Gothenburg (SE); Baden-Wurttemberg (DE), Lombardy (IT) and North West England (UK). In 2014 EU-28 Countries generated 2 589 million tonnes of waste. Based on Eurostat data "Waste indicator on generation and landfilling- monitoring sustainable development" in 2014 EU-27 produced **60 million** of wood waste. The most valuable and detailed data on waste management in Europe come from Eurostat. The total theoretical biomass



potential of wood waste amounted at 22588 kt. The total theoretical biomass potential of demolition wood amounted at 51635 kt. The total theoretical potential wood industry by products amounted at 5580 kt.

Wood waste management is better developed in highly developed countries, where general waste management stands at a higher level. These countries produce more waste including wood waste. Statistic data from partners shows differences between regions, more inhabited and wealthy regions produce more wood waste (e.g. Lombardy 700kt wood waste) than poorer regions (Lubelskie 105k tonnes wood waste). Theoretical potential of wood waste is the highest in the biggest countries like Germany, France, Italy. Full use of the wood waste potential is an extremely important and difficult task which we will have to face.



1 TABLE OF CONTENTS	
1	Table of Contents.....5
	Abbreviations.....6
2	Introduction.....7
3	EU Statistic.....8
3.1	Data bases.....8
3.1.1	Eurostat.....8
3.1.2	OECD.....8
3.1.3	AEBIOM.....8
3.1.4	EEA.....8
3.2	Data description.....9
4	Regional statistic.....17
4.1	Recipient region.....18
4.1.1	Normandy.....18
4.1.2	Lubelskie (PL),.....19
4.1.3	Alentejo, Lisboa (PT).....20
4.2	Model regions.....22
4.2.1	Västsverige; Gothenburg (SE).22
4.2.2	Vorarlberg; Styria (AT).....23
4.2.3	Karlsruhe; Baden-Wurttemberg (DE).24
4.2.4	Lombardy, Emilia-Romagna, (IT).....26
4.2.5	North West England (UK).....27
5	Theoretical Wood waste Potential in EU.....30
5.1	Wood waste from municipal waste.....30
5.1.1	Method.....30
5.1.2	Result.....30
5.2	Demolition and construction wood.....32
5.2.1	Scope and definitions.....32
5.2.2	Method.....32
5.2.3	Result.....33
5.3	Bio-Waste of wood industry by-products.....34
5.3.1	Scope and definitions.....34
5.3.2	Method.....35
5.3.3	Result.....35
6	Waste wood treatment.....37
7	SUMMARY45
8	Literature.....47
9	List of tables.....48
10	List of figures.....48
11	Charts index.....48



ABBREVIATIONS

All abbreviations shall have the meaning defined either herein or in the Rules for Participation or in the Grant Agreement (GA) including its Annexes without the need to replicate said terms herein.

CLC – Corine Land Cover

EEA – European Environmental Agency

EUROSTAT – Statistical Office of the European Communities,

NUTS- Nomenclature of territorial units for statistics,

OECD - Organisation for Economic Co-operation and Development

RENEW- Renewable fuels for advanced powertrains

LHV – Lower heating value



2 INTRODUCTION

In Europe, we currently use 16 tonnes of material per person per year, 6 tonnes of which become waste. On average, out of 475 kg of waste produced by each person in EU, 39 % is recycled. According to the European Commission plan to achieve 50% recycling rates in 2020, it is a big challenge for the member countries. Only 5 countries have reached this level. Waste management is a significant issue for the current generation (Eurostat, 2017).

Waste composition is influenced by many factors such as culture, economic development and climate. In highly developed countries consumption of inorganic materials (e.g. plastic, paper, aluminium) increases. In low- and middle-income countries organic fraction has a high percentage in total waste (from 40 to 85%) (Hoornweq, Bhada-Tata 2012). Climate also has a significant impact on waste generation. A good example is Ulan Bator (Mongolia) where ash in winter makes up to 60% of MSW, in summer only 20% (Hoornweq, Bhada-Tata 2012). Waste composition can be influenced by geography, determining building material, ash content etc. The type of energy source also has impact on MSW composition especially in low-income countries or regions where district heating systems or the electricity grid are not well developed or there are none at all.

Forest area in EU 28 in 2015 was around 41% (Eurostat, 2017). Currently we observe positive trends about quantity of wood: according to State of Europe's Forest 2015 an annual increase of 242,000 ha (0.9%) over last 25 years. UE and local governments make effort to protect forest. Better use of wood waste may help to improve the quantity and quality of forests. Wood waste can be a rich source of useful wood material.

At this point the problem is that there exists neither a legal solution nor a unified division of wood waste. Each country has different division of wood waste, or does not use any. For example, English classification contains four grades (A, B, C, D). Grade A is "clean" recycled wood – material produced from pallets and secondary manufacture etc. and suitable for producing animal bedding and mulches. Grade B stands for "industrial feedstock grade" – including grade A, but mixed with construction and demolition waste; this is suitable for making panel board. Grade C is a "fuel grade" – which is made from all of the above material plus that from municipal collections and civic amenity sites and can be used for biomass fuel. Grade D means "hazardous waste" – this consists of all grades of wood including treated material such as fencing and track work and requires disposal at special facilities (<http://www.letsrecycle.com/news/latest-news/recycled-wood-grades-defined-for-the-first-time>), while Netherlands use classification with three grades (A, B, C). Grade A includes only clean wood (unpainted and untreated). Grade C impregnated being treated timber. Grade B cannot be classified as group A or C (included painted and varnished and glue wood) (NL Agency, 2013). The EU list of waste classification is based on the European List of Waste (Commission Decision 2000/532/EC) and Annex III to Directive 2008/98/EC. The list should be used as reference nomenclature to provide a common terminology to the EU community to improve the efficiency of waste management activities.



3 EU STATISTIC

3.1 DATA BASES

3.1.1 EUROSTAT

Eurostat is the European Union statistic office. Their mission is to provide high quality statistic for Europe, which allows for comparison between EU members. There are many data and reports on Eurostat containing details about waste management (e. g. Waste statistic, Waste indicators on generation and landfilling-monitoring sustainable development, Packaging waste statistics, waste generation and treatment).

3.1.2 OECD

The Organization for Economic Co-operation and Development is an organization associating 35 countries. Their mission is to promote policies that will improve economic and social well-being. OECD created Environmental Performance Reviews to provide evaluation of countries' progress in environmental policy. Reports include assessment of actual achievements and recommendations in the areas identified for improvement, show the strengths and weaknesses. On the example of Poland 2015 reviews, the report consisted of five chapters (1- Key environmental trends; 2- Policy-making environment; 3- towards green growth; 4- Forestry and biodiversity; 5- Waste and material management). Each report is different, but most contain similar topics.

3.1.3 AEBIOM

AEBIOM is a non-profit organization created in 1990, consociating 30 national associations and 90 companies. Five fundamental goals remained same from the beginning:

"To communicate to EU policy makers the opportunities and concerns regarding the development of bioenergy in Europe;

To develop, deepen and disseminate the knowledge concerning the use of biomass for energy, from scientific, technological, economic, sociological, legal and political perspectives, as well as in any other aspect having a relevance at European level;

To develop and promote the technical quality of the European bioenergy industry;

To support any initiative at national and international level aiming at the promotion of the use of bioenergy;

To actively promote the abolition of any technical or trade barriers which hamper the development of an open bioenergy market at European level."

3.1.4 EEA

The European Environmental Agency (EEA) is a European Union agency to provide independent data, information about environmental issues. There are 33 EEA members- 28 EU countries plus Turkey, Iceland,



Norway, Switzerland and Liechtenstein. In addition, 6 countries (Albania, Bosnia and Herzegovina Macedonia Serbia Montenegro) applied for membership and have been cooperating with the EEA for several years. The main objectives of EEA are to help member countries to improve environment, create policies and coordinate European environmental information and observation network.

3.2 DATA DESCRIPTION

The most useful and containing regional data base is EUROSTAT. Based on Eurostat data in 2014 (table 1.) every citizen of the European Union made 475 kg of waste. Totals of municipal waste generated in 2014 differed greatly, from 759 kg per capita in Denmark to 272 kg per capita in Poland and Romania. From 1995 till 2014 the annual quantity per habitant has been virtually the same (473 kg in 1995, 475 kg in 2014). However, in each country different situation was observed. On one hand there are countries which significantly reduce municipal waste generation like Bulgaria (36%), Norway (32%) or Slovenia (28%) but on the other hand in many countries it has increased, such as in Malta (52%) Denmark (48%) Austria (29%). In 22 of 26 countries the amount of municipal waste generated per capita increased between 1995 and 2000 (only Bulgaria Lithuania, Hungary and Slovenia reduced this value). From 2000 till 2004, 11 from 28 EU members reduced waste production per person (general municipal waste generated in EU28 reduced from 521 kg in 2000 to 511 kg in 2004). Between 2004 and 2008 only 6 countries from EU28 reduced this value (there has been an increase in EU of 9 kg annually per person). In only 7 from 28 countries the quantity of municipal waste generated per habitant increased between 2008 and 2014 (general municipal waste generated in EU28 reduced from 520 kg in 2008 to 475 kg in 2014).

Table 1. *Municipal waste generated by country in selected years (kg per capita)*

	1995	2000	2004	2008	2011	2014	change (%) 1995-2014
EU-28	:	521	511	520	496	475	:
EU-27	473	523	513	521	497	475	0
Belgium	455	471	485	479	456	435	-4
Bulgaria	694	612	599	599	508	442	-36
Czech Republic	302	335	279	306	320	310	3
Denmark	521	610	620	741	781	759	46
Germany	623	642	587	589	614	618	-1
Estonia	371	453	445	392	301	357	-4
Ireland	512	599	737	718	617	586	14
Greece	:	412	436	458	503	510	:
Spain	510	658	600	551	485	435	-15
France	475	514	519	541	538	511	8
Croatia	:	262	304	415	384	387	:
Italy	454	509	540	552	529	488	7
Cyprus	595	628	684	728	683	626	5
Latvia	264	271	318	345	350	281	6
Lithuania	426	365	373	428	442	433	2
Luxembourg	587	654	679	697	666	616	5
Hungary	460	446	454	454	382	385	-16
Malta	395	546	623	674	589	600	52
Netherlands	539	598	599	600	568	527	-2
Austria	437	580	574	600	573	565	29
Poland	285	320	256	320	319	272	-5
Portugal	352	457	445	518	490	453	29



	1995	2000	2004	2008	2011	2014	change (%) 1995-2014
Romania	342	355	349	411	259	272	-20
Slovenia	596	513	485	542	415	432	-28
Slovakia	295	254	261	313	311	321	9
Finland	413	502	469	521	505	482	17
Sweden	386	428	460	483	449	438	13
United Kingdom	498	577	602	541	491	482	-3
Iceland	426	462	503	495	320	345	-19
Norway	624	613	414	487	485	423	-32
Switzerland	600	656	660	736	689	730	22
Montenegro	:	:	:	:	:	508	:
The former Yugoslav Republic of Macedonia	:	:	:	:	357	370	:
Serbia	:	:	:	347	375	302	:
Turkey	441	465	440	400	416	405	-8
Bosnia and Herzegovina	:	:	:	:	340	349	:

Sources: Eurostat 2015 (env_wasmun)

Table 2 shows the amounts of municipal waste treated in EU-27 between 1995 to 2014 by treatment method in millions of tonnes and kg per capita. The amount of landfilled waste constantly drops, even when total waste generated in EU increases. In the period from 1995 to 2014 this value decreased from 144 million tonnes and 302 kg per habitant to 66 million tonnes and 131 kg per person. As a result, disposal in landfill has dropped more than by half (54%) since 1995.

Furthermore, a significant increase can be observed in incineration, composting and recycling. Between 1995 and 2014 EU27, the amounts of waste steered towards incineration have increased from 32 million tonnes and 67 kg per capita in 1995 to 64 million tonnes and 128 kg per person in 2014. The fact that recycling municipal waste remarkably improved reaching 166% is extremely important in the context of EU strategy. In 1996 only 25 million tonnes and 52 kg of waste per habitant were recycled and in 2014 that amount increased to 66 million tonnes and 132 kg per capita.

Waste composting has increased the most, up to 170%. Between 1995 and 2014 the increase was 24 million tonnes and 46 kg per habitant.

The 'other treatment' category was calculated as the difference between the sum of the amounts of waste treated and the amounts of waste generated. This difference arises in countries that have to estimate waste generation in areas not covered by a municipal waste collection scheme and thus report more waste generated than treated. In addition, the 'other treatment' category reflects the effects of import and export, weight losses, double-counting of secondary waste (e.g. landfilling and recycling of residues from incineration), differences due to time lags, temporary storage and, increasingly, the use of pre-treatment, such as mechanical biological treatment (MBT) (Blumenthal, 2011). Other categories decreased by about half, from 10 million tonnes and 22 kg per habitant in 1995 to 5 million and 10 kg per capita in 2014.



Table 2. Municipal waste landfilled, incinerated, recycled and composted in EU 27, 1995 to 2004.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	change (%) 1995- 2014
million tonnes																					
Landfill	144	142	143	140	139	139	135	131	124	117	109	108	106	99	96	92	84	78	71	66	-54
Incineration	32	32	35	35	36	39	40	41	41	44	48	51	52	55	56	57	60	59	62	64	100
Recycling	25	28	32	35	40	40	42	46	47	49	52	54	59	60	61	62	64	66	65	66	166
Composting	14	16	17	18	19	24	24	26	26	28	29	31	32	35	35	34	34	36	37	38	170
Other	10	14	12	12	12	11	12	12	12	13	16	13	11	10	7	7	6	6	6	5	-52
kg per capita																					
Landfill	302	296	299	290	288	288	278	269	255	239	221	220	214	200	193	184	168	152	143	131	-57
Incineration	67	68	72	73	75	80	82	85	85	90	98	104	105	110	112	114	120	119	122	128	90
Recycling	52	59	66	72	82	83	88	95	97	99	105	109	119	120	123	124	129	131	129	132	152
Composting	30	34	36	37	40	49	50	53	54	57	59	62	64	71	70	68	69	72	74	76	158
Other	22	29	26	24	25	24	24	24	24	27	33	27	22	20	15	13	13	12	10	8	-64

Sources: Eurostat 2017 (env_wasmun)



Chart 1. Municipal waste treated in 2009 by country and treatment category, sorted by percentage of landfilling (% of municipal waste treated). Sources: Eurostat 2011

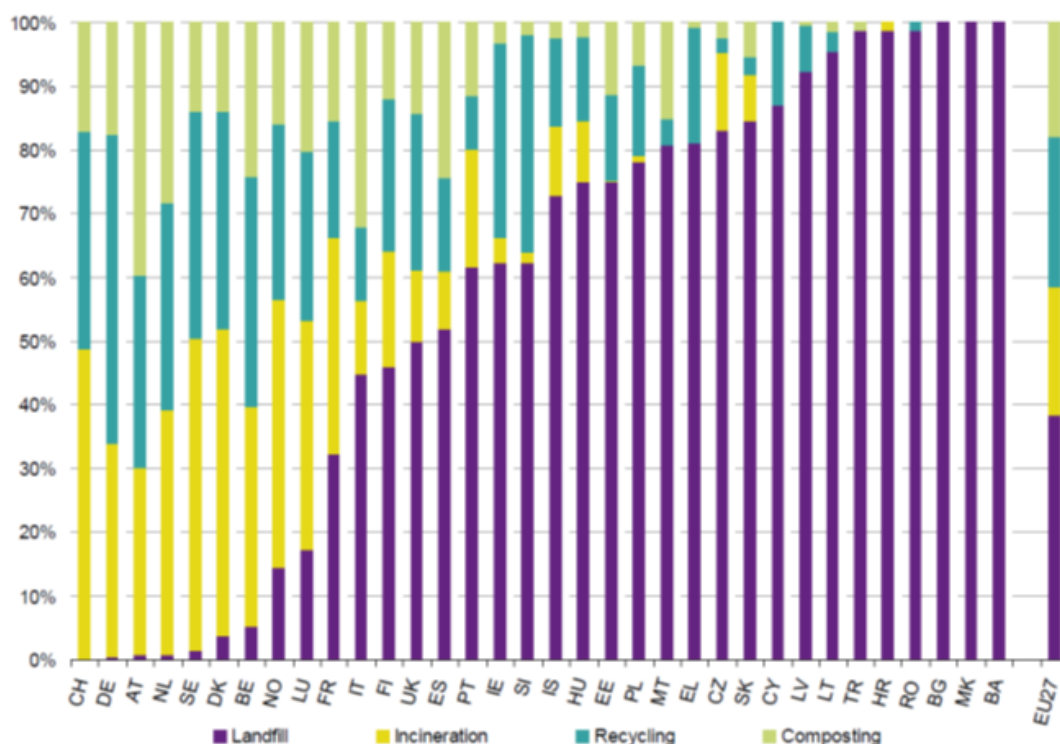


Chart 1 shows a massive difference in waste management (quantity of municipal waste recycled, composed, incinerated and landfilled) in 2009 in Europe. There are couple of countries which are highly developed in that area. In Switzerland, Germany, Netherlands, Sweden, Austria, Denmark and Belgium landfill rates are less than 5%, it happened so that these countries have taken steps to reduce landfilled waste. Denmark (in 1997) and Sweden (2002) have forbidden landfilling combustible waste and significantly increased percent of another treatment methods. Almost 50% of municipal waste in these countries is incineration. In Sweden, since 2005 no organic material can be landfilled, which caused a decrease of landfilled waste. But still there are countries where landfill is a major component of waste management, like Bulgaria, Macedonia, Romania where 100% (or almost) goes there.



This project has received funding from the European Union's H2020 research and innovation programme under grant agreement no 727958.

Table 3. Waste generated in 2004 – 2010 in UE27

	Waste generation in 1000 tonnes				Waste generation in kg/inhabitant			
	2004	2006	2008	2010	2004	2006	2008	2010
Spent solvents	2 970	2 860	2 730	3 220	6	6	5	6
Acid, alkaline or saline wastes	7 740	8 020	7 040	6 140	16	16	14	12
Used oils	4 270	6 440	5 620	5 160	9	13	11	10
Chemical wastes	30 240	27 940	25 220	19 920	62	57	51	40
Industrial effluent sludges	8 870	11 190	13 960	14 540	18	23	28	29
Sludges and liquid wastes from waste treatment	:	:	:	8 900	:	:	:	18
Health care and biological wastes	1 810	2 370	2 070	3 940	4	5	4	8
Metallic wastes	83 700	94 180	99 360	97 690	171	191	199	195
Glass wastes	14 790	15 540	16 150	18 100	30	31	32	36
Paper and cardboard wastes	56 250	63 670	58 710	56 590	115	129	118	113
Rubber wastes	2 840	3 790	3 710	3 510	6	8	7	7
Plastic wastes	11 520	14 680	14 930	15 000	24	30	30	30
Wood wastes	66 930	69 460	68 550	60 780	137	141	137	121
Textile wastes	4 410	3 810	3 090	3 320	9	8	6	7
Waste containing PCB	50	110	70	80	0	0	0	0
Discarded equipment	3 040	3 450	4 310	5 540	6	7	9	11
Discarded vehicles	9 700	14 150	8 180	11 000	20	29	16	22
Batteries and accumulators wastes	1 330	1 630	1 870	1 720	3	3	4	3
Vegetal wastes	117 550	116 190	96 090	91 920	240	235	193	183
Animal faeces, urine and manure	33 320	27 880	21 050	16 530	68	56	42	33
Household and similar wastes	213 030	206 830	199 420	184 900	435	418	400	368
Mixed and undifferentiated materials	64 790	43 470	38 160	53 010	132	88	77	106
Sorting residues	35 070	38 620	47 770	57 460	72	78	96	115
Common sludges	15 980	17 470	15 600	19 010	33	35	31	38
Combustion wastes	161 490	158 420	156 880	124 620	330	321	315	248
Mineral wastes from waste treatment and stabilised wastes	:	:	:	44 050	:	:	:	88
Solidified, stabilised or vitrified wastes	2 910	3 400	4 840	:	6	7	10	:
Waste excluding major mineral wastes(1)	954 610	955 560	915 370	926 640	1 948	1 933	1 836	1 847

(1) 2010: EU-27 Eurostat Estimate.

Source Eurostat (env_wasgen)

According to Eurostat data (table 3) “Waste indicator on generation and landfilling- monitoring sustainable development” in 2010 EU27 countries generated 60 780 thousand tonnes of wood waste, which is 6.5% of total (excluding major mineral waste).

EEA report “Diverting Waste from landfill” shows that in 2004 EU generated 70.5 million tonnes (table 4) of wood waste (from working industry, construction and demolition, packaging and bulky waste).



Table 4. Generation and recovery of selected waste streams in the EU, 2004

	Total		Share from municipal sources	From municipal sources	
	Waste generation	Recovery		Waste generation	Recovery
	Million tonnes	%	%	Kilograms per capita	Kilograms per capita
Biodegradable waste	87.9	37	67	120	44
Waste paper	79.5	56	44	71	40
Waste wood *	70.5	65	n/a	n/a	n/a
Textiles	12.1	32	50	12	4

Note: * From wood working industry, construction and demolition, packaging and bulky waste.

Source: Alwast et al. 2008.

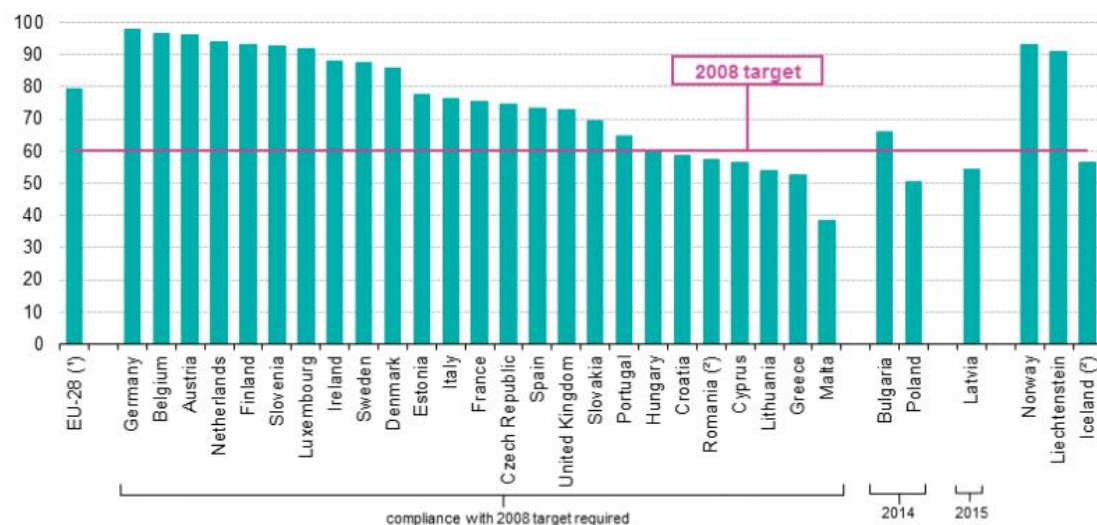
Source: EEA, 2009

An average citizen of the European Union produces 156.9 kg of packaging waste (in 2013). Germany has the highest production, 210.4 kg per habitant, in Croatia it is only 47.6 kg per capita.

In the case of directive 2004/12/EC of the European Parliament and of the Council proper management of packaging waste is mandatory. According to Article 6 till 31.12.2008 at least 55% of packaging waste and 80% at maximum will be recycled. In 2013 there were still 4 countries that failed to fulfil this obligation.

Chart 2. Recovery rate for all packaging (%). Source Eurostat 2016 (env_waspac)





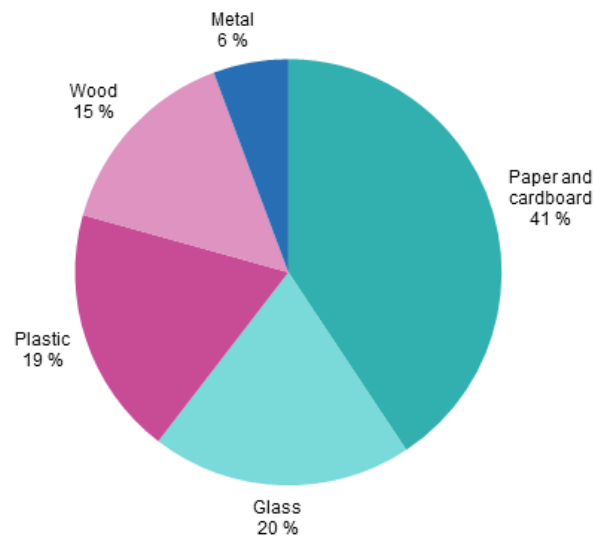
(*) Estimate.
(*) 2012 data.

The same directive (2004/12/EC), which has already been mentioned, determines recovery rates for packaging waste at 60% at least till the end of 2008 (chart 2). Also in this case, there are countries that are not able to fulfil this task (Croatia, Romania, Cyprus, Lithuania, Greece and Malta).

According to waste packaging statistic (chart 3) the most common type is paper and cardboard (41%) second glass (20%) next plastic (19%), further wood (15%) and the least common is metal (6%) (chart 3).

Chart 3. Shares of packaging waste generated by weight, EU 28, 2013. Sources: Eurostat 2016 (env_waspac)





(*) Estimate.

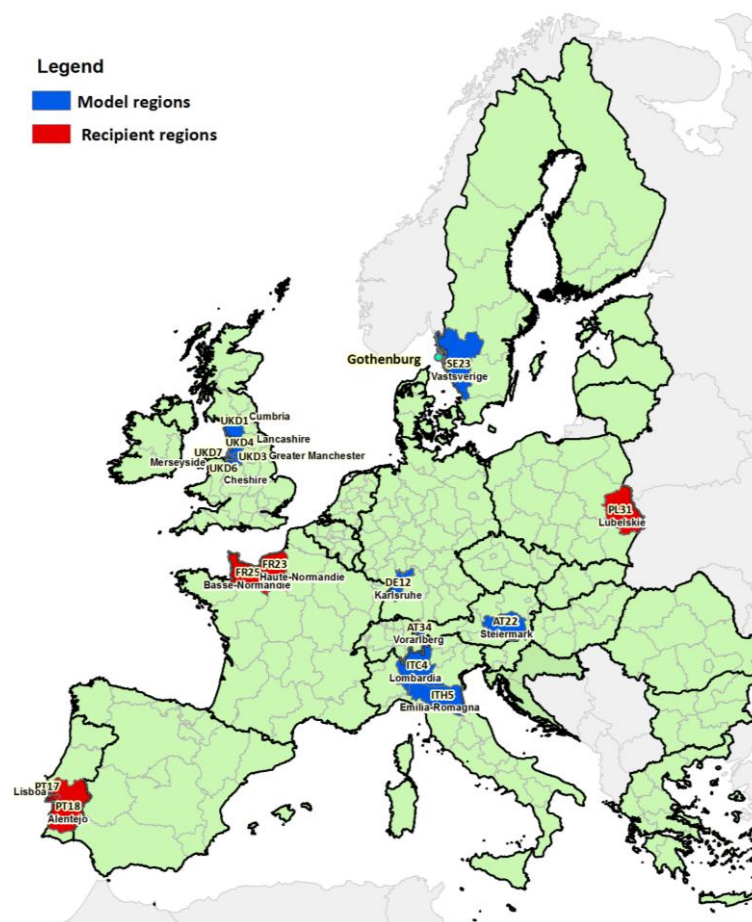


4 REGIONAL STATISTIC

Three recipient regions were selected for this project: singled out according to their unused waste wood potential. They include the regions of Normandy (France), Lubelskie (Poland) and Alentejo and Lisboa (Portugal). The rationale behind their choice included the different current profiles of the wood waste industries in the respective regions and the diversity of obstacles they are currently facing to implement a successful wood waste ecosystem (policy, legal, industrial).

Demonstrator regions were selected on the basis of their expertise at different stages of the wood waste value chain including different wood waste source, pre-sorting, sorting, collection, recycling and wood waste treatment (to materials, biochemicals or biofuels) as well as the different wood and respectively wood waste categories (softwood or hardwood), grading and regional wood waste composition in each country.

Figure 1. Case study (recipient and model regions)



4.1 RECIPIENT REGION

4.1.1 NORMANDY

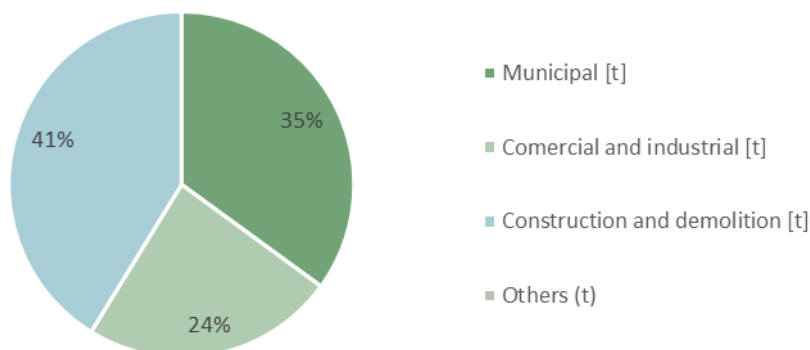
Normandy is a region in the north of France. NUTS 2 id FR23. The area is 29 906 km², population according to Eurostat is 3 343 247. Density of population is 110 people per km². Crude rate of total population change 1.8% for Haute- Normandie and -0.5% for Basse- Normandie. Purchasing power standard (PPS) per inhabitant is 25.600.0 for Haute Normandie and 23.400.0 for Basse- Normandie. Total Gross Domestic Product (GDP) is 90.4 billion Euro, and 27 200 Euro per habitant. The biggest city in the region is Rouen (112k inhabitant).

In 2011 in Normandy 2 066.5 thousand tonnes of municipal waste was generated (1124.1 in Haute- Normandie and 942.4 in Basse- Normandie) based on Eurostat data.

On the basis of data from Biomasse Normandy (ECIRBEN) total wood waste in 2015 in region amounted to 294 500 tonnes.

In fact, there is no data available about the percentage of wood waste in total waste. However, it is known that in France 2.1% of waste is wood waste.

Chart 4. Wood waste source in Normandy



Considering the source of wood waste (chart 4) in the region, construction and demolition generated most of wood waste (121 400 t), second was municipal (103 100 t), and the last Commercial and industrial (70 000 t).

In Normandy 204 700 tonnes of wood are classified as solid wood (134 700 t is treated solid wood, 70 000 t clean).

314 500 tonnes of wood waste was recovered in Normandy region. Almost half (150 000 t) is used in CHP industry. Only 9 000 tonnes of wood waste was landfilled.



4.1.2 LUBELSKIE (PL)

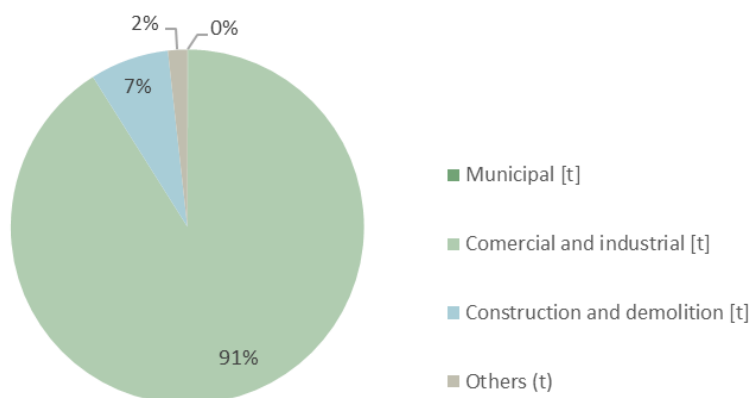
Lubelskie is a region in the eastern part of Poland. NUTS 2 id PL31. The province borders two countries- Ukraine and Belarus. The area of Lubelskie is 25 122.46 km², population according to Eurostat is 2 118 528. Density of population is around 85 people on 1 km². Crude rate of total population change - 3.7%. Purchasing power Standard (PPS) per inhabitant was 13.000.0 in 2012. The biggest city and capitol of region is Lublin (population 360k people). In Lubelskie there are 2 national parks (23 in Poland) and 17 landscape parks (122 in Poland).

General municipal waste generated in the region in 2013 was 472.81 thousand tonnes (Eurostat data). According to Statistical Office in Lublin in 2015 in Lubelskie total municipal waste generated amounted to 384.8 thousand tonnes, 179 kg per habitant. It is one of the lowest indicators in EU.

On the basis of data received from Marshal Office in Lublin total wood waste in 2015 in region was 104 561.87 tonnes. There is no data on the percentage content of wood waste in this group.

In National Waste Management Plan the content of wood waste in municipal waste depends on the place where it is produced. In cities with more than 50k inhabitants, only 0.2 % is wood waste, in cities with less than 50k people the percentage of wood waste is 0.3 in rural area 0.7.

Chart 5. Wood waste source in Lubelskie



Considering the source of wood waste (chart 5) in the region, commercial and industrial sources generated most of wood waste (95103.73t), second construction and demolition (7541.38 t) next other sources (1849.38t) and the least municipal waste (64.38 t).

Recycling level of wood packaging waste in 2011 according to the report of waste management plan was 2.1%. In 2014 in Poland recycling level of natural (wood and textiles) packaging waste was 48.2%. Based on waste management plan for Lublin region recovery rate of wood from construction and demolition was lower than 1%. 46% of waste from group 03 (wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard) was recovered (including recycled) in Lubelskie, the rest – outside the region.



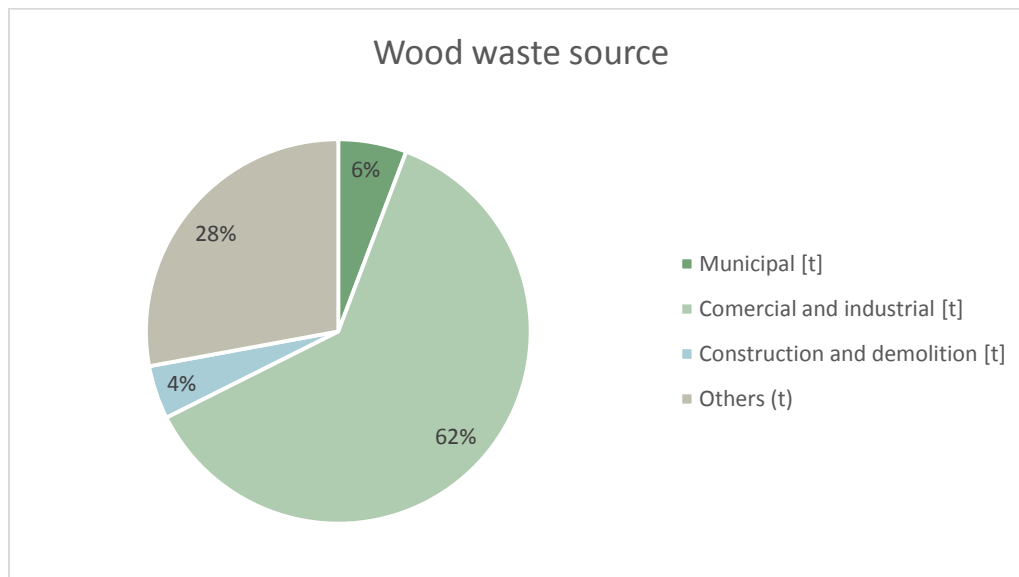
4.1.3 ALENTEJO, LISBOA (PT)

Lisboa is a region in Portugal which includes 2 NUTS3 regions: Greater Lisbon and Peninsula of Setubal. NUTS 2 id PT17. The area is 3 001,95 km², population according to Eurostat is 2 812 678. Density of population is 938 people per km². Crude rate of total population change - 1.2%. Purchasing power standard (PPS) is 29.300.0. Gross domestic product in 20013 was 63.219 billion euro, and 22 500 per capita.

Municipal waste generated in 2013 was 1 287,598 thousand tonnes (Eurostat).

Total wood waste in generated in region was 67 236t which was 0,81% of total waste in region.

Chart 6. Wood waste source in Lisboa



Considering the source of wood waste (chart 6) in the region, commercial and industrial generated most of wood waste (41 587 t), second was others source (18 757t), next municipal (3 868 t) and the last one construction and demolition (3 023t)

In Lisboa only 83t of wood waste was classified as hazardous waste, rest (67 153t) as non-hazardous waste.

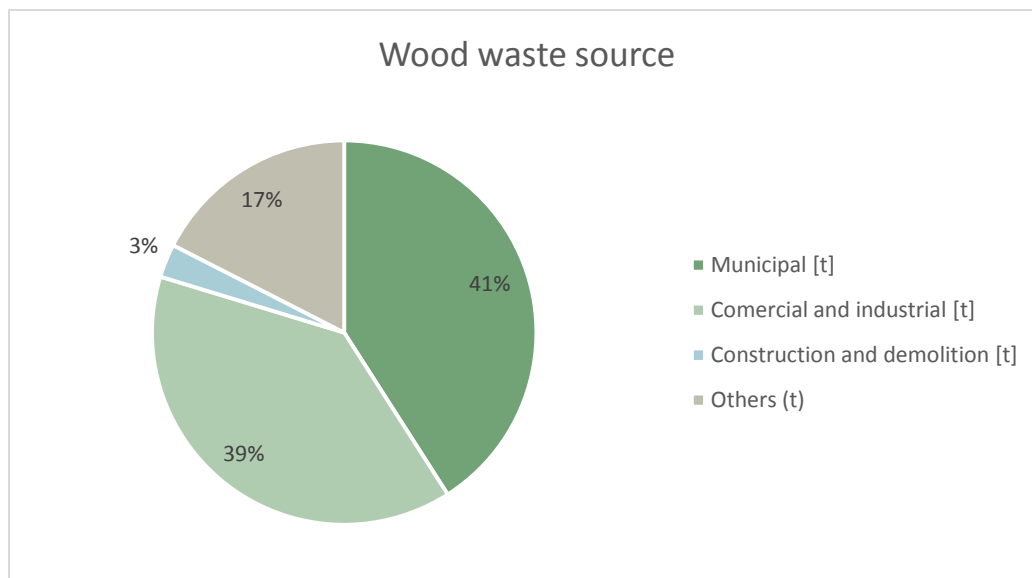
Alentejo is a region in the central and southern part of Portugal. NUTS2 id PT18. The area is 26 000km² (its 1/3 of Portugal), population according to Eurostat is 724 391. Purchasing power standard (PPS) is 19.300.0. Crude rate of total population change - 12.3%.

Municipal waste generated in 2013 was 360.775 thousand tonnes (Eurostat).

Total wood waste in generated in region was 26 727t which was 0,81% of total waste in region.



Chart 7. Wood waste source in Alentejo



Considering the source of wood waste (chart 7) in the region, municipal generated most of wood waste (10 942 t), second was commercial and industrial (10 359t), next other source (3 023t) and the last one construction and demolition (753t)

In Alentejo only 21t of wood waste was classified as hazardous waste, rest (26 706t) as non-hazardous waste.



4.2 MODEL REGIONS

4.2.1 VÄSTSVRIGE; GOTHENBURG (SE).

Västsvrige is a region in the west part of Sweden. NUTS2 id SE23. The area is 29 399km², population according to Eurostat is 1 963 466. Density of population: 62 people on km². Crude rate of total population change 14.4%.

Purchasing power standard (PPS) is 32.500.0. The biggest city in the region is Goteborg (population of 447 thousand people).

There is no data about wood waste available for Västsvrige region.

In Sweden total wood waste generated in 2014 amounted at 1 200 000 tonnes (West treatment Report, Sweden 2016).

There is no data about the percentage of wood waste in total waste.

Renova is a waste and recycling company, owned by 10 municipalities surrounding Göteborg. Household waste from these municipalities is treated at Renova, as well as is industrial and commercial waste from these communities and others.

Mixed wastes of larger sizes go to sorting plants where wood is sorted and passed on to suitable recycling.

Table 5. *Handled wood waste at Renova in 2015*

	To Renova	From Renova to external recycling	Main type of recycling
Fresh larger wood sized >25 cm diameter	400		Waste to Energy
Twigs and other smaller sized fresh wood	9.000		Composting and Waste to Energy
Impregnated wood	19.000		Waste to Energy
Treated wood painted	38.000	30.000	Waste to Energy plant and other Energy production plants such as paper mills and biomass energy plants
Untreated wood Not painted	3.000	4.000	other Energy production plants such as paper mills and biomass energy plants
Wood waste in mixed smaller fractioned waste	NA	NA	Waste to energy



4.2.2 VORARLBERG; STYRIA (AT)

Vorarlberg is a region in the west part of Austria. Borders with 3 countries (Switzerland, Lichtenstein and Germany) and from the east with the Tyrol region. NUTS 2 id AT34. The area is 2 601,48 km², population according to Eurostat 383 657. Density of population is 145 people per km². Crude rate of total population change 14.8%. Purchasing power standard (PPS) per inhabitant is 38.200.0. The capital of the region is Bregenz (population 28 thousand people).

In fact, there is no data available about the percentage of wood waste in total waste. However, it is known that in Austria 1.89% of waste are wood waste.

Total wood waste collected in region was 157 300 t. 149 400t was classified as clean solid wood, 7 900t as treated solid wood (Federal Waste Management Plan 2017).

Chart 8. Wood waste source in Vorarlberg



Considering the source of wood waste (chart 8) in the region, construction and demolition generated most of wood waste (38 709t), second was municipal (7 973t), and the last Commercial and industrial (1 335t).

Styria (Steiermark) is a region in the southern part of the country. Borders with Slovenia. NUTS2 id is AT22. The area is 16 401.04 km². Population according to Eurostat 1 230 756. Density of population is 74 people per km².

Total wood waste collected in region was 48 017 t. 9 246t was classified as clean solid wood, 38 711t as treated solid wood (Federal Waste Management Plan 2017; Annual Styrian Waste Management Plan 2015).



Chart 9. Wood waste source in Styria



Considering the source of wood waste (chart 9) in the region, construction and demolition generated most of wood waste (124 800t), second was municipal (19 600t), and the last Commercial and industrial (12 900t).

4.2.3 KARLSRUHE; BADEN-WÜRTTEMBERG (DE).

Karlsruhe is one of the north- western regions in Baden-Württemberg. NUTS2 id DE12. The area is 6 919.17 km², population according to Eurostat 2 761 977. Density of population is 400 people per km². Crude rate of total population change - 14.8%. Purchasing power Standard (PPS) per inhabitant is 38.600.0. The biggest city is Karlsruhe.

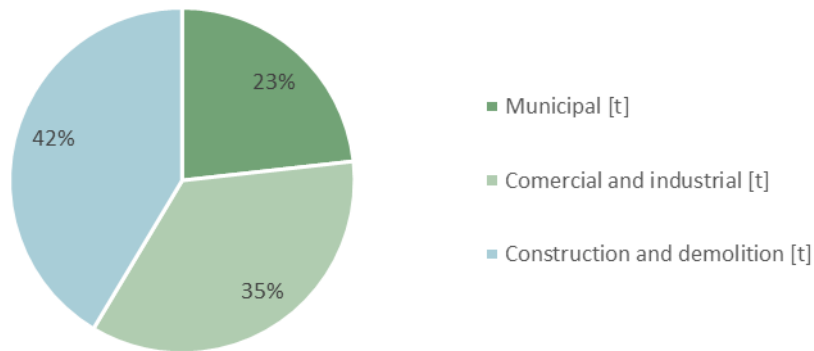
The region in 2013 generated 1 268.9 thousand tonnes of municipal waste based on Eurostat data.

On the basis of data from DEMOWOOD (extrapolation) total wood waste in 2015 in the region amounted to 949 000 tonnes.

There is no data available about percentage of wood waste in total waste.



Chart 10. Wood waste source in Karlsruhe



Considering the source of wood waste (chart 10) in the region, construction and demolition generated most of wood waste (385 400 t), second was Commercial and industrial (329 000 t) and the last municipal (216 200 t).

At least 250 000 tonnes of waste wood are steered towards 4 biomass plants located in Khel and Ulm. The rest of the generated wood waste is valorised as fraction of "refuse derived fuel" (rdf) in waste-to-energy plant and in material recycling (panel industry) (source CEDEN). In Baden-Wurtemberg, no wood waste is disposed in landfills, hence, it is used for production of wood panel or for energy.



4.2.4 LOMBARDY, EMILIA-ROMAGNA, (IT).

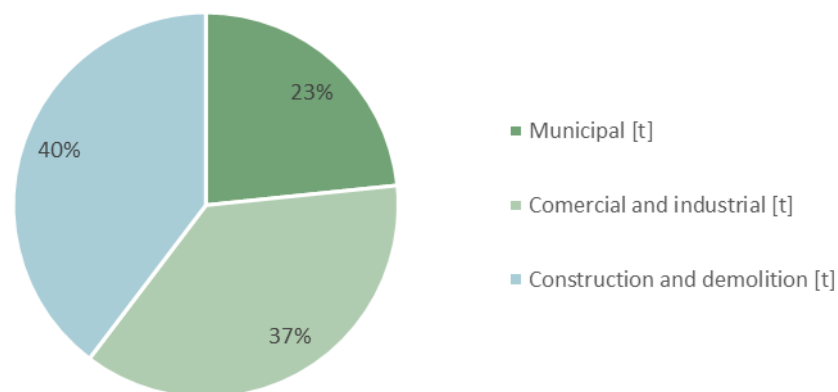
Lombardy is a region in the north of Italy. It borders with Switzerland in the north. NUTS2 id ITC4. The area is 23 816 km², population based on Eurostat 10 008 349. Density of population is 397 people per km². Crude rate of total population 0.6%. Purchasing power standard (PPS) per inhabitant 32.200.0. The biggest city is Milan.

Region in 2013 generated 4 594,69 thousand tonnes of municipal waste based on Eurostat data.

Total wood waste in 2015 in the region was 721 322 tonnes.

There is no data available about percentage of wood waste in total waste.

Chart 11. Wood waste source in Lombardy



Considering the source of wood waste (chart 11), in the region construction and demolition generated most of wood waste (286 090t), second was Commercial and industrial waste (266 721t) and the last municipal (168 500t).

There is no data about wood waste recovery.

Emilia-Romagna is a region in the north of Italy. NUTS 2 id ITH5. The area is 22 454.78 km², population based on Eurostat 4 448 146. Density of population is 198 people per km². Crude rate of total population -0.5% . Purchasing power standard (PPS) per inhabitant 34.700.0. The biggest city is Bologna (population 386 thousand people).

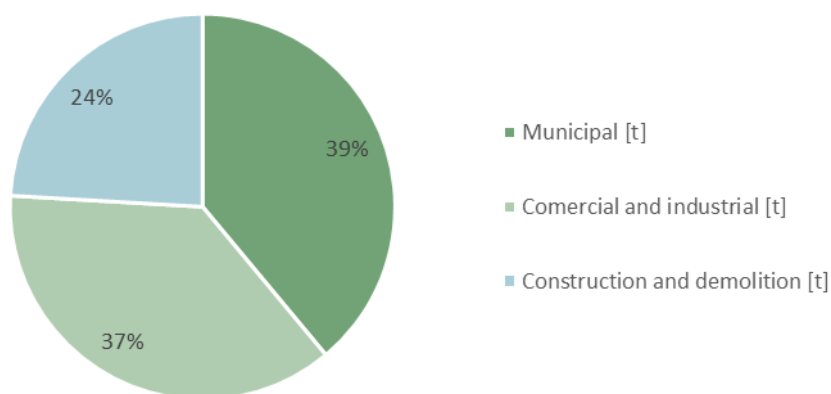
Region in 2013 generated 2 780,3 thousand tonnes of municipal waste based on Eurostat data.

On the basis of data from DEMOWOOD/ EUwood (extrapolation) total wood waste in 2015 in the region was 721 322 tonnes.

There is no data available about percentage of wood waste in total waste.



Chart 12. Wood waste source in Emilia- Romagna



Considering the source of wood waste (chart 12) in the region, municipal waste constituted most of wood waste (123 600 t), second was construction and demolition (117 357 t) and the last Commercial and industrial (76 420 t).

There is no data about wood waste recovery but according to the state of art carried out in these two regions as a part of BIOREG, waste wood is mainly valorised in panel industry (very present in the area) and the one in Europe which uses the high rate of recycled wood for the production of wood panel. There are no identified biomass plants using waste wood in the two regions, but some waste-to-energy plants using RDF, and, therefore, a part of waste wood.

In Italy, landfill is still widely used for municipal and industrial waste but the panel industry takes steps in order to collect as much waste wood as possible, included from France for Northern Italy. Indeed, Northern Italy is the heartland of the Italian particleboard industry, with many producers well positioned to source from France. Some of the largest of these have established railway infrastructure to transport wood waste over long distances and have regular deliveries from the neighbouring countries.

4.2.5 NORTH WEST ENGLAND (UK).

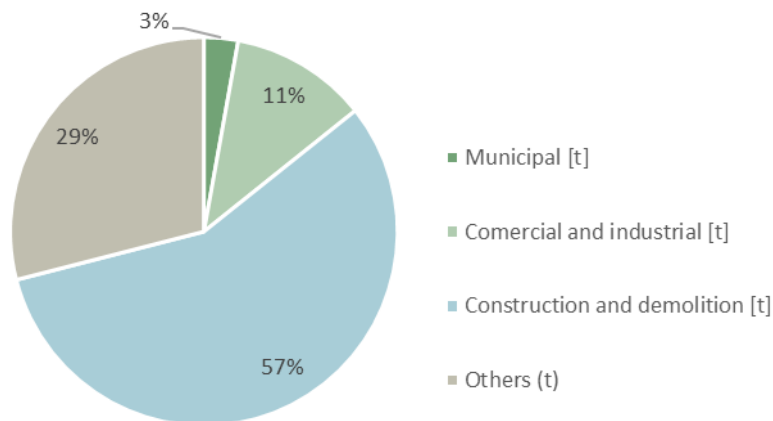
North West England is one of nine regions in England. NUTS 1 id is UKD. The area 14 165 km², population according to Eurostat 7 187 231. Density of population is around 500 people on 1 km². Crude rate of total population changes 4.3%. Purchasing power Standard (PPS) per inhabitant 25.200.0. Gross value added 231 billion-pound, 18 438 pound per habitant. There are 2 cities with more than 400k inhabitants- Manchester and Liverpool. Region has 3 National Parks and 3 areas of Outstanding Natural Beauty.

On the basis of data from literature review total wood waste in 2015 in the region amounted at 542 900 tonnes.

There is no data available about percentage of wood waste in total waste.



Chart 13. Wood waste source in North West England



Considering the source of wood waste (chart 13) in region, construction and demolition generated most of wood waste (254 100 t), second were other sources (125 300 t), next commercial and industrial (49 500 t) and the last one municipal (12 300 t).

In the United Kingdom, total wood waste generated was 4 572 900 t. 3 330 000 tonnes of wood waste are classified as solid wood (1 426 600 t as clean solid wood, and 1 903 400 t as treated solid wood). Total reconstituted wood amounted at 4069700 t.

There is no data about wood waste recovery.

North West England consists of five NUTS2 regions. Data for NUTS-2 have been calculated proportionally to the population in each region.

The most populated region is Greater Manchester (NUTS2 id Ukd3)- 2 765 142 people. Total municipal waste generated in 2011 based on Eurostat data was 1 233.04 thousand tonnes. Total wood waste generated was 208 869.8. Considering wood waste source in the region, construction and demolition generated most of wood waste (94 297.28 t), second were other sources (48 206.64 t), next commercial and industrial (19 044.13 t) and the last one municipal (4 732.18 t).

According to Eurostat, population of Lancashire (NUTS-2 id Ukd4) is 1 479 227. Total municipal waste generated was 740.63 thousand tonnes. Wood waste generated was 111 736t. Considering wood waste source in the region, construction and demolition generated most of wood waste (50 444.81t), second were other sources (25 788.39t), next commercial and industrial (10 187.75t) and the last one municipal (2 531.5t).

The second most populated region is Merseyside (NUTS2 id Ukd7)- 1 526 142 people. Total wood waste generated was 115 279.8. Considering wood waste source in the region, construction and demolition generated most of wood waste (52 044.72 t), second were other sources (26 606.3 t), next commercial and industrial (10 510.87 t) and the last one municipal (2 611.8 t).



The largest but the least populated region is Cambria (NUTS2 id Ukd1) 497 677 inhabitants. Total municipal waste generated was 271.1 thousand tonnes. Wood waste generated was 37 592.9t. Considering wood waste source in the region, construction and demolition generated most of wood waste (16 971.85 t), second were other sources (8 676.35 t), next commercial and industrial (3 427.6 t) and the last one municipal (851.7 t).

Cheshire is NUTS2 region (id Ukd6) in the southern part of North West England, population is 919 043 people. Total wood waste generated amounted at 690421.5t. Considering wood waste source in the region construction and demolition generated most of wood waste (31 341.34 t), second were other sources (16 022.32 t), next commercial and industrial (6 329.65 t) and the last one municipal (1 572.82 t).



5 THEORETICAL WOOD WASTE POTENTIAL IN EU

5.1 WOOD WASTE FROM MUNICIPAL WASTE

Based on 2006 IPCC Guidelines for National Gas Inventories the amount of wood waste depends on the region. In the Northern part of Europe (Denmark, Finland, Iceland, Norway, Sweden) 10% of MSW are wood waste, in the Eastern part (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia) it is 7.5%, in Southern Europe (Cyprus, Greece, Italy, Malta, Portugal, Spain, Turkey) 10.6%, the highest amount of wood waste is in the Western Part of Europe (Austria, Belgium, France, Germany, Ireland, Luxemburg, Netherlands, Switzerland, United Kingdom) 11%.

According to Phylis2 data base wood waste (as received, material in natural form) Lower Heating Value (LHV or net calorific value- NCV) is 15.67MJ/kg.

5.1.1 METHOD

$$TP_CDW_{x,y, mass} = CDW_{a,x,y} * WC_x$$

$$TP_CDW_{x,y, energy} = CDW_{a,x,y} * WC_x * LHV$$

$TP_CDW_{x,y, mass}$ – theoretical biomass potential of wood waste of country x in y year (thousand tonnes/year)

$TP_CDW_{x,y, energy}$ – theoretical biomass potential of wood waste of country x in y year (J/ year)

$CDW_{a,x,y}$ – municipal solid waste (MSW) in country x in year y

$*WC_x$ – Wood content in MSW

LHV – lower heating value of wood waste

x –country

y- Year

5.1.2 RESULT

The total assessed theoretical potential of wood waste from municipal wastes amounts at: 22.58 Mt. Average value for NUTS is 85.5 kt. There are 74 NUTS-2 where the biomass potentials are over 100 kt. The highest potential of biomass was found in NUTS-2: FR10 (Ile de France) 608.82 kt, but the highest density of biomass was calculated for UKI1 (Inner London) 608.9 t/km².



Figure 2. Theoretical biomass potential of wood waste

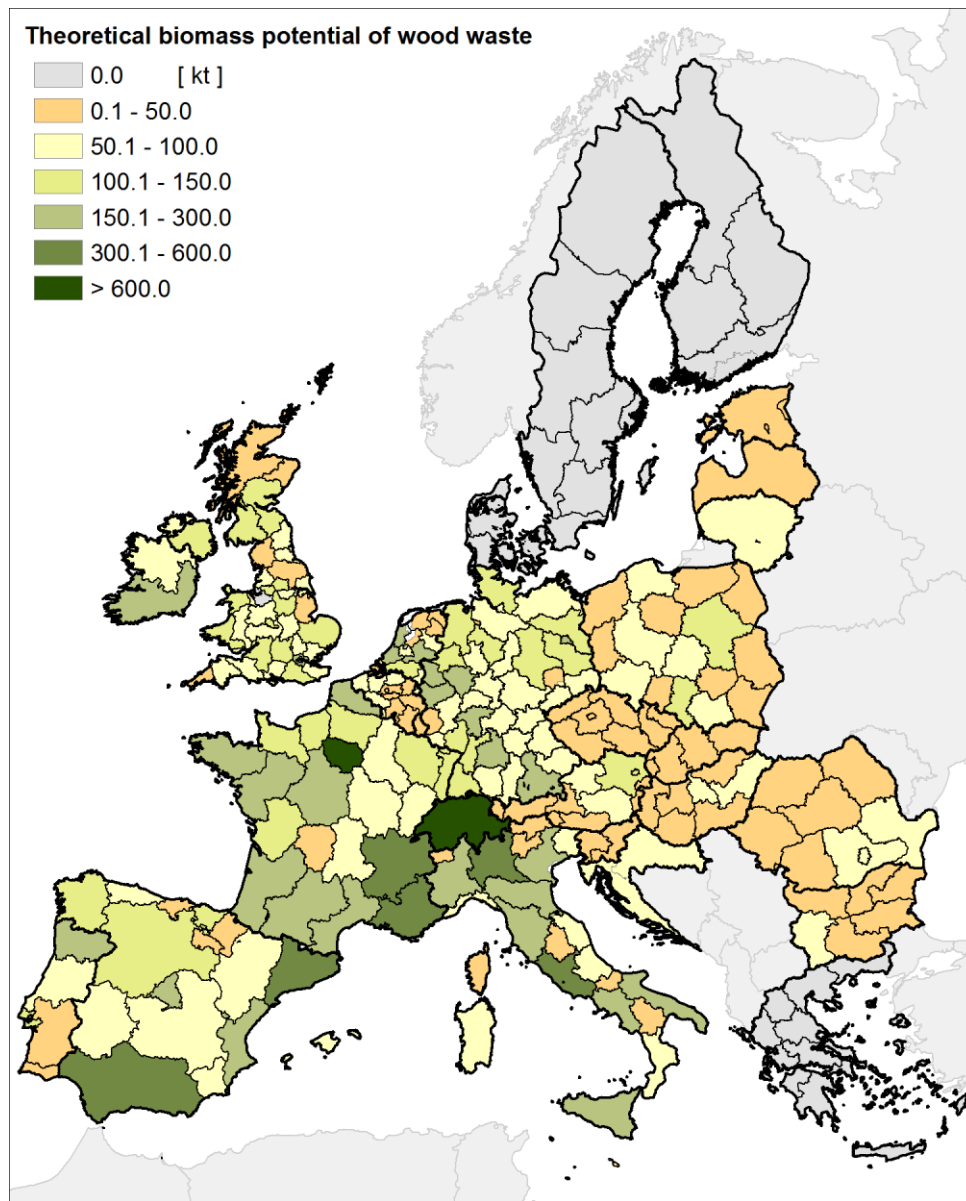
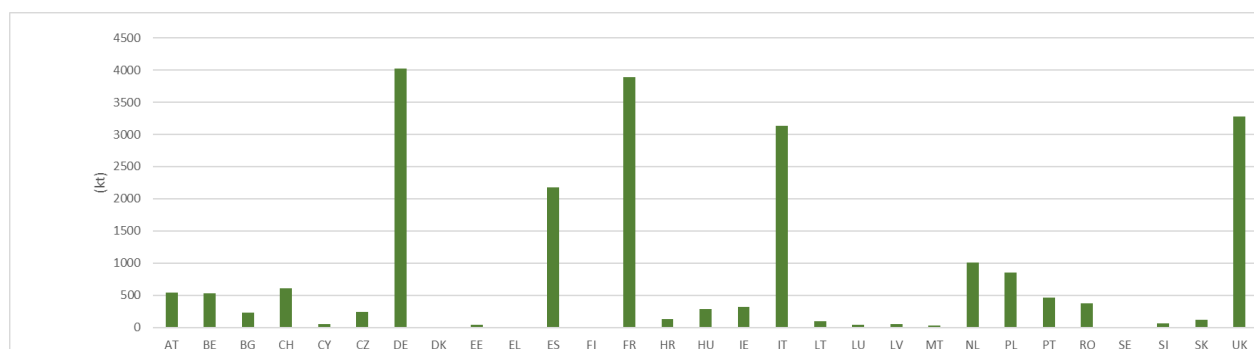


Chart 14. Theoretical potential of wood waste.



The highest theoretical potential of biomass from wood waste (chart 14) is in countries like Germany, France, United Kingdom, Italy, Spain. Those countries generated the biggest amount of waste which affected the quantity of wood waste. Analogically, small countries which generated little amount of waste have low potential like Malta, Luxemburg, Estonia. There is no data available for Denmark, Greece, Finland and Sweden.

5.2 DEMOLITION AND CONSTRUCTION WOOD

5.2.1 SCOPE AND DEFINITIONS

The scope of this activity was to assess the potential of demolition and construction wood.

5.2.2 METHOD

$$TP_CDW = P * PCDW$$

Where:

TP_CDW - Theoretical potential of construction and demolition wood of country

POP - population

PCDW - production of construction and demolition wood (kg per capita)

Table 6. Data sources of demolition and construction wood

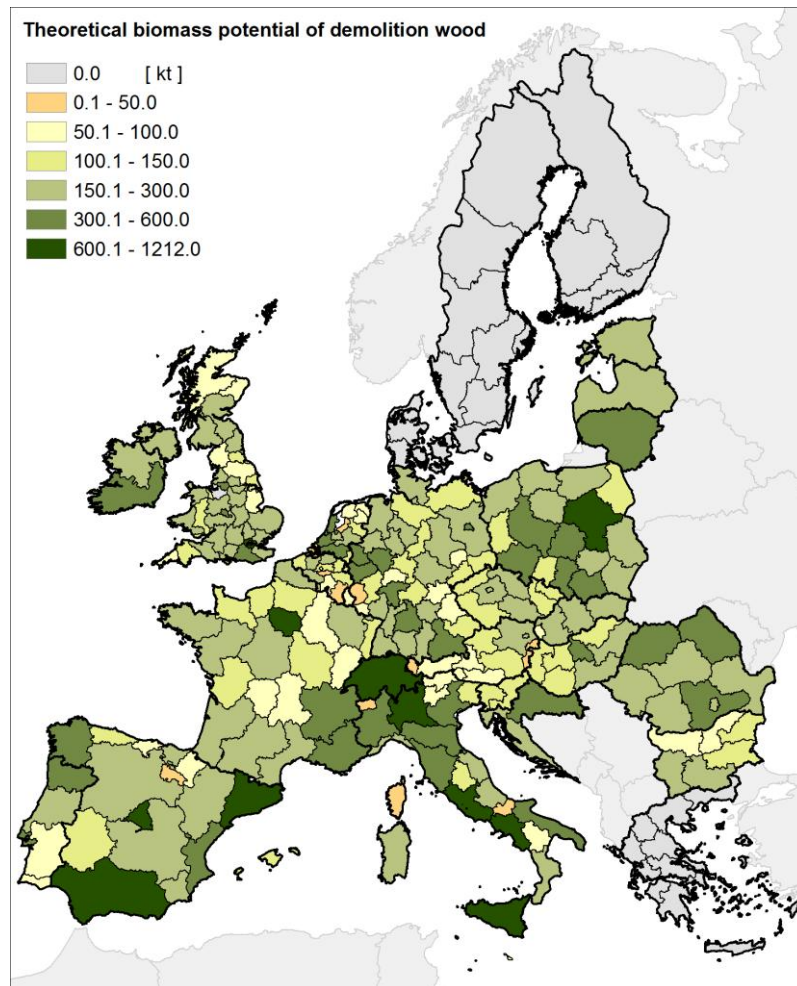
Indicator	Source	Location
PCDW	DEMOWOOD	Own sources
POP	Esri; Michael Bauer Research GmbH	http://www.arcgis.com/home/item.html?id=cf3c8303e85748b5bc097cddb5d39c31



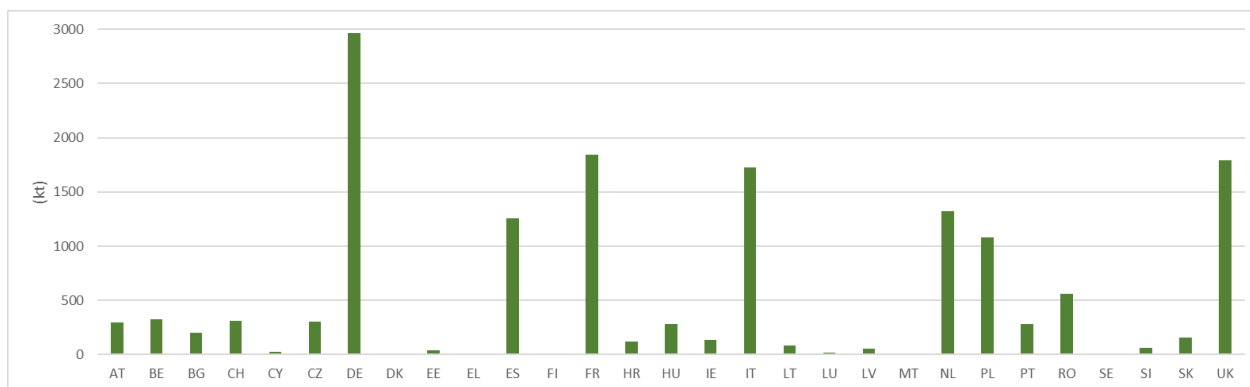
5.2.3 RESULT

The total assessed potential of demolition and construction wood amounts at: 51,0 Mt. Average value for NUTS2 is 188.95 kt. There are 184 NUTS-2 where the biomass potentials are over 100 kt. The highest potential of biomass was found in NUTS-2: ITC4 (Lombardia); 1211.01 kt, but the highest density of biomass was calculated for UKI1 (Inner London); 1324.63 t/km².

Figure 3. Theoretical biomass potential of wood waste



Theoretical potential of demolition and construction wood.



The highest theoretical potential of biomass from demolition and construction wood (chart 15) is in countries like Germany, Italy, United Kingdom, Spain, France, Poland, Netherlands. Those countries generated the biggest amount of construction and demolition waste which affected the quantity of wood waste. Analogically, small countries which generated little amount of waste have low potential like Malta, Luxembourg, Estonia. There was no data for Denmark, Greece, Finland, Sweden.

5.3 BIO-WASTE OF WOOD INDUSTRY BY-PRODUCTS

5.3.1 SCOPE AND DEFINITIONS

The scope of this activity was to assess the potential of wood industry by-products for bioenergy use. The data about wood industry waste was obtained from the Renew project. The potential of biomass from wood industry is grouped in four fractions:

- by-products from sawmills,
- by-products from pulp and paper industry,
- by-products from board industry,
- by-products from other wood processing industries.

The method of theoretical potential assessment was based on specific factors, which allowed conversion of input data from the international database into amounts available for BtL uses. The estimation was based on the areas covered by forest available for wood supply, net annual increment and felling rates specific for each European country (TB FRA, 2000; TB FRA, 2005). The values of regional specific factors, which were not possible to derive from the database, were taken from literature or relevant experts. If it was not possible to define the factors on a national level, the average value for Europe was used.

In order to assess the technical potential available for BtL the theoretical potential was reduced. Ecological restrictions are necessary for proper and sustainable functioning of forest ecosystem. Various difficulties make it technically or economically impossible to harvest and supply the residues (small, scattered felling areas, slopes,



etc.). Finally, part of the harvestable residues is utilized by wood industry, like the fibreboard industry, and must be excluded from the total available potential for BtL if the rule that food and fibre production cannot be affected is applied.

The forestry potentials estimates were performed for three RENEW scenarios: SP, S1 and S2, which were described in the chapter 2. 'Forest residues'.

Due to the fact that fibre production cannot be affected, for each scenario wood demand for wood industry is taken into consideration.

5.3.2 METHOD

The result of the Renew project assessed for NUTS 0 were downscaled to NUTS-2 level by using land cover raster map (CLC) as information on the most probable spatial distribution. Downscaling assumes that forestry residuals are proportional to forest areas in NUTS-2 regions.

Downscaling for wood industry assessment - Formula 16:

$$WI_N2 = FR_N0 * CLC_{Forest_N2} / CLC_{Forest_N0}$$

Where:

WI_N2 = assessed wood industry for NUTS-2

WI_N0 = wood industry by RENEW for NUTS-0

CLC_{Forest_N2} = area of forest in NUTS-2(subset of CLC_{Forest_N2})

CLC_{Forest_N0} = area of forest in NUTS-0

///CLC_{Forest} = class 23 (Broad-leaved forest) + class 24 (Coniferous forest) + Class 25 (Mixed forest) of Corine land cover

Table 7. Data sources of wood industry residues

Indicator	Source	Location
WI_N0	RENEW Project	http://www.renew-fuel.com/fs_documents.php
CLC _{Forest_N2} CLC _{Forest_N0}	EEA: CORINE	http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster-2

5.3.3 RESULT

The total assessed feedstock potential of Wood industry amounts at: 5.59 Mt (56 PJ). Average value for NUTS2 is 20.8 kt. There are 127 NUTS-2 where the biomass potentials are over 10 kt. The highest potential of biomass was found in NUTS-2: FI1D (Pohjois- Jalta-Suomi); 512.19 kt, but the highest density of biomass was calculated for BE34 (Prov. Luxembourg (BE)); 5.54 t/km².



Figure 4. Technical biomass potential of wood waste from industry

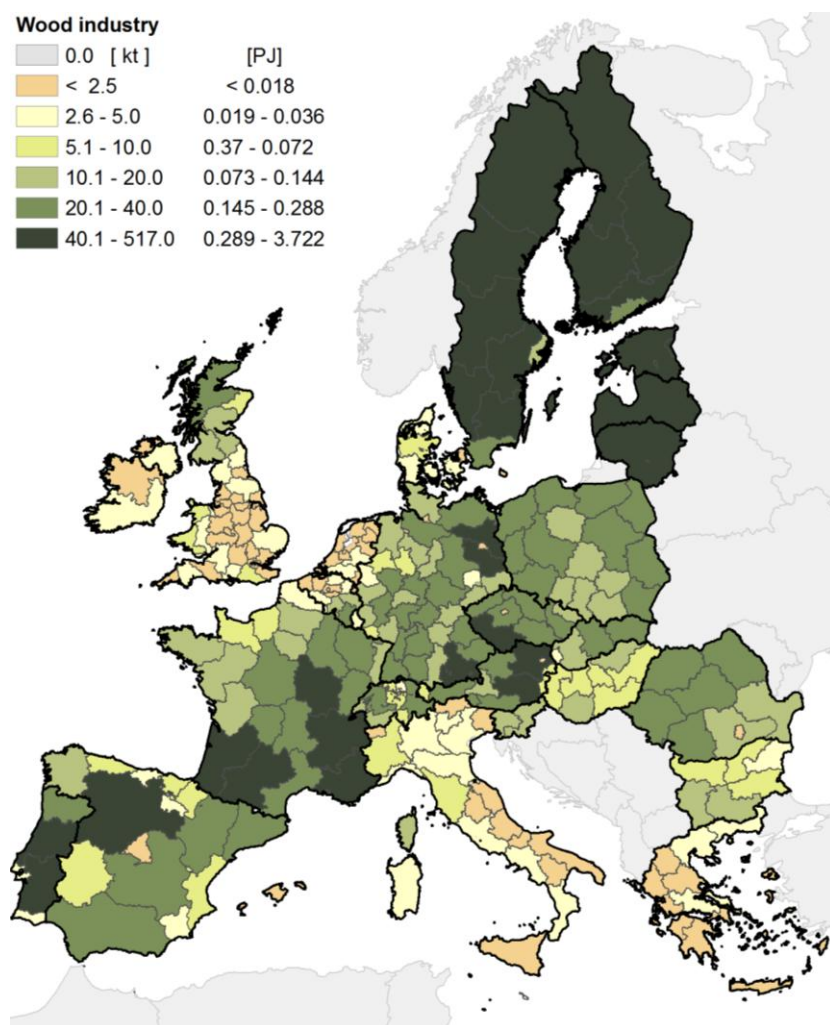
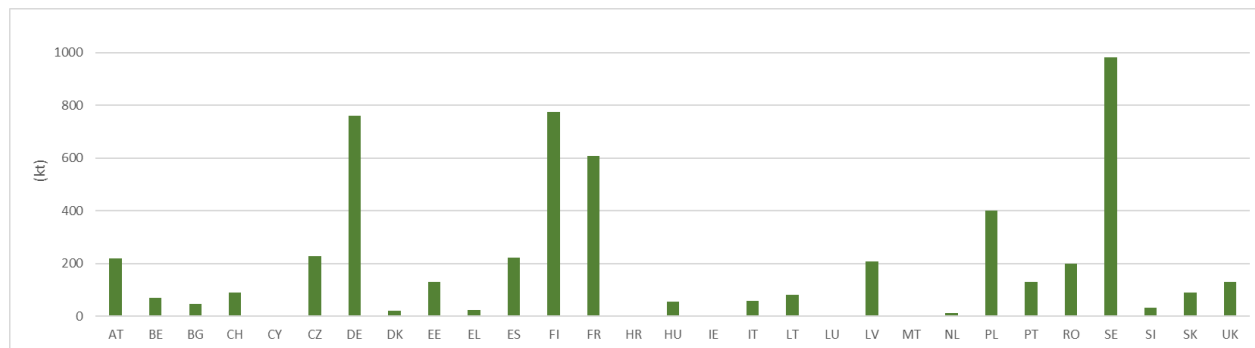


Chart 15. Technical potential of wood waste from wood industry.



The highest technical potential of biomass from wood industry waste (chart 16) is in countries like Sweden, Finland, France Germany. Those countries has well developed wood industry and large forest area which affected the quantity of wood waste. Analogically, small countries which wood industry are not so good developed have low potential like Luxemburg, Slovenia. There is no data available for Malta, Hungary and Cyprus.

6 WASTE WOOD TREATMENT

According to Eurostat data (chart 17) in 2016 54,76 million tons of wood waste were generated in EU countries, witch over 48 million of that was treated, which is 88%.

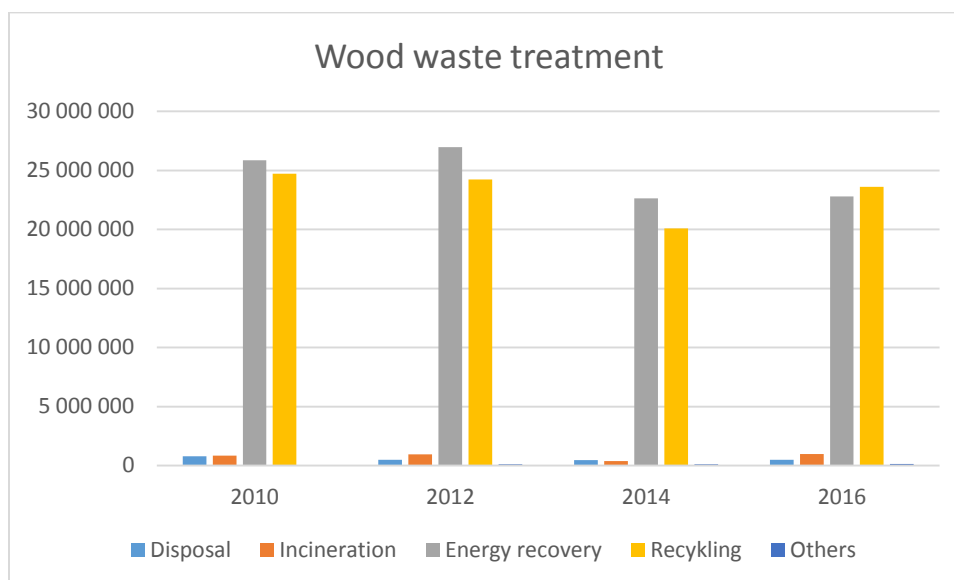
Chart 16. Waste wood generation and treatment in EU.





Chart below shows values of different kind of wood waste treatment in EU. As we can see the most popular way of dealing with waste wood is energy recovery and recycling. In 2016 recycling reach higher value that energy recovery.

Chart 17. Wood waste treatment



What we can observe is that disposal of wood waste is on low level. But still there is some wood waste which can be treated in different way. Please note that still not all wood wastes are recovered. In addition, it should be remembered that large part of wood waste is not collected and segregated, and some are used in households in an



inappropriate way (combustion in home heating systems like open fireplaces) or burnt outdoor in demolition or construction sites. All this represents unused wood waste potential and because of lack of data is hard to completely be characterized.

Table and maps thereafter show data about wood waste treatment in individual EU countries. There are several categories of wood waste treatment, but most common is energy recovery and recycling (panel board industry). It is worth noting the fact that in some countries, level of wood waste treatment is higher than their production, because of import of wood waste. This is related to the fact that large proportion of wood waste is not a real waste; they are still suitable for use as a full value product or as by-products.



GEO/WST_OPER	Waste treatment	Disposal - landfill and other (D1-D7, D12)	Disposal - landfill (D1, D5, D12)	Disposal - incineration (D10)	Disposal - other (D2-D4, D6-D7)	Recovery - energy recovery (R1)	Recovery - recycling and backfilling (R2-R11)	Recovery - recycling	Recovery – backfilling
European Union	48 010 000	490 000	490 000	970 000	0	22 800 000	23 750 000	23 600 000	150 000
Belgium	1 310 319	65	65	61 967	0	495 362	752 925	752 925	0
Bulgaria	307 518	636	626	466	10	185 603	120 813	120 813	0
Czech Republic	308 280	4 812	4 812	251	0	21 476	281 741	281 118	623
Denmark	330 742	2 228	2 228	0	0	50 401	278 113	278 113	0
Germany	10 802 911	0	0	2 351	0	8 113 985	2 686 575	2 686 575	0
Estonia	379 492	236	236	0	0	200 048	179 208	178 901	307
Ireland	127 962	4 310	4 310	0	0	42 121	81 531	69 439	12 092
Greece	59 675	40 959	40 959	0	0	5 496	13 220	13 220	0
Spain	1 069 621	17 646	17 646	0	0	74 429	977 546	977 546	0
France	6 412 266	315 004	315 004	95 810	0	1 733 861	4 267 591	4 267 591	0
Croatia	18 332	1 086	1 086	0	0	4 562	12 684	12 684	0
Italy	4 883 725	707	707	2 379	0	874 182	4 006 457	4 006 440	17
Cyprus	7 732	5 415	5 415	0	0	130	2 187	2 187	0
Latvia	13 403	4 429	4 429	0	0	6 700	2 274	2 232	42
Lithuania	97 159	1 586	1 586	0	0	16 335	79 238	79 238	0
Luxembourg	35 538	0	0	0	0	34 688	850	850	0
Hungary	217 840	532	532	119	0	16 051	201 138	201 138	0
Malta	8 850	8 829	8 829	0	0	0	21	21	0
Netherlands	2 277 404	49 257	49 257	1 930	0	1 323 079	903 138	903 138	0
Austria	1 263 759	0	0	114	0	424 212	839 433	839 433	0
Poland	3 607 312	32	32	236	0	1 426 406	2 180 638	2 180 638	0
Portugal	129 345	1 003	1 003	223	0	4 001	124 118	124 118	0



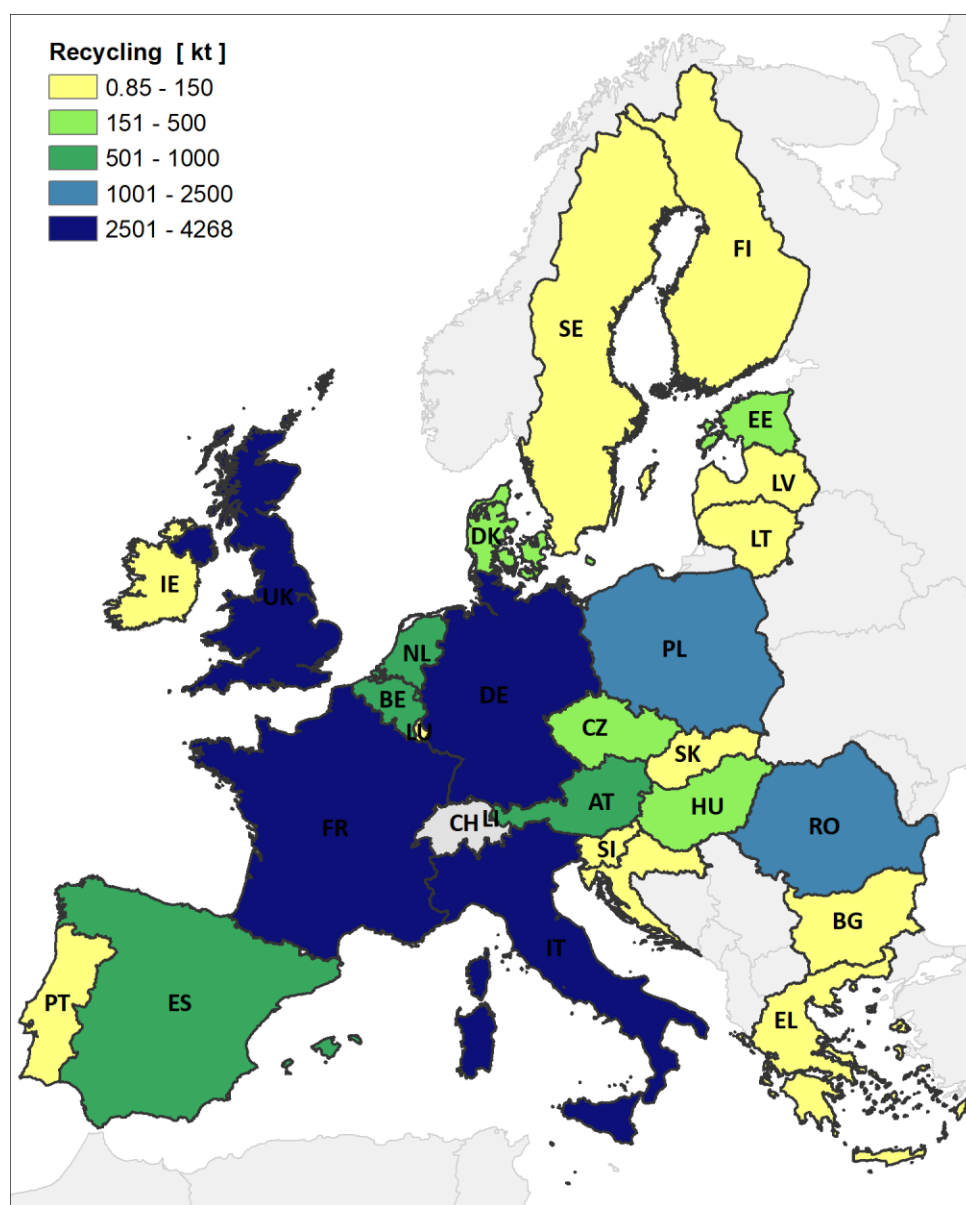
This project has received funding from the European Union's H2020 research and innovation programme under grant agreement no 727958.

Romania	3 283 896	291	291	6 079	0	1 708 745	1 568 781	1 568 781	0
Slovenia	99 406	13	13	18	0	91 881	7 494	7 494	0
Slovakia	330 708	1 853	1 849	72	4	222 396	106 387	106 387	0
Finland	3 286 631	41	41	3 205	0	3 160 819	122 566	122 566	0
Sweden	2 100 233	0	0	45 560	0	2 032 437	22 236	22 236	0
United Kingdom	3 959 847	28 291	28 291	745 645	0	609 329	2 576 581	2 439 508	137 073

Table 8. Wood waste treatment in EU countries.

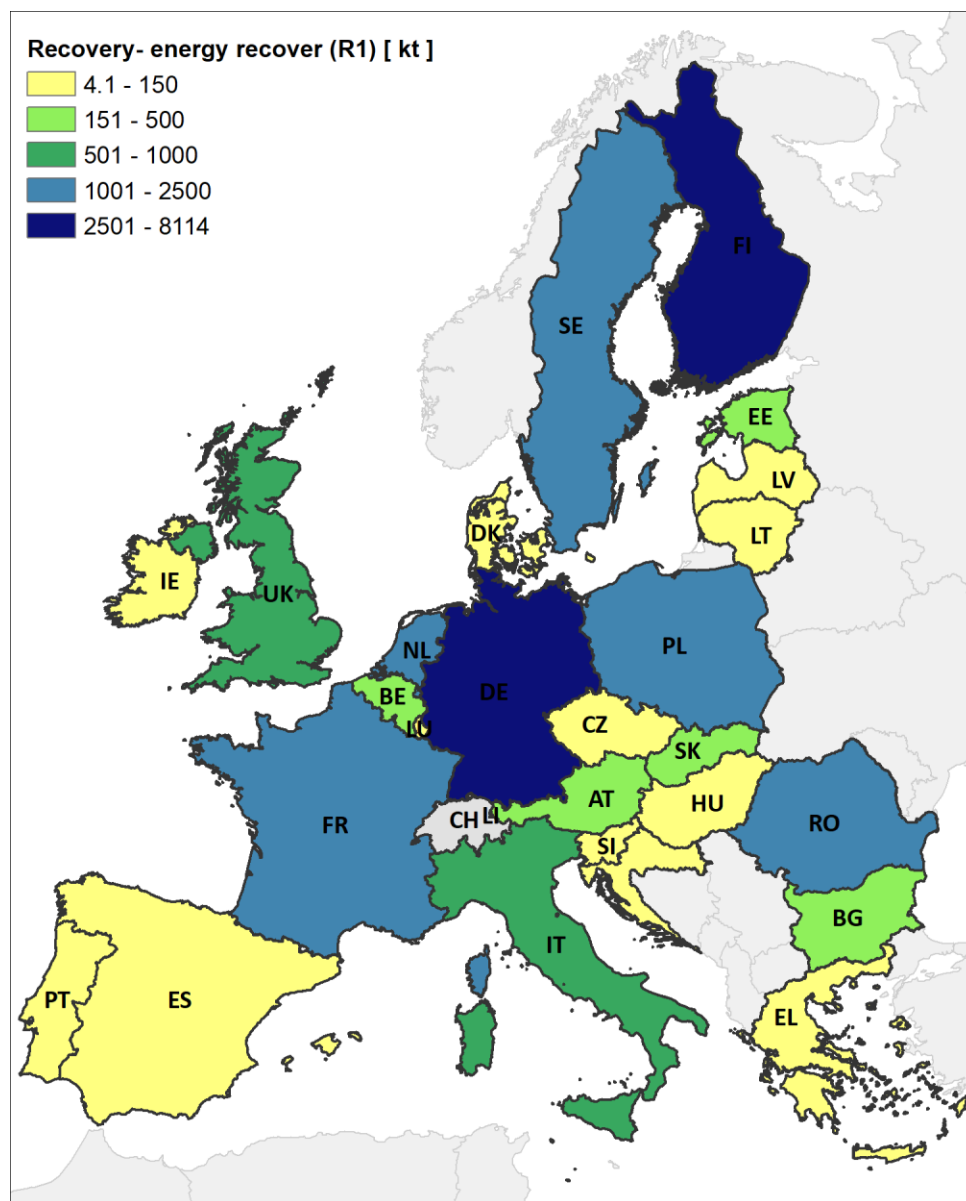


Figure 5. Recycling rates for Nuts0.



This project has received funding from the European Union's H2020 research and innovation programme under grant agreement no 727958.

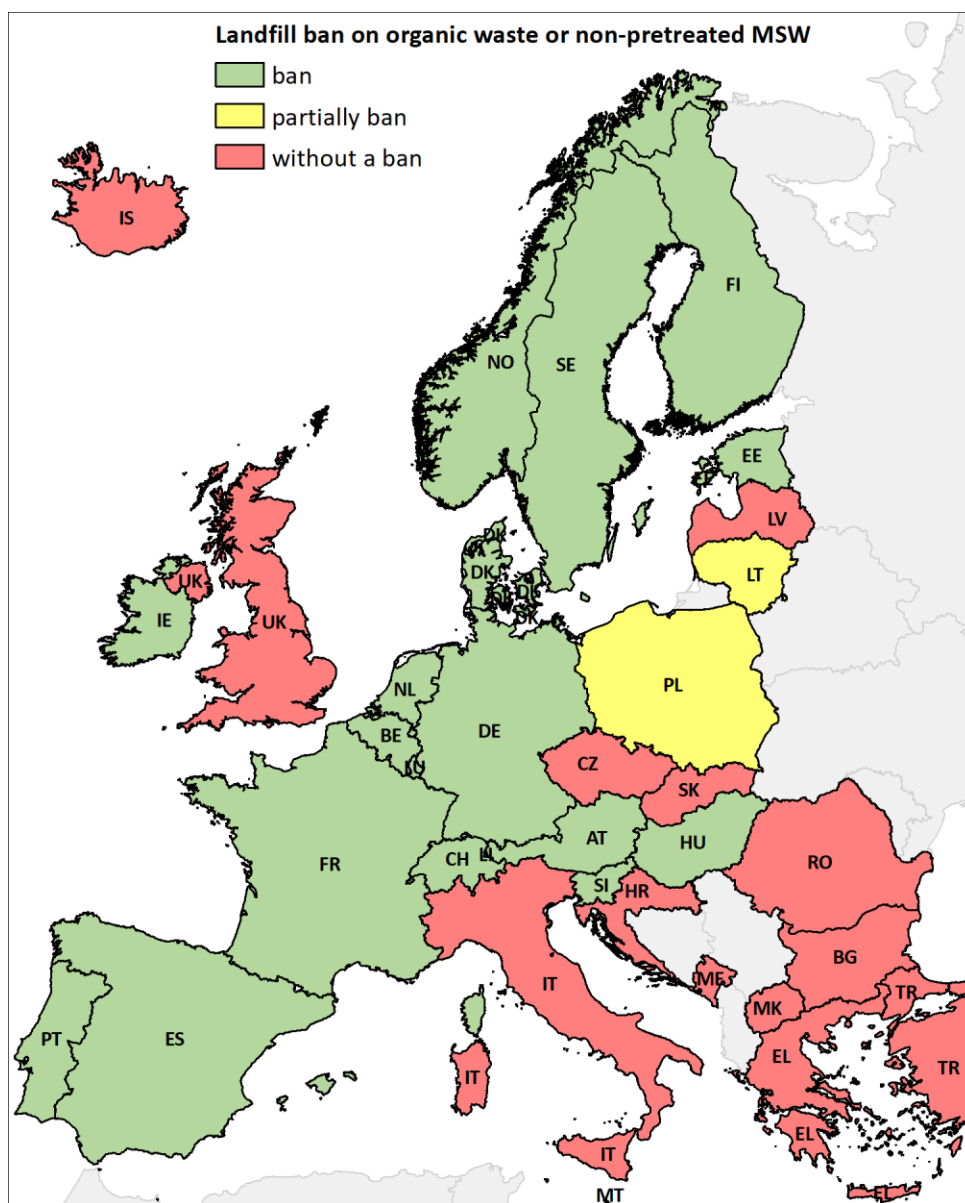
Figure 6. Energy recovery rates for Nuts0.



According to EEA data in many EU countries landfilling organic waste or non-pre-treated MSW are banned. In Poland and Lithuania only biodegradable waste is banned from landfilling. Currently in Europe you can notice trend in which less and less waste loads on landfills. Some countries, such as Germany, have decided to introduce a zero-waste policy, completely forbidding to store waste. It is important to note that ban is theoretical in some countries. In France for example, landfilling is prohibited for non-recyclable wastes “under current economic and technical conditions”: in the end, operators may justify the non-recyclable character of a waste, and resort to landfilling, and this in compliance with law. Besides, it is complicated to make out limit between pure incineration (waste treatment without energy recovery) and waste to energies plants (incinerators with high recovery valorisation rate) at European scale: therefore, it is likely that energy recovery rate is over estimated.

Figure 7. Landfill ban on organic waste or non-pre-treatment.





7 SUMMARY

Wood waste potential depends on many factors. County size, population impact of quantity of wood waste. Big country like France, Italy, Germany produced more waste than a smaller one like Malta or Estonia. Degree of

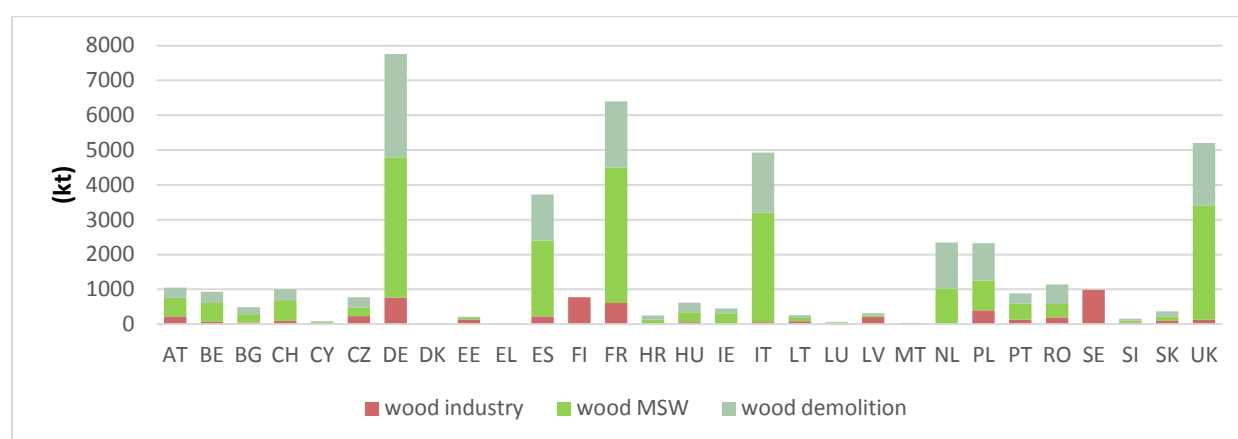


develop wood industry also affects wood waste potential. Countries with high expand of this sector (Germany, Sweden, Finland) has big potential of wood waste from industry.

The total theoretical potential of wood waste from wood industry, wood MSW (municipal solid wastes) and demolition wood (chart 19) amounts at around 45 000 kt. The highest total theoretical potential of biomass from wood waste is in countries like Germany (7 800 kt), France (6 500 kt), United Kingdom (5 200 kt) and Italy (4 900 kt).

Data from Eurostat regarding outlets for wood waste (energy, recycling, landfilling...) show orientations in terms of valorization or elimination of wood waste of the different countries in Europe and provides information on the valorization rate. However, these data don't consider, or probably minimize, certain bad practices like household heating (fireplaces) or open burning, and thus, probably overestimate the real global valorization rate.

Chart 18. Total theoretical potential of wood waste in EU.



8 LITERATURE

1. Phyllis2: database for biomass and waste. [https://www.ecn.nl/phyllis2/Browse/Standard/ECN-Phyllis#wood waste](https://www.ecn.nl/phyllis2/Browse/Standard/ECN-Phyllis#wood%20waste)
2. EUROSTAT: http://ec.europa.eu/eurostat/statistics-explained/index.php/Archive:Waste_indicators_on_generation_and_landfilling_-_monitoring_sustainable_development
3. EUROSTAT: http://ec.europa.eu/eurostat/statistics-explained/index.php/Forestry_statistics
4. EUROSTAT: http://ec.europa.eu/eurostat/statistics-explained/index.php/Packaging_waste_statistics
5. EUROSTAT: ec.europa.eu/eurostat/statistics-explained/index.php/Waste_statistics
6. Blumenthal K., 2011, Generation and treatment of municipal waste, Eurostat Statistics in focus 31/2011
7. EEA, Diverting waste from landfill, report No 7/2009
8. NL Agency, 2013, Competition in wood waste: Inventory of policies and markets
9. Forest Europe, 2015, State of Europe's Forests
10. Ministry of the environment, 2016, Waste management plan 2022
11. Statistic Office in Lublin, 2016 Gospodarka odpadami komunalnymi w województwie lubelskim w 2015 roku
12. Hoornweq D., Bhada-Tata P., 2012, What a Waste: Global review of Solid Waste Management
13. http://www.renew-fuel.com/fs_documents.php
14. Bossard M., Ferenec J., Otahel J.: CORINE land cover technical guide – Addendum 2000. EEA, Technical report No 40, Copenhagen, 2000.
15. Bossard M., Ferenec J., Otahel J.: CORINE land cover technical guide – Addendum 2000. EEA, Technical report No. 40, Copenhagen, 2000, pp. 105.
16. <http://www.letsrecycle.com/news/latest-news/recycled-wood-grades-defined-for-the-first-time/>
17. http://www.scb.se/Statistik/_Publikationer/MI0305_2014A01_BR_MI0305BR1601.pdf
18. Federal Waste Management Plan 2017, 2017, Austria
19. Annual Styrian Waste Management Plan, 2015, Austria



9 LIST OF TABLES

Table 1.	Municipal waste generated by country in selected years (kg per capita).....	9
Table 2.	Municipal waste landfilled, incinerated, recycled and composted in EU 27, 1995 to 2004.	11
Table 3.	Waste generated in 2004 – 2010 in UE27.....	13
Table 4.	Generation and recovery of selected waste streams in the EU, 2004.....	14
Table 5.	Handled wood waste at Renova in 2015.....	22
Table 6.	Data sources of demolition and construction wood.....	32
Table 7.	Data sources of wood industry residues.....	35
Table 8.	Wood waste treatment in EU countries.....	41

10 LIST OF FIGURES

Figure 1.	Case study (recipient and model regions)	17
Figure 2.	Theoretical biomass potential of wood waste.....	31
Figure 3.	Theoretical biomass potential of wood waste.....	33
Figure 4.	Technical biomass potential of wood waste from industry.....	36
Figure 5.	Recycling rates for Nuts0.	42
Figure 6.	Energy recovery rates for Nuts0.	43
Figure 7.	Landfill ban on organic waste or non-pre-treatment.	44

11 CHARTS INDEX

Chart 1.	Municipal waste treated in 2009 by country and treatment category, sorted by percentage of landfilling (% of municipal waste treated). Sources: Eurostat 2011.....	12
Chart 2.	Recovery rate for all packaging (%). Source Eurostat 2016 (env_waspac)	14
Chart 3.	Shares of packaging waste generated by weight, EU 28, 2013. Sources: Eurostat 2016 (env_waspac) ..	15
Chart 4.	Wood waste source in Normandy.....	18
Chart 5.	Wood waste source in Lubelskie	19
Chart 6.	Wood waste source in Lisboa.....	20
Chart 7.	Wood waste source in Alentejo	21
Chart 8.	Wood waste source in Vorarlberg	23
Chart 9.	Wood waste source in Styria.....	24
Chart 10.	Wood waste source in Karlsruhe	25
Chart 11.	Wood waste source in Lombardy	26
Chart 12.	Wood waste source in Emilia- Romagna	27
Chart 13.	Wood waste source in North West England	28
Chart 14.	Theoretical potential of wood waste.	32
Chart 15.	Theoretical potential of demolition and construction wood.....	34
Chart 16.	Technical potential of wood waste from wood industry.	37
Chart 17.	Waste wood generation and treatment in EU.	37
Chart 18.	Wood waste treatment	38
Chart 19.	Total theoretical potential of wood waste in EU.	46

