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IEA BIOENERGY – TASK40
Sustainable International Bioenergy Trade Securing Supply and Demand
Country Report Belgium/Flanders (2014)

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The content of this report was gathered through intensive literature study and does not necessarily reflect the opinion of the IEA Bioenergy Implementing Agreement, nor of Belgian policy makers (federal or regional level).

This report is an update of the previous report IEA BIOENERGY – TASK40 Sustainable International Bioenergy Trade Securing Supply and Demand Country report Belgium (2011)[1].

[1] http://www.bioenergytrade.org/downloads/iea-task-40-country-report-2011-belgium.pdf

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CHAPTER 1 GENERAL INTRODUCTION

1.1. GENERAL COUNTRY CHARACTERISTICS

The following table gives an overview of general country characteristics. Figures are based on 2012 data from Eurostat (http://epp.eurostat.ec.europa.eu/).

Belgium is a **small country**, with **high population density** and **low available agricultural and forest land** per capita. The country is industrialised, with **strong chemical and food processing industry**; despite the low domestic woody resources, importance of wood and paper products manufacturing is relatively high. Belgium has **high primary energy demand**, **high energy dependence** and **high focus on trade** (accessibility is an asset); quite **intensive agriculture**, with **high livestock density** (manure excess); **developed waste management**, with low landfill.

Table 1: General country characteristics of 2012 (Source: Eurostat)

1. Population and land surface		
Population:	11.1	million
Area:	30530	km²
Population density:	363	persons/km²
2. GDP and trade		
GDP at market prices:	376	billion €
	33900	€/capita
GDP (pps):	120	
Cross border movements :	214	billion €
	19300	€/capita
3. Energy		
Primary energy consumption:	48.7	million toe
	4.39	toe/capita
Energy dependence:	74.0	%
4. Agriculture		
Utilised agri area (UAA):	1334	1000 ha
	0.12	ha/capita
Productivity: cereal yield:	8.8	tonne/ha
Livestock density:	2.85	livestock units/ha
5. Forestry		
Forested land:	706	1000 ha
	0.06	ha/capita
Annual forest increment:	5.2	million m³/yr
	7.5	m³/ha/yr
	0.48	m³/capita/yr

6. Municipal waste		
Total municipal waste:	456	kg/capita/yr
Landfill:	1.1	%
Incineration:	42.1	%
Recycling:	36.2	%
Composting/digestion:	21.1	%
7. Industry relevance (turnover)		
Sawmill & wood planing:	58	€/capita
Wood products:	287	€/capita
Paper & products:	506	€/capita
Food products:	3520	€/capita
Chemical products:	3304	€/capita

1.2. GHG REDUCTION TARGETS AND REQUIREMENTS

1.2.1. BELGIUM

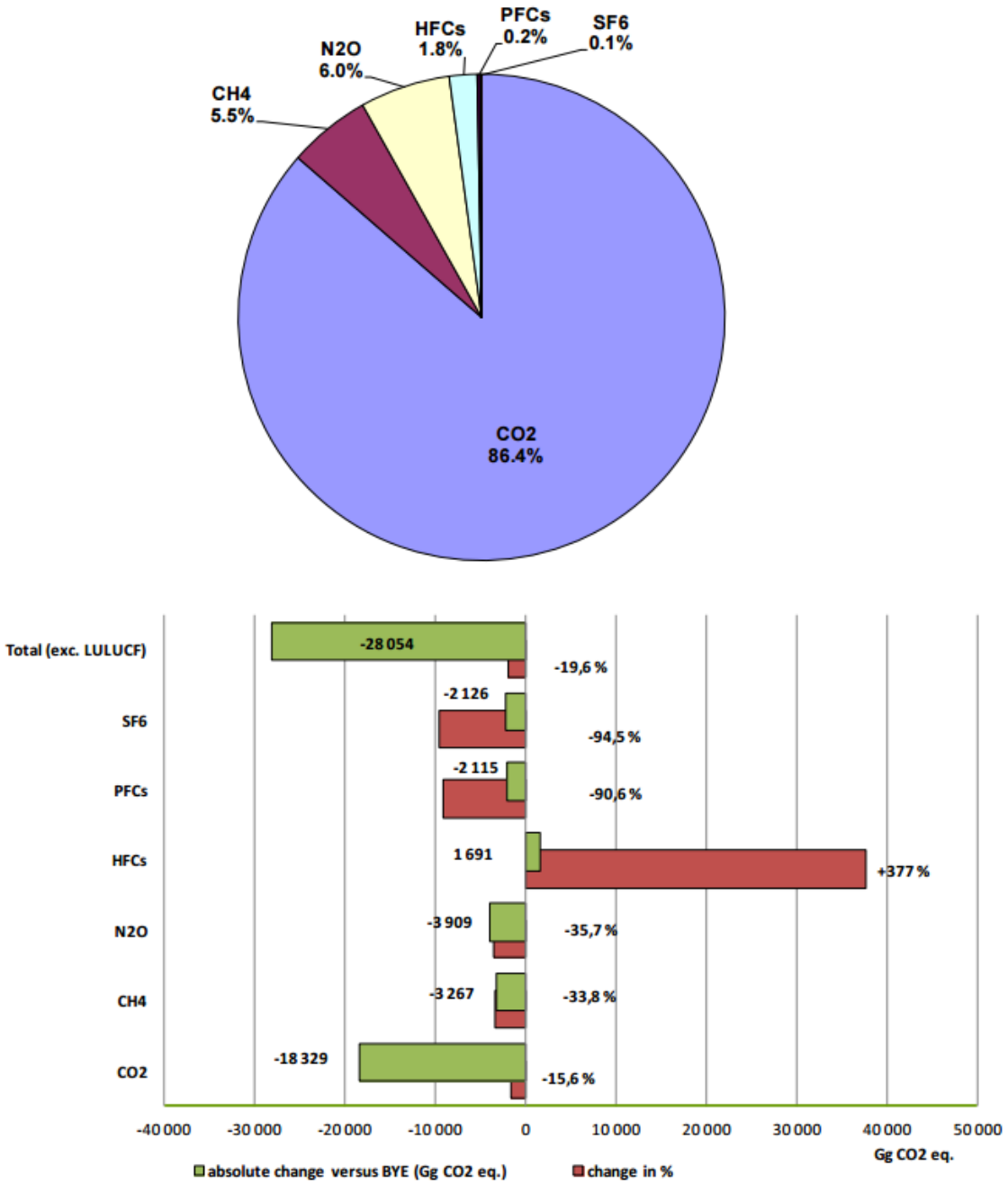
The Kyoto Protocol was signed and ratified by Belgium respectively in April 1998 and in May 2002. It entered into force in February 2005. As a country included in Annex B to this Protocol, Belgium is committed to a specific greenhouse gas (GHG) emission reduction. Under the Kyoto Protocol, the European Community pledged to reduce its GHG emissions by 8% below 1990 levels by 2008-2012. This overall target has been redistributed among the then 15 Member States, including Belgium. This redistribution, commonly called the "EU burden sharing agreement" (BDS), is laid down by Decision 2002/358/EC6 and Decision 2006/944/EC7. These decisions define for each Member State its assigned amount of GHG emissions, equal to a percentage. According to this BDS, Belgium must reduce its GHG emissions by 7,5% by 2008-2012 compared to 1990 levels. This means a reduction from 146,9 million tonne (Mt) CO2-eq. to 135,9 Mt CO2-eq. by the period 2008-2012 (source: Egmont Paper 18, The Kyoto Policy of Belgium, Karel VAN HECKE & Tania ZGAJEWSKI).

A burden-sharing agreement determined separate targets for each of the regions. The Flemish region and the Walloon region have to reduce their GHG emissions by respectively 5,2% and 7,5% while the Brussels-Capital region can increase its emissions by 3,475% compared to 1990 levels during the period 2008-2012. Taking into account this burden-sharing, Belgium assigned more emission rights to its regions than available under its Kyoto target. To compensate this deficit, it was agreed that the federal government would acquire emission allowances as a result of the use of flexible mechanisms under the Kyoto Protocol equivalent to 2,46 Mt CO2-eq. per year.

Total greenhouse gas emissions (without LULUCF) in Belgium amounted to 116.5 Mt eq. CO_2 in 2012 and to 116.7 Mt eq. CO2 (with LULUCF article 3.36). Emissions in 2012 (with LULUCF article 3.3) are 19.9 % under base year emissions (Graphic 1). Under the Kyoto Protocol and the EU 'burden sharing' agreement, Belgium is committed to reduce its GHG emissions by 7.5%. Because of the economic crisis experienced since 2009, Belgium complies with its commitments for the five years of the commitment period despite the rise in emissions in 2010. For the first commitment period, Belgium has reduced its emissions (expressed on an annual basis) by 13.9 %.(source: Belgium's greenhouse gas inventory (1990-2012), April 2014)

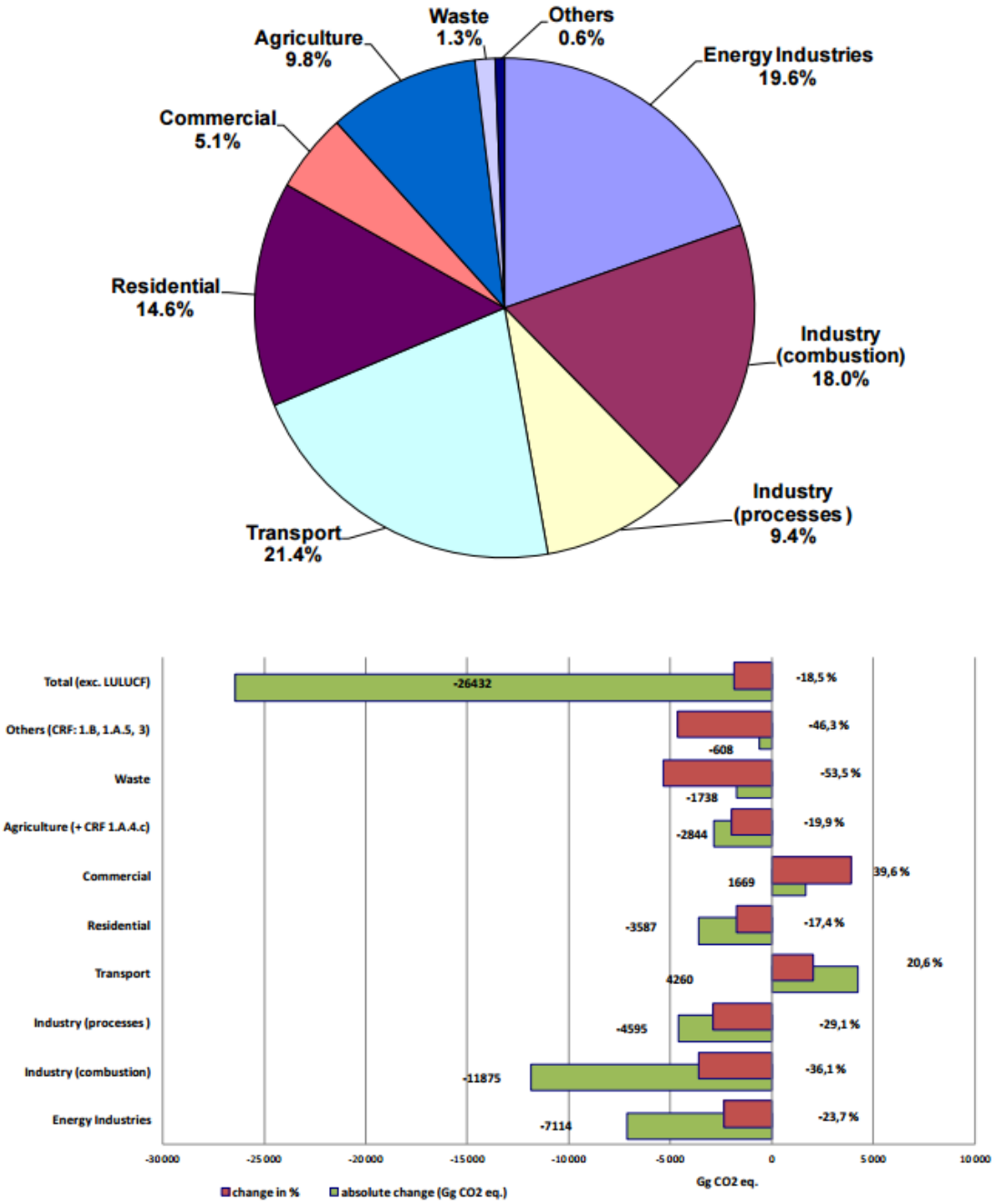
The major greenhouse gas in Belgium is carbon dioxide (CO2), which accounted for 86.4% of total GHG emissions in 2012. Methane (CH4) accounts for 5.5%, nitrous oxide (N2O) for 6.0%, and fluorinated gases for 2.1% (Figure 2.2). Emissions of CO2 decreased by 15.4% during 1990-2012, while CH4, N2O and fluorinated gas emissions have dropped with respectively 33.8%, 35.9% and 50.7% 8 during the same period. (Source: Belgium's greenhouse gas inventory (1990-2012), April 2014).

Graphic 1: Belgium GHG and CO_2 emissions 1990-2012 (excl. LULUCF), compared with Kyoto target. Unit: Index point (base year emissions = 100). For the fluorinated gases, the base year is 1995. (Source: Belgium's greenhouse gas inventory (1990-2012), April 2014)



Graphic 2: Share of greenhouse gases in Belgium (2012) and changes compared to base year (1990 for CO_2, CH_4 and N_2O; 1995 for F-gases) (Source: Belgium's greenhouse gas inventory (1990-2012), April 2014)

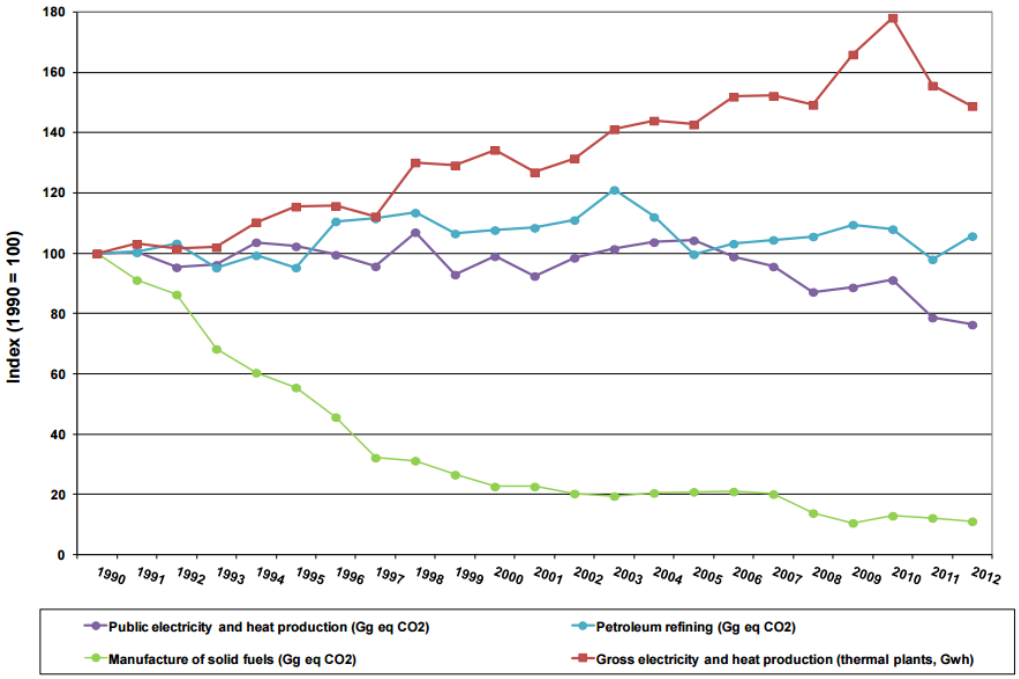
An overview of the contribution of the main sectors to Belgium greenhouse gas emissions is given in Graphic 3. Industry (process & combustion), energy industries, transport and residential heating are the most important sectors in the total GHG emissions in 2012.



Graphic 3: GHG emissions: share of main sectors in 2012 and changes from 1990 to 2012 (Source: Belgium's greenhouse gas inventory (1990-2012), April 2014)

The main source for the energy sector is public electricity and heat generation, which accounted for 79% of sectoral emissions in 2012. Petroleum refining and manufacture of solid fuels accounted for 20% and 1% respectively. An important increase in GHG emissions can still be found in the transport and commercial sector. Emissions in 2012 from petroleum refining are 6% higher in comparison with 1990. Emissions in this sector can fluctuate depending on the general economic context and planned shut-down for inspection, - maintenance- and renovation works. This was the case in 2011 for one of the biggest refineries. As mentioned above, the main driver in this sector is public electricity and heat generation. While electricity and heat production have risen by 49% between 1990 and 2012, emissions have decreased (-24%) due to technological improvements, increase of number of combined heat-power installations and the switch from solid fuels (coal) to gaseous fuels (natural gas) and renewable fuels.

This is illustrated in Graphic 4.



Graphic 4: GHG emissions from public electricity and heat generation, in relation to gross electricity generation. (Source: Belgium's greenhouse gas inventory (1990-2012), April 2014)

1.3. MAIN INDUSTRY SECTORS

Belgium has a very open economy, situated at the heart of a zone of intense economic activity. Exports of goods and services represented 82.2% of GDP in 2012 and imports 81.8% (Source: The World Bank). This trade occurs in large measure with the European market. 69% of Belgium's exports are sold within the EU mostly to Germany, France and the Netherlands, and 31% outside Europe. Imports follow more or less the same proportions (73% import from EU, 27% from outside EU). This situation reflects Belgium's role as the hub of the European Union.

The Belgian economy is currently dominated by the services sector. GDP at current prices in 2012 amounted to 376 billion EUR. In 2009, the economic crisis also affected Belgium with negative growth rates for the GDP (Figure 1). In the second half of 2010, the recovery started holding on till 2011 but not going back to the growth levels of 2007. In 2012, the growth declined again reducing to 0 an even a negative growth. In 2014, the growth rate recovered but very slowly.

In the past, iron and steel, mechanical engineering, textiles and chemicals were the flagships of the Belgian industry. Their output was exported to a large extent. Since 1960, however, in Belgium as in other parts of Europe, the profile of industry has changed significantly. Its importance in the economy has declined and its structures and spatial distribution have been transformed.

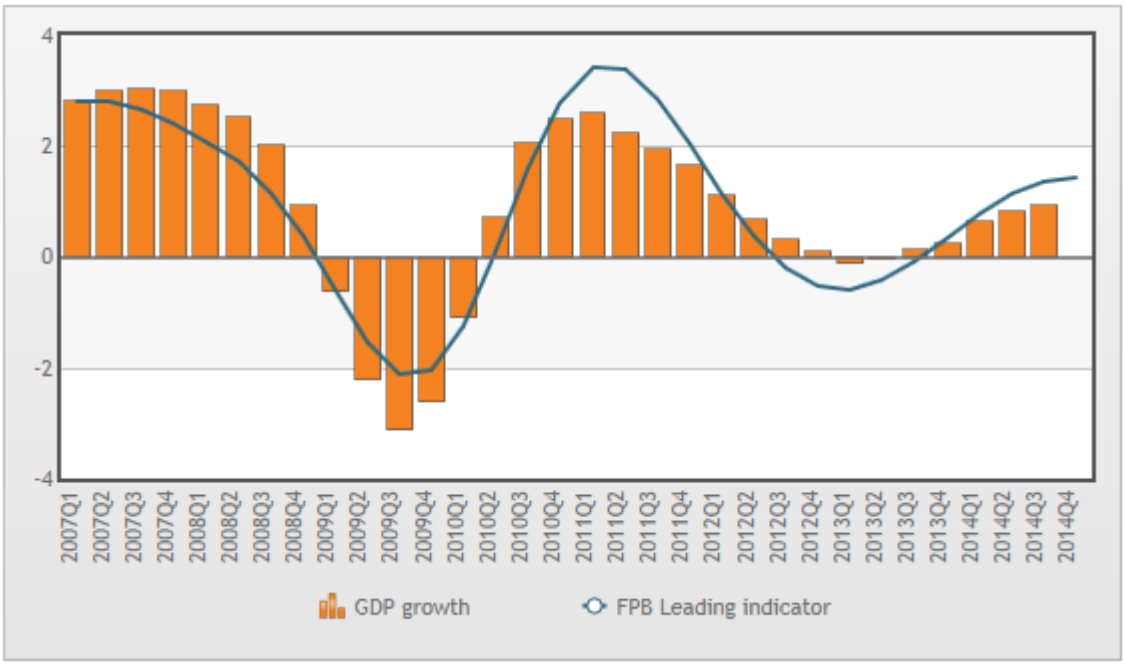


Figure 1: Belgian GDP growth and leading indicator (Year over Year growth rates of 4-quarter moving averages). Source: INR/ICN, FPB

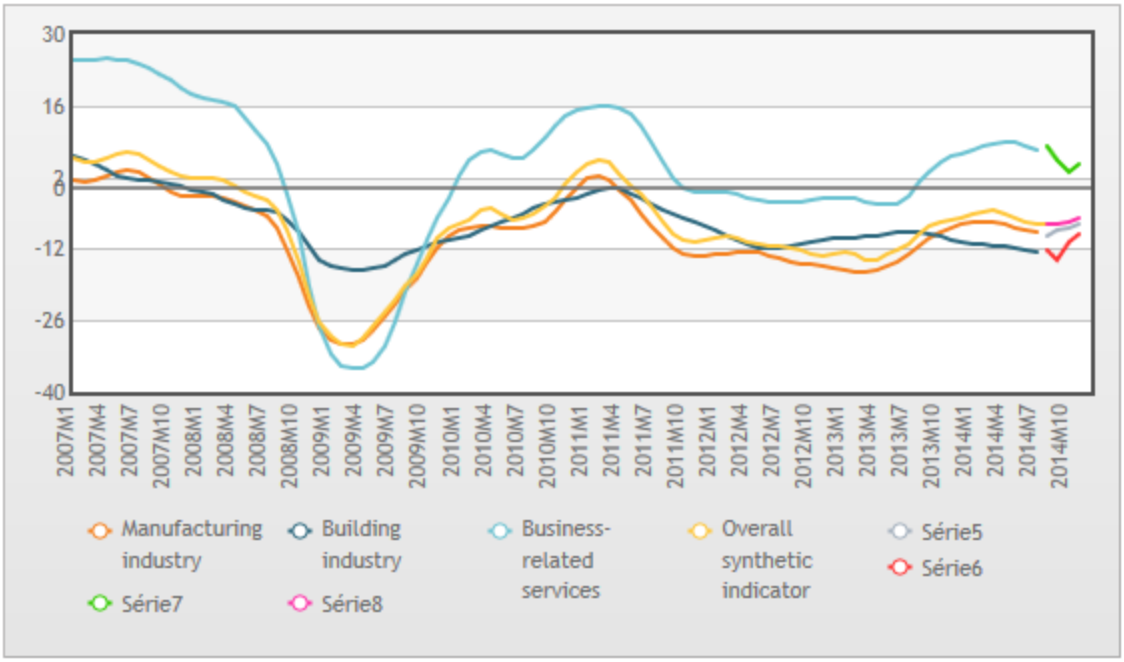


Figure 2: Belgian business cycle indicator (indices). Source: NBB

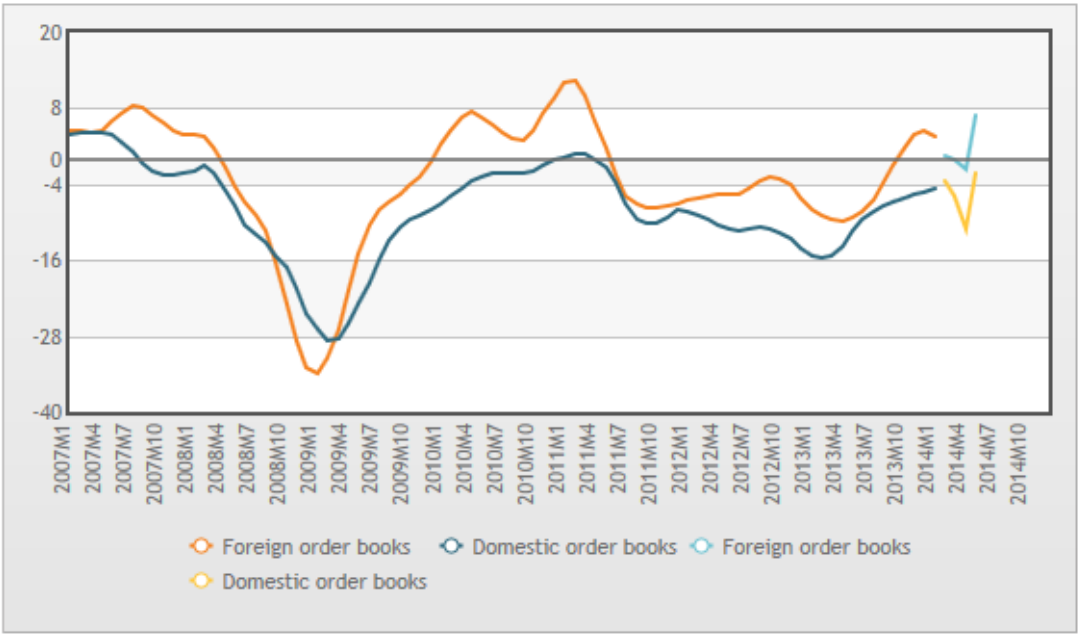


Figure 3: Manufacturing industry: order books (business survey indices). Source: NBB

→ **Agri-foods**

The food industry is the second most important sector in the Belgian processing industry after chemicals. Food companies are distributed throughout the country with concentrations in Northern Kempen, South-West Flanders, the Ghent region, the region south of Antwerp, the Verviers region and to the west of the Hainaut region. The sector has 90,000 employees.

The 5,223 companies in the food industry together realise an annual rising turnover that amounted to EUR 40 billion in 2009, with an added value of EUR 6 billion. These figures represent more than 13% of the turnover of all industrial sectors together and around 2% of the gross domestic product.

Almost half of the turnover, EUR 19 billion, was exported in 2009. The leading exported products are chocolate and cocoa products, bakery products, pork, beef and poultry meats, processed or non-processed or deep-frozen vegetables, fruit and fruit juices, milk and dairy products, beers, animal feeds, margarines, lemonades and malt.

The export of food products has followed a rising trend for many years, with a trade balance that annually shows a positive balance of around 4 to 5 billion EUR. Two thirds of exports go to our neighbouring countries France, the Netherlands, Germany and Great Britain. 19% is destined for the rest of Europe and 15% for the rest of the world.

In this last segment, the US, Russia, Algeria and Japan are the leading export markets.

In 2009 Belgium is the number four ranking EU exporter of foods to other Member States and to third countries, and accounts for 9 percent of trade in foodstuffs in the EU.

→ **Textiles, wood and furniture**

In 2009 the Belgian textile, wood and furniture industry realised a turnover of 10.5 billion euros, of which 71% was realised abroad.

The 2,430 companies of this industry employ more than 49,000 people and invested over 300 million euros in 2009. With an added value worth 2.6 billion euros and a positive trade balance of 1.8 billion euros, the sector offers a major contribution to Belgium's prosperity.

→ **Chemicals**

The chemicals industry is a diversified sector.

In addition to basic chemistry, the sector also includes plastics and rubber processing, pharmaceuticals and biotechnology, cosmetics, soaps and detergents as well as paints and varnishes.

Together all of these sub-sectors in Belgium represented a turnover of 45 billion euros in 2009 and added value of more than 10 billion euros. This represents one quarter of industrial activity in Belgium. The sector employs 91,500 people. Employment in the chemicals industry has stayed stable during the past twenty years. The number of jobs in industry overall fell in the same period, with the logical consequence that the chemicals industry's share rose: from 13.6% in 1990 to 17.4% in 2009. Furthermore, 1 direct job in chemicals generates 1.6 indirect jobs in other sectors. The chemicals industry is therefore one of the most important sectors in Belgium.

The Belgian chemicals industry is one of the most diversified and integrated chemicals clusters in the world. The Belgian cluster (especially in Antwerp Port) is the biggest in the world after Houston. 11 of the top-15 global chemicals groups have production facilities In Belgium. The share of the chemical industry in the total Belgian economy is twice the size of the average in the European Union and even bigger than in the traditional chemicals country Germany.

The sector is characterised by its strongly international nature: more than 75% of the products are exported to Europe and the rest of the world. In 2009 the sector's exports amounted to 92.7 billion euros, which is 35% of all products that Belgium exports. This is partly due to the fact that other countries export via Belgium, e.g. via Antwerp Port. The sector's trade surplus almost doubled in ten years from 10.8 billion in 2000 to 19.8 billion euros in 2009. The sector therefore contributes structurally to Belgian prosperity.

→ **Building and engineering**

In 2009 the total construction turnover in Belgium amounted to 46.2 billion EUR excluding taxes, the building market accounting for 83.5% and civil engineering for the remaining 16.5%. The sector occupied over 262,100 workers and its value-added accounted for 5% of the GDP.

The Belgian construction industry is made up of several thousand enterprises (85,000), mainly small and medium sized businesses. Just as the Belgian economy in general, the construction industry is quite open and well integrated in the European single market. A lot of Belgian contractors work and establish subsidiaries in neighbouring countries, as well as in Central and Eastern Europe.

Conversely, several Belgian construction companies are part of European groups.

Fewer Belgian construction companies are engaged in operations outside Europe, but they succeed quite well. The turnover of our largest international contractors outside of the EU was last year almost 3.8 billion EUR. 70% were realized in the Middle East where they carried through some outstanding works on earth and at sea. Belgian international contractors also operate in Africa, Asia, Australia and Central and South America.

The international engagement of Belgian contractors is not new. At the turn of the 20th century, they were already involved in ambitious projects such as the railways in Russia and China, the tramways in Cairo, the Paris subway, and various projects in Central Africa. Many of these works, often completed in very difficult conditions, are still in operation.

They laid the foundation for the Belgian construction reputation.

Since then, many other successful projects carried out in various places of the world have confirmed the expertise of Belgian construction companies: in dredging and marine works — where Belgian contractors are amongst the world leaders (D.E.M.E. Group NV and Jan De Nul Group NV) —, in hydraulic, road and railways works, in building projects of course — high-rise buildings (including the highest one in the world), airports, hotels, hospitals, offices, commercial centres, housing — as well as in industrial facilities.

Besides civil engineering and general contracting, Belgian contractors have developed an international activity in specialized trades and, as sustainability becomes more important every day, in environmental works (water treatment, decontamination of soils, waste disposal, renewable energy, etc.).

1.4. TOTAL DOMESTIC PRODUCTION OF ELECTRICITY, HEAT AND TRANSPORT FUELS PRODUCTION

1.4.1. BELGIUM

Belgium is a country depending for a large amount on import of energy (74 386 ktoe). The import of crude oil and petroleum products is the most important one (54484 ktoe), followed by the import of gas (14 167 ktoe) and solid fossil fuel (3600 ktoe). Belgium is also a transit country for petroleum products (export of 26 690 ktoe) and solid fossil fuels (818 ktoe). The inland primary production of energy counts on the production of nuclear heat (10 394 ktoe), renewable energy (2 816 ktoe) and non-renewable waste (2 460 ktoe).

The final energy consumption is dominated by the transport sector on the road with 8 213 ktoe mostly crudo oil and petroleum products. The residential sector is also responsible for quite a large amount of energy consumption (7444 ktoe) using crude oil and petroleum products, gas and electricity. Within the industry 3 main consuming industries can be seen: the chemical industry using large amounts of gas and electricity, the iron and steel industry depending on solid fossie fuels, gas and electricity and the food and beverage industry depending on gas and electricity.

Table 2: Energy Balance Sheet 2011-2012 for Belgium – Eurostat Statistical Books

Belgium, 2012 (ktoe)	Total (all products)	Solid fossil fuels	Crude oil & petroleum products	Gas	Nuclear heat	Renewable energies	Non-renewable wastes	Electricity	Derived heat
+ Primary production	15 670				10 394	2 816	2 460		
+ Primary production receipt	535		535						
+ Other sources (recovered products)	54		54						
+ Recycled products	33		33						
+ Imports	74 386	3 612	54 484	14 167		674		1 449	
+ Stock changes	564	173	185	199		6			
- Exports	28 255	818	26 690			153		594	
- Bunkers	6 048		6 048						
- Direct use	617		617						
Gross inland consumption	56 321	2 967	21 936	14 366	10 394	3 343	2 460	854	
Transformation input	54 882	3 108	35 217	4 152	10 394	1 280	605	10	115
+ Conventional thermal power stations	6 960	799	27	4 146		1 273	600		115
+ Nuclear power stations	10 394				10 394				
+ District heating plants	28			6		7	5	10	
+ Coke ovens	1 728	1 728							
+ Blast furnaces	582	582							
+ Gas works									
+ Refineries	35 190		35 190						
+ Patent fuel plants									
+ BKB/PB plants									
+ Charcoal production plants									
+ Coal liquefaction plants									
+ For blended natural gas									
+ Gas-To-Liquids (GTL) plants									
+ Non-specified Transformation Input									
Transformation output	44 697	1 311	35 183	883				6 562	758
+ Conventional thermal power stations	3 844							3 097	747
+ Nuclear power stations	3 465							3 465	
+ District heating plants	11								11
+ Coke ovens	1 613	1 311		301					
+ Blast furnaces	582			582					
+ Gas works									
+ Refineries	35 183		35 183						
+ Patent fuel plants									
+ BKB/PB plants									
+ Charcoal production plants									
Exchanges, transfers and returns	252		252			- 452		452	
Consumption of the energy branch	2 401		1 431	462				369	139
Distribution losses	355					0		355	
Available for final consumption	43 632	1 170	20 723	10 635		1 611	1 855	7 135	504
Statistical difference	- 552	- 95	- 508	42		10		- 0	
Final non-energy consumption	7 587		7 444	143					
Final energy consumption	36 597	1 266	13 787	10 450		1 601	1 855	7 135	504
+ Industry	13 263	1 164	478	5 348		592	1 855	3 376	451
+ Iron and Steel	2 029	807	16	718		0		487	
+ Chemical and Petrochemical	5 333	57	19	2 050		7	1 691	1 129	378
+ Non-ferrous metals	294		7	99		0	24	164	
+ Non-metallic minerals	1 998	268	139	1 034		112	128	318	
+ Transport eEquipment	244		4	77				163	
+ Machinery	152		20	55		2		75	
+ Mining and Quarrying	88			88					
+ Food, Beverages and Tabacco	1 061	1	12	531		61		423	32
+ Paper, Pulp and Printing	677		24	107		244	12	251	39
+ Wood and Wood products	202			14		156		33	
+ Construction	267		56	142				69	
+ Textile and Leather	171		1	77		1		91	1
+ Not elsewhere specified (Industry)	748	31	180	355		9		172	
+ Transport	9 922		9 420	21		346		136	
+ Rail	187		54					132	
+ Road	8 215		7 861	8		346			
+ International aviation	1 352		1 352						
+ Domestic aviation	2		2						
+ Domestic navigation	151		151						
+ Pipeline transport	4			0				4	
+ Not elsewhere specified (Transport)	12			12					
+ Other sectors	13 411	102	3 889	5 081		663		3 623	53
+ Commercial and public services	4 371		874	1 520		44		1 888	45
+ Residential	7 444	102	2 591	2 466		582		1 697	7
+ Agriculture / Forestry	661		371	245		37		6	2
+ Fishing									
+ Not elsewhere specified (Other)	935		52	851				32	

Belgium	ktoe							average annual growth rate (%)	
	1990	1995	2000	2005	2010	2011	2012	90 > 12	05 > 12
Primary production	12 421	11 520	13 401	13 654	15 115	17 648	15 670	1.06	1.99
Solid fossil fuels	610								
Crude oil & other hydrocarbons									
Natural gas	10	0	2						
Nuclear heat	11 020	10 668	12 422	12 277	12 367	12 442	10 394	-0.27	-2.35
Renewable energies	481	443	534	875	1 989	2 465	2 816	8.36	18.17
Non-renewable wastes	300	409	443	502	758	2 741	2 460	10.04	25.48
Net imports	39 654	46 753	50 350	53 123	53 685	49 111	46 131	0.69	-2.00
Solid fossil fuels	9 611	9 423	7 220	5 150	3 591	3 444	2 794	-5.46	-8.36
Crude oil & other hydrocarbons	26 869	26 440	34 025	31 978	30 976	28 577	30 147	0.52	-0.84
Petroleum products	- 4 723	36	- 4 650	354	1 709	1 270	- 2 353		
Natural gas	8 217	10 418	13 278	14 817	16 791	15 209	14 167	2.51	-0.64
Renewable energies		85	104	281	571	393	521		9.22
Gross inland consumption	48 693	53 939	59 150	58 733	61 037	59 669	56 321	0.66	-0.60
Solid fossil fuels	10 597	8 652	7 922	5 081	3 673	3 405	2 967	-5.62	-7.40
Crude oil & petroleum products	18 446	22 721	23 984	24 447	24 638	22 874	21 936	0.79	-1.54
Gas	8 169	10 611	13 369	14 728	16 999	15 124	14 366	2.60	-0.35
Nuclear heat	11 020	10 668	12 422	12 277	12 367	12 442	10 394	-0.27	-2.35
Renewable energies	481	528	638	1 156	2 554	2 865	3 343	9.21	16.38
Non-renewable wastes	300	409	443	502	758	2 741	2 460	10.04	25.48
Transformation input	53 487	51 550	61 638	60 437	58 665	55 390	54 882	0.12	-1.37
Conventional thermal power stations	6 555	7 160	7 081	7 747	8 450	7 286	6 960	0.27	-1.52
Nuclear power stations	11 020	10 668	12 422	12 277	12 367	12 442	10 394	-0.27	-2.35
District heating plants	12	8	44	29	6	21	28	3.87	-0.83
Coke-ovens	5 010	3 305	2 699	2 362	1 815	1 804	1 728	-4.72	-4.37
Blast-furnaces	1 095	997	939	807	600	643	582	-2.83	-4.56
Refineries	29 794	29 399	38 450	37 209	35 426	33 193	35 190	0.76	-0.79
BKB / PB plants									
Transformation output	41 679	40 038	49 631	48 284	46 526	43 779	44 697	0.32	-1.10
Conventional thermal power stations	2 570	2 968	3 451	3 760	4 665	4 080	3 844	1.85	0.32
Nuclear power stations	3 673	3 556	4 141	4 092	4 122	4 147	3 465	-0.27	-2.35
District heating plants	10	6	38	7	4	19	11	0.46	6.54
Coke-ovens	4 541	3 105	2 615	2 414	1 717	1 706	1 613	-4.60	-5.60
Blast-furnaces	1 095	997	939	807	600	643	582	-2.83	-4.56
Refineries	29 788	29 391	38 444	37 199	35 418	33 184	35 183	0.76	-0.79
BKB / PB plants									
of which: electricity	6 021	6 291	7 076	7 325	7 876	7 337	6 562	0.39	-1.56
of which: derived heat	233	238	553	534	915	910	758	5.51	5.12
Exchanges, transfers and returns	137	159	251	288	217	213	252		
Consumption of the energy branch	2 365	2 272	2 332	2 124	2 412	2 405	2 401	0.07	1.77
Distribution losses	322	330	388	394	377	366	355	0.45	-1.48
Energy available for final consumption	34 335	39 985	44 675	44 350	46 327	45 501	43 632	1.10	-0.23
Solid fossil fuels	4 180	3 108	3 760	2 023	1 702	1 550	1 170	-5.62	-7.52
Gas/Diesel Oil (w/o bio)	8 587	9 892	10 735	12 017	12 308	10 744	10 346	0.85	-2.12
Motor Gasoline (w/o bio)	2 899	3 037	2 405	1 862	1 267	1 305	1 185	-3.98	-6.25
Kerosene Type Jet Fuel	954	942	1 489	1 256	1 611	1 706	1 377	1.68	1.32
Naphtha	1 395	3 751	4 317	4 593	4 561	4 041	4 312	5.26	-0.90
LPG	444	628	630	296	1 116	1 579	1 482	5.63	25.90
All other oil & petroleum products	2 684	2 990	2 926	3 110	2 424	2 309	2 021	-1.28	-5.97
Natural gas	6 760	8 502	10 155	10 597	11 697	10 948	10 298	1.93	-0.41
Derived gases	849	590	564	496	408	424	337	-4.11	-5.36
Solid biomass & charcoal	321	340	405	614	853	813	1 172	6.06	9.67
Liquid biofuels				1	369	356	359		155.72
All other renewable energies	4	8	4	28	41	65	80	14.91	16.52
Non-renewable wastes	52	87	124	123	137	2 103	1 855	17.62	47.31
Electricity	4 986	5 885	6 667	6 908	7 163	6 894	7 135	1.64	0.46
Derived heat	221	225	492	428	668	663	504	3.82	2.33
Statistical difference	- 354	- 342	298	81	511	- 31	- 552		
Final non-energy consumption	3 135	5 820	6 739	7 516	8 275	7 697	7 587	4.10	0.13
Final energy consumption	31 555	34 507	37 637	36 754	37 541	37 835	36 597	0.68	-0.06
Industry	12 065	11 994	14 218	11 770	11 761	13 864	13 263	0.43	1.72
Transport	7 815	8 609	9 747	10 011	10 785	10 682	9 922	1.09	-0.13
Road transport	6 551	7 203	7 825	8 321	8 902	8 837	8 215	1.03	-0.18
Domestic & International aviation	955	947	1 524	1 283	1 541	1 475	1 354	1.60	0.77
Other sectors	11 674	13 904	13 672	14 973	14 995	13 289	13 411	0.63	-1.56
Services	2 882	3 470	3 448	4 160	5 040	4 409	4 371	1.91	0.71
Residential	8 299	9 326	9 500	9 944	9 007	7 436	7 444	-0.49	-4.05

Table 3: Belgian Energy factsheet (Source: EU ENERGY IN FIGURES – POCKETBOOK 2014)

	1995	2000	2005	2010	2011	2012
Installed Capacity (GW)	**14.9**	**15.7**	**16.1**	**18.3**	**20.1**	**20.8**
Combustible Fuels	7.9	8.5	8.7	9.2	10.3	9.5
Nuclear	5.6	5.7	5.8	5.9	5.9	5.9
Hydro	1.4	1.4	1.4	1.4	1.4	1.4
Wind	0.0	0.0	0.2	0.9	1.1	1.4
Solar PV			0.0	0.9	1.4	2.6
Geothermal						
Tide, Wave and Ocean						
Other Sources						
Gross Electricity Generation (TWh)	**74.4**	**84.0**	**87.0**	**95.1**	**90.2**	**82.9**
Solid Fuels	16.5	12.9	8.2	4.2	3.4	3.4
Petroleum and Products	1.3	0.8	1.7	0.3	0.2	0.1
Gases	12.9	19.1	25.1	33.2	27.4	25.6
Nuclear	41.4	48.2	47.6	47.9	48.2	40.3
Renewables	1.6	2.3	3.4	7.9	9.6	11.8
Wastes, non-RES	0.7	0.8	0.7	1.3	1.2	1.5
Cogeneration Heat and Power						
CHP Electrical Capacity (GW)			1.9	2.6	2.6	
CHP Electricity Generation (TWh)			7.4	15.2	14.5	
CHP in Total Electricity Generation (%)			8.5%	16.0%	16.0%	
CHP Heat Production (PJ)			75.9		93.7	
Transport Fuels (ktoe)						
Final Consumption Petroleum Products	8 483	9 623	9 865	10 283	10 198	9 420
Motor Gasoline	3 038	2 408	1 890	1 277	1 293	1 206
Gas/Diesel Oil	4 313	5 454	6 541	7 399	7 358	6 784
Final Consumption Biofuels				352	338	346
Biogasoline				53	48	48
Biodiesel				299	290	298
Main Energy Indicators						
Energy Intensity (toe/M€'05)	221	211	194	190	182	172
Energy per Capita (kgoe/cap)	5 321	5 773	5 607	5 608	5 435	5 095
Final Electricity per Capita (KWh/cap)	6 752	7 568	7 657	7 655	7 298	7 507
Primary Efficiency (toe/M€'05)	198	187	169	164	159	149
Import Dependency (%)	**80.9%**	**78.1%**	**80.0%**	**78.2%**	**73.9%**	**74.0%**
on Solid Fuels	108.9%	91.1%	101.4%	97.8%	101.2%	94.2%
on Hard Coal	108.5%	90.4%	100.9%	100.2%	102.6%	93.8%
on Petroleum Fuels	99.6%	100.2%	100.8%	101.4%	100.7%	99.3%
on Crude and NGL	99.8%	100.2%	99.5%	99.9%	100.3%	99.7%
on Natural Gas	98.2%	99.3%	100.6%	98.8%	100.6%	98.6%
RES of the Gross Final Energy (%)						
Overall RES with Aviation Cap				5.0%	5.2%	6.8%
RES-H&C – Heating and Cooling				5.0%	4.7%	6.6%
RES-E – Electricity Generation				7.1%	8.8%	11.1%
RE-T – Transport				4.1%	4.0%	4.5%
Gases emissions (Mio ton CO_2)						
CO_2 Emissions	140	146	153	142	131	124
GHGs Emissions	166	167	171	159	146	140
Main Emissions Indicators						
CO_2 per Capita (kg CO_2/cap)	13 827	14 235	14 591	13 065	11 891	11 245
Carbon Intensity (kg CO_2/toe)	2 599	2 466	2 602	2 329	2 188	2 207
CO_2 GDP Intensity (ton CO_2/M€'05)	576	520	504	442	398	380

The installed capacity in total has increased, the growth was realised by the solar and wind installations. Nuclear capacity stayed on the same level the last 20 years, also hydro didn't change. The installed capacity for combustible fuels decreased slightly the last year. The main electricity producers were the nuclear power plants (40 TWh), followed by gas power plants (25.5 TWh) and renewable installations (11.8 TWh). The increasing trend of the last 10 years in renewable electricity is proceeding.
Only 16% of the electricity production is done in CHP installations, the growing trend of the last year didn't set through in 2011.
A positive evolution can be seen in all parameters calculating the energy intensity of Belgium. All parameters are declining, only the electricity intensity is increasing, meaning that more and more electrification is on-going. CO2 emissions and GHGs emissions are proceeding with the declining trend since 2010.

1.5. OVERVIEW OF ENERGY CONSUMPTION

1.5.1. BELGIUM

The Gross Inland Consumption of primary energy was 56.3 million tonnes of oil equivalent in 2012 (Source: Pocketbook energy statistics Eurostat). The Energy intensity was 172.2 kg of oil equivalent per EUR 1000 of GDP.

Most economic sectors show a decrease over the last 10 years in energy consumption, only the service sector has experienced substantial increase.

Table 4: Overview of energy consumption by economic sector 2004-2013 in Belgium in TJ

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Gross inland consumption	2.482.566	2.470.528	2.426.380	2.384.215	2.481.624	2.386.733	2.568.418	2.421.916	2.293.255	2.375.065
Transformation input	2.793.956	2.541.838	2.521.578	2.601.104	2.522.398	2.379.504	2.457.338	2.312.549	2.308.391	2.184.928
Final Non-energy Consumption	291.152	314.689	297.432	301.164	343.637	337.336	357.593	329.984	359.044	391.429
Final Energy Consumption	1.590.763	1.536.757	1.520.062	1.472.229	1.560.337	1.429.266	1.571.461	1.510.159	1.416.245	1.458.133
Final Energy Consumption - Industry	524.678	492.974	523.056	514.650	504.388	404.821	489.356	500.265	430.537	437.941
Final Energy Consumption - Transport	434.461	417.563	404.293	411.603	444.675	437.698	443.698	445.768	414.653	408.643
Final Energy Consumption - Other Sectors	631.624	626.220	592.713	545.976	611.275	586.747	638.407	564.126	571.055	611.549
Residential	420.511	416.427	374.203	346.828	376.823	355.847	387.966	319.468	350.696	375.881
Agriculture/Forestry	34.477	34.406	37.500	34.978	36.246	35.612	36.198	35.580	27.913	30.096
Services	171.550	174.163	180.909	164.139	197.971	192.718	211.090	184.543	190.142	203.594
Non-specified (Other)	5.086	1.224	101	31	234	2.552	3.153	24.535	2.305	1.978

CHAPTER 2 DOMESTIC BIOMASS RESOURCES, CURRENT USE, TRENDS, AND MAIN USERS

2.1. CURRENT USE OF SOLID, LIQUID AND GASEOUS BIOMASS FOR BIOENERGY

2.1.1. FLANDERS

The share of biomass within the renewable share is quite high (Figure 4). The share of biomass has grown from 2004 till 2012. Reason for this high percentage is the use of biomass in cofiring power plants. A change can be seen in 2013. The cofiring plant of Ruien has closed down during the year 2013 resulting in a decrease of circa 6% between 2013 and 2012.

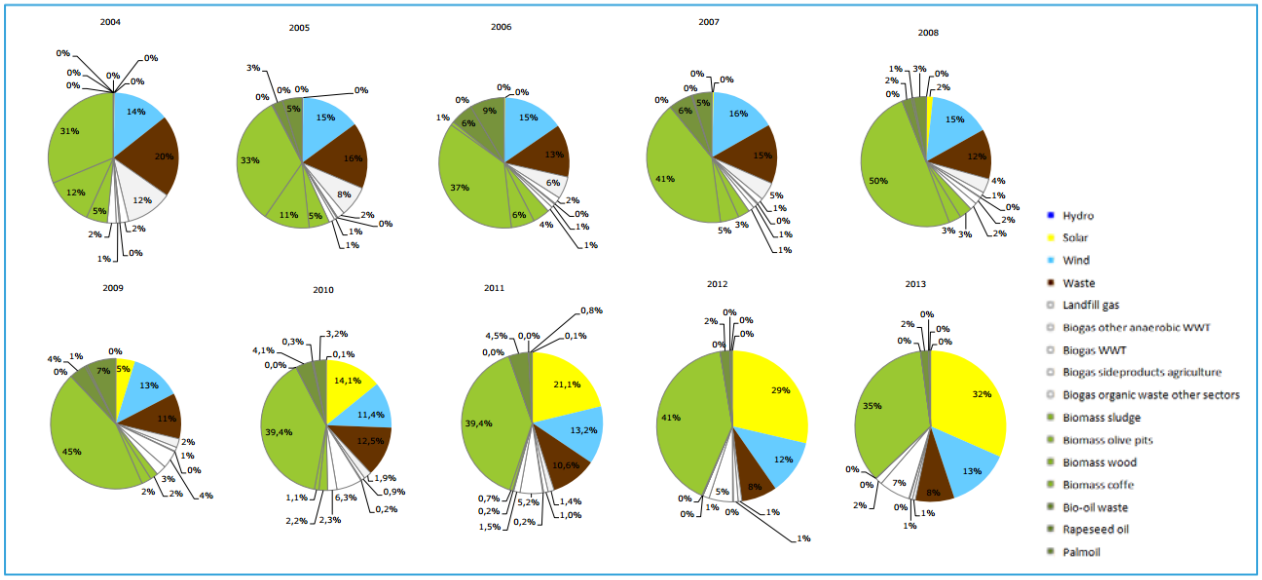
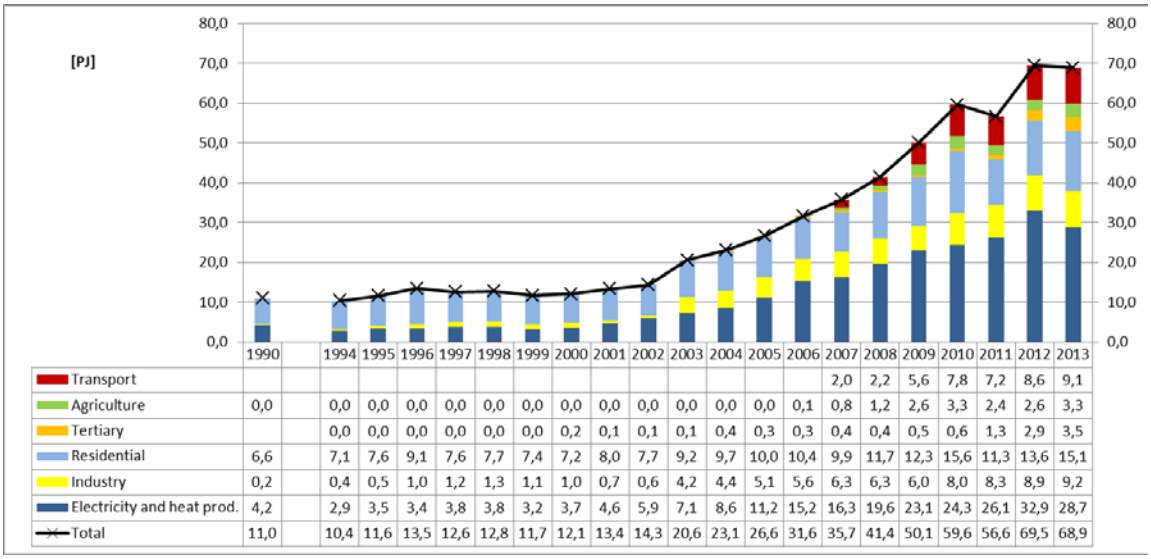


Figure 4: Overview (2004-2013) of shares in total gross green power production

Figure 5 gives insight in the evolution of use of biomass for energy in Flanders over the last 10 years over the different sectors. The use of biomass for energy purposes has decreased in 2013 in Flanders with 1.0% in comparison to the level of 2012. In all end-user sectors, the use of biomass has increased. The transformation sector is responsible for a decrease of 13%. The closing of the Ruien co-firing power plant in spring 2013 has an important share in this decrease. The raise in the end-user sectors is probably because of the climate: 2013 was a colder year than 2012 in temperature.



	1990	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Transport															2,0	2,2	5,6	7,8	7,2	8,6	9,1
Agriculture	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,8	1,2	2,6	3,3	2,4	2,6	3,3
Tertiary		0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,1	0,1	0,1	0,4	0,3	0,3	0,4	0,4	0,5	0,6	1,3	2,9	3,5
Residential	6,6	7,1	7,6	9,1	7,6	7,7	7,4	7,2	8,0	7,7	9,2	9,7	10,0	10,4	9,9	11,7	12,3	15,6	11,3	13,6	15,1
Industry	0,2	0,4	0,5	1,0	1,2	1,3	1,1	1,0	0,7	0,6	4,2	4,4	5,1	5,6	6,3	6,3	6,0	8,0	8,3	8,9	9,2
Electricity and heat prod.	4,2	2,9	3,5	3,4	3,8	3,8	3,2	3,7	4,6	5,9	7,1	8,6	11,2	15,2	16,3	19,6	23,1	24,3	26,1	32,9	28,7
Total	11,0	10,4	11,6	13,5	12,6	12,8	11,7	12,1	13,4	14,3	20,6	23,1	26,6	31,6	35,7	41,4	50,1	59,6	56,6	69,5	68,9

Figure 5: Evolution of the use of biomass for energy in Flanders 1990, 1994-2013 (Source: Inventaris hernieuwbare energiebronnen in Vlaanderen 2005-2013, February 2015)

2.2. MAIN BIOMASS FOR BIOENERGY USERS

2.2.1. FLANDERS

The electricity and heat production sector is still the largest biomass user for energy in Flanders (28,7 PJ/y), followed by the residential sector (15,1 PJ/y), industry (9,2 PJ/y) and the transport sector (9,1 PJ/y).

Table 5: Summary biomass energy balance 2013 (Source: Inventaris hernieuwbare energiebronnen in Vlaanderen 2005-2013, February 2015)

[TJ]	Gasoline	Biodiesel	Liquid biomass (excl. Biodiesel and bio-gasoline)	Landfill gas	Biogas (excl. landfill gas)	Solid biomass	Waste (HEB)	Total
Transformation sector			**888**	**260**	**232**	**18473**	**8886**	**28739**
Electricity & heat			888	260	232	18473	8886	28739
Refineries								
Cokes factories								
Others								
End-energy consumption	**1666**	**7440**	**193**	**155**	**5473**	**24521**	**669**	**40118**
Non-energetic usage								
Industry			57		917	7524	669	9186
Residential & equated			136	155	4556	16996		21843
Of which residential			0.4			15051		15051
Of which tertiary			20	155	1926	1405		3507
Of which agriculture			115		2630	540		3285
Transport	1666	7440						9106
Total	**1666**	**7440**	**1081**	**415**	**5705**	**42994**	**9555**	**68857**

2.3. BIOMASS FOR BIOENERGY TRENDS

2.3.1. FLANDERS

→ Solid and liquid biomass

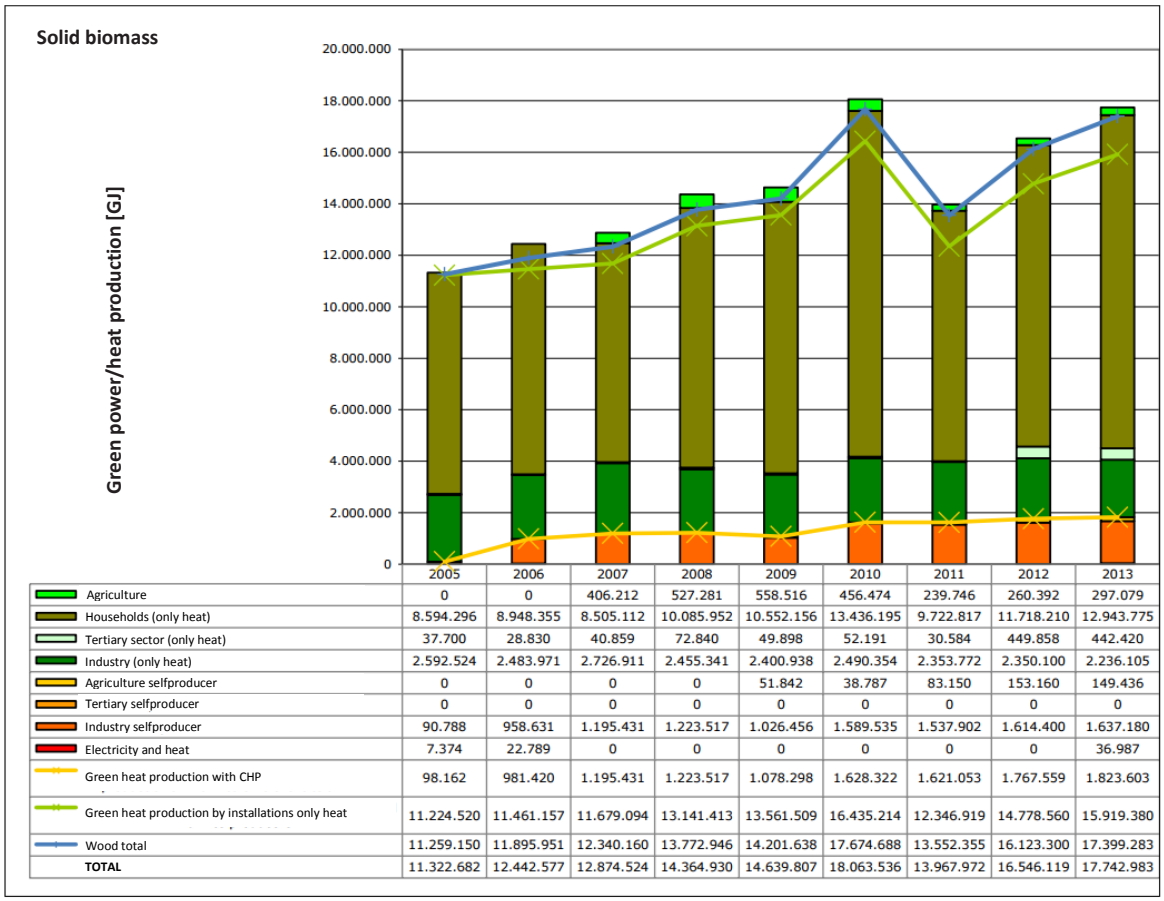
Electricity

Table 6: Evolution of green power production by solid and fluid biomass (Source: Inventaris hernieuwbare energiebronnen Vlaanderen 2005-2013)

	Aantal (1)	groen operationeel vermogen kWe (1)	TJ biomassa (2)	groene bruto elektriciteitsproductie MWh (3)	totaal operationeel vermogen kWe (2)	totale bruto elektriciteitsproductie MWh (2)	vollastdraaiuren	% aandeel tov totale bruto groene stroomproductie
2004	7	112.639	3.495	333.450	115.624	345.929	2.733	***48%***
2005	16	165.910	5.743	607.601	208.928	670.661	2.954	***57%***
2006	20	258.009	9.986	981.950	266.767	1.004.944	3.490	***62%***
2007	32	273.704	11.778	1.051.091	292.584	1.073.581	3.385	***60%***
2008	37	352.413	14.595	1.373.287	414.374	1.443.106	3.259	***62%***
2009	36	483.937	17.696	1.885.237	486.874	1.897.740	3.657	***61%***
2010	48	550.069	18.647	1.767.696	591.453	1.869.403	2.971	***50%***
2011	46	573.650	21.422	1.996.949	589.634	2.092.058	3.340	***46%***
2012	47	530.996	28.340	2.633.960	541.147	2.696.884	4.926	***44%***
2013	37	477.850	24.830	2.321.580	484.631	2.376.146	4.040	***37%***
2013/2012	***-21%***	***-10,0%***	***-12,4%***	***-11,9%***	***-10,4%***	***-11,9%***	***-18%***	

The share of solid biomass in the total net green power production in 2013 was 35%. The gross green power production decreased in 2013 with 11.7%. The shut-down of the co-firing installation of Ruien was the main cause. Solid biomass in this category means the use of wood, olive pulp and pits and coffee drab.

Heat



	2005	2006	2007	2008	2009	2010	2011	2012	2013
Agriculture	0	0	406.212	527.281	558.516	456.474	239.746	260.392	297.079
Households (only heat)	8.594.296	8.948.355	8.505.112	10.085.952	10.552.156	13.436.195	9.722.817	11.718.210	12.943.775
Tertiary sector (only heat)	37.700	28.830	40.859	72.840	49.898	52.191	30.584	449.858	442.420
Industry (only heat)	2.592.524	2.483.971	2.726.911	2.455.341	2.400.938	2.490.354	2.353.772	2.350.100	2.236.105
Agriculture selfproducer	0	0	0	0	51.842	38.787	83.150	153.160	149.436
Tertiary selfproducer	0	0	0	0	0	0	0	0	0
Industry selfproducer	90.788	958.631	1.195.431	1.223.517	1.026.456	1.589.535	1.537.902	1.614.400	1.637.180
Electricity and heat	7.374	22.789	0	0	0	0	0	0	36.987
Green heat production with CHP	98.162	981.420	1.195.431	1.223.517	1.078.298	1.628.322	1.621.053	1.767.559	1.823.603
Green heat production by installations only heat	11.224.520	11.461.157	11.679.094	13.141.413	13.561.509	16.435.214	12.346.919	14.778.560	15.919.380
Wood total	11.259.150	11.895.951	12.340.160	13.772.946	14.201.638	17.674.688	13.552.355	16.123.300	17.399.283
TOTAL	11.322.682	12.442.577	12.874.524	14.364.930	14.639.807	18.063.536	13.967.972	16.546.119	17.742.983

Figure 6: Green heat production by solid biomass installations

77% of the total green heat production in 2013 is produced by biomass-installations using solid biomass. The main green heat production is from wood combustion installations (stoves, open fires, …) in households (73% of the total green heat production by solid biomass). Also the industry (only heat production) is contributing an important part: 12,6% of the total green heat production by solid biomass. This green heat production is situated in the traditional wood processing industries (wood panel industry and paper mills). 9,2% of the green heat production in the category of 'solid biomass' is coming from CHP installations in the industry. Main biomass streams used are wood and sludge. An increasing trend can be seen in the period between 2007 and 2010 of the amount of wood combustion installations in the agricultural sector. In 2011, the number of wood combustion installation are suddenly decreasing (-47% in comparison to 2010). In 2012, an increase of 8.6% and in 2013 of 14,1% can be observed for wood combustion installations in the agricultural sector.

The green heat production with solid biomass increased with 7,2% in 2013 in comparison to 2012, probably due to the colder temperatures (2010 was very cold, 2011 rather warm and 2012 rather average, 2013 colder than 2012). Heating systems fuelled with wood raised with 10,5% in 2013.

The contribution of wood to green heat in the mix of solid biomass is 98%. Only few installations are using other biomass streams for green heat production (sludge, olive pits/pulp, coffee waste).

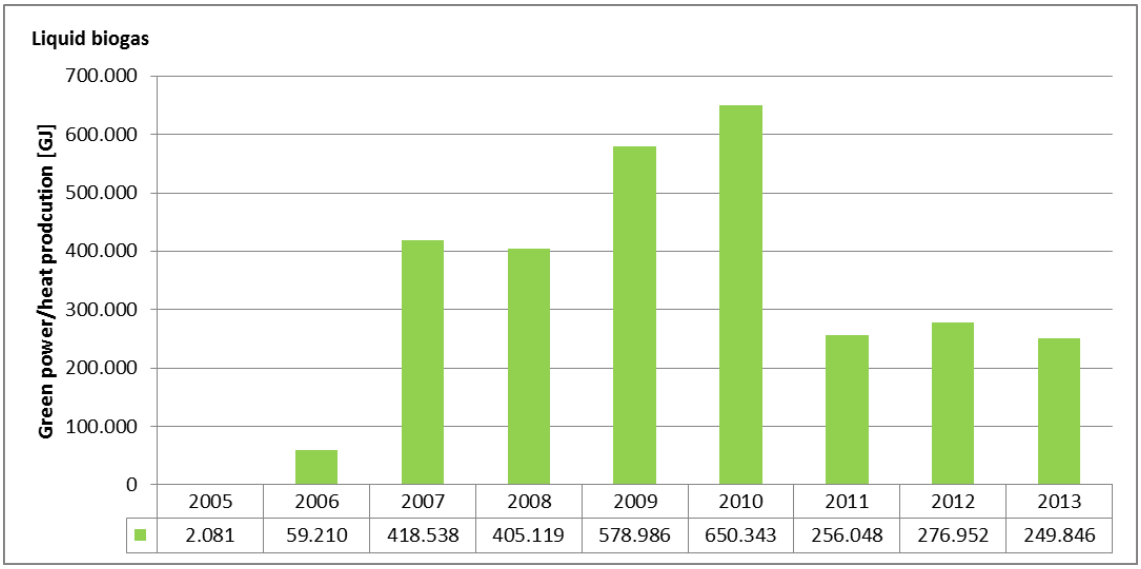


Figure 7: Green heat production by biomass installations based on liquid biomass

In 2013, the green heat production using liquid biomass was only 1% of the total green heat production. 84% of the total green heat production by liquid biomass is used in CHP-installations. In 2010, the industry and agriculture (45%, resp. 36%) are the sectors where liquid biomass was used; nowadays, it is mostly the transformation and the agricultural (57%, resp. 22%). The use of liquid biomass has strongly decreased since 2011.

→ Renewable fraction of waste

Electricity

Table 7: Evolution of green power production by combustion of renewable fraction of waste in Flanders (Source: Inventaris hernieuwbare energiebronnen Vlaanderen 2005-2013)

	Aantal (1)	groen operationeel vermogen kWe (1)	TJ afval HEB (2)	groene bruto elektriciteitsproductie MWh (3)	totaal operationeel vermogen kWe (4)	Totale bruto elektriciteitsproductie MWh (4)	Vollastdraaiuren	% aandeel tov totale bruto groene stroomproductie
2004	10	24.528	4.780	140.228	59.716	341.394	5.515	***20%***
2005	10	24.292	4.809	176.100	66.356	433.063	6.158	***16%***
2006	11	37.797	5.831	208.439	105.293	538.558	4.810	***13,1%***
2007	9	37.410	5.832	260.048	102.833	703.940	6.676	***14,7%***
2008	10	38.353	6.612	274.839	102.833	736.701	6.997	***12,4%***
2009	11	51.482	7.058	351.347	121.833	838.641	6.626	***11,4%***
2010	11	57.336	9.172	438.412	120.833	924.146	7.409	***12,5%***
2011	11	60.421	8.919	461.413	123.833	943.292	7.439	***10,6%***
2012	11	66.420	9.807	460.823	135.913	939.099	6.879	***7,6%***
2013	11	75.381	9.803	521.916	151.035	1.015.302	6.722	***8,3%***
2013/2012	***0,00%***	***13,5%***	***-0,04%***	***13,3%***	***11,1%***	***3,6%***	***-2,3%***	

The share of green power production by waste incineration is declining from 20% in 2004 till 8,3% in 2013 due to the high increase of other renewables like wind and solar. The green power production in 2013 has increased slightly with 13% in comparison to 2012. The green power production from waste includes the renewable fraction of waste (and sludge, animal meal, wood waste).

Heat

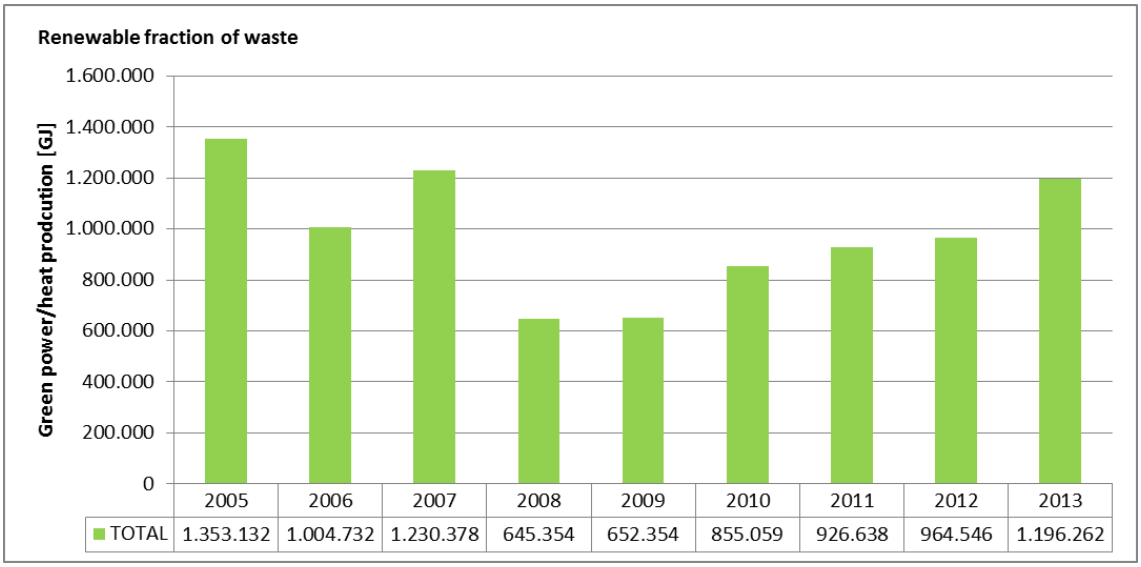


Figure 8: Green heat production from renewable fraction of waste for installations with combined electricity & heat production and installation which only produce heat

In 2013, the renewable heat produced by waste-to-energy installation was 5.2% of the total green heat production. The green heat production from waste increased with 24% in comparison to 2012 (due to a more accurate inventory). The installation from Stora Enso (papermill) active since 2010 is using RDF (Refused Derived Fuel) partly is renewable.

→ **Biogas**

Electricity

Table 8: Evolution of green power production of biogas in Flanders
(Source: Inventaris hernieuwbare energiebronnen Vlaanderen 2005-2013)

	Aantal (1)	groen operationeel vermogen kWe (1)	TJ biogas (2)	groene bruto elektriciteitsproductie MWh (3)	totaal operationeel vermogen kWe (2)	totale bruto elektriciteitsproductie MWh (2)	vollastdraaiuren	% aandeel tov totale bruto groene stroomproductie
2004	36	33.739	1.426	115.914	51.942	185.358	3.345	***17%***
2005	38	30.159	1.629	126.299	45.049	237.696	5.042	***11,8%***
2006	47	35.472	1.752	154.877	70.713	331.963	4.392	***9,7%***
2007	54	44.652	1.759	156.297	79.247	299.510	3.571	***8,9%***
2008	66	58.215	1.996	191.691	94.530	352.284	3.525	***8,7%***
2009	68	69.615	3.354	319.393	106.219	464.067	4.129	***10,3%***
2010	75	83.341	4.060	406.814	167.087	876.055	5.070	***11,6%***
2011	81	86.863	3.862	403.839	163.261	851.210	5.088	***9,2%***
2012	112	99.582	4.772	507.891	173.862	969.397	5.427	***8,4%***
2013	127	108.529	5.545	602.019	139.388	709.321	4.914	***9,6%***
2013/2012	***13%***	***9,0%***	***16%***	***19%***	***-19,83%***	***-27%***	***-9,5%***	

The gross green power production from biogas has a share of 9,6% in the total Flemish gross renewable power production in 2013. The strong increase in 2013 is caused by 5 new large anaerobic digesters on agricultural waste streams starting to operate in 2013. Also 29 pocket digesters started operating on mainly cattle manure. Also, a serious increase in biogas from organic biological waste streams enhanced the raise of electricity production of biogas.

Heat

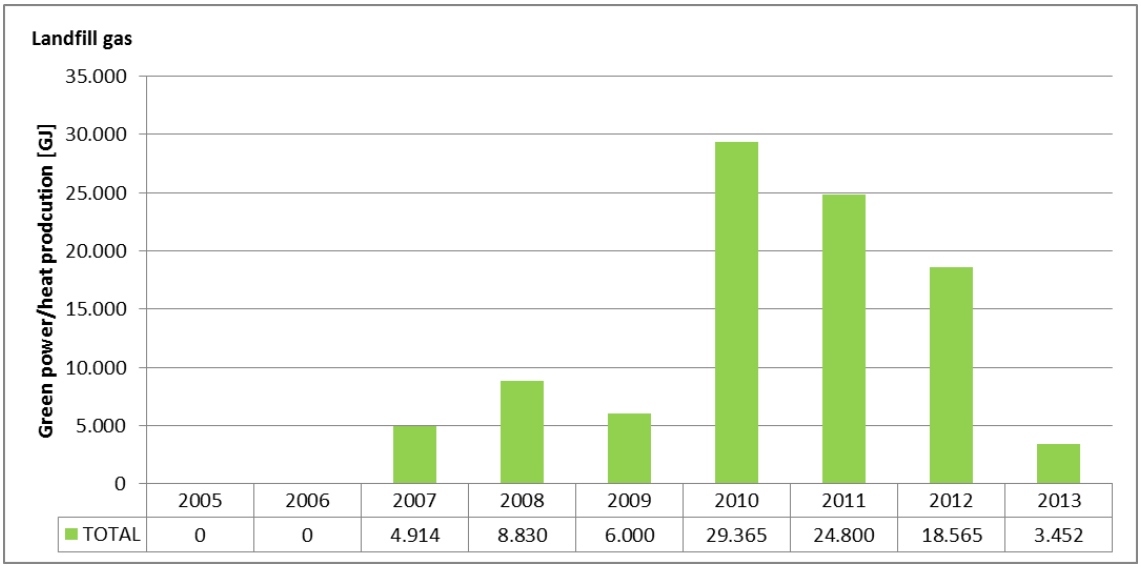


Figure 9: Green heat production from landfill gas installations

In 2013, the green heat production of landfill was only 0.01% of the total green heat production. The production is (for the third year in a row) decreasing, the last year very significantly with 81% due to the age of the installation or due to the end-of-life of the subsidies. These installation reoriented back to burning the landfill gas without energy recuperation.

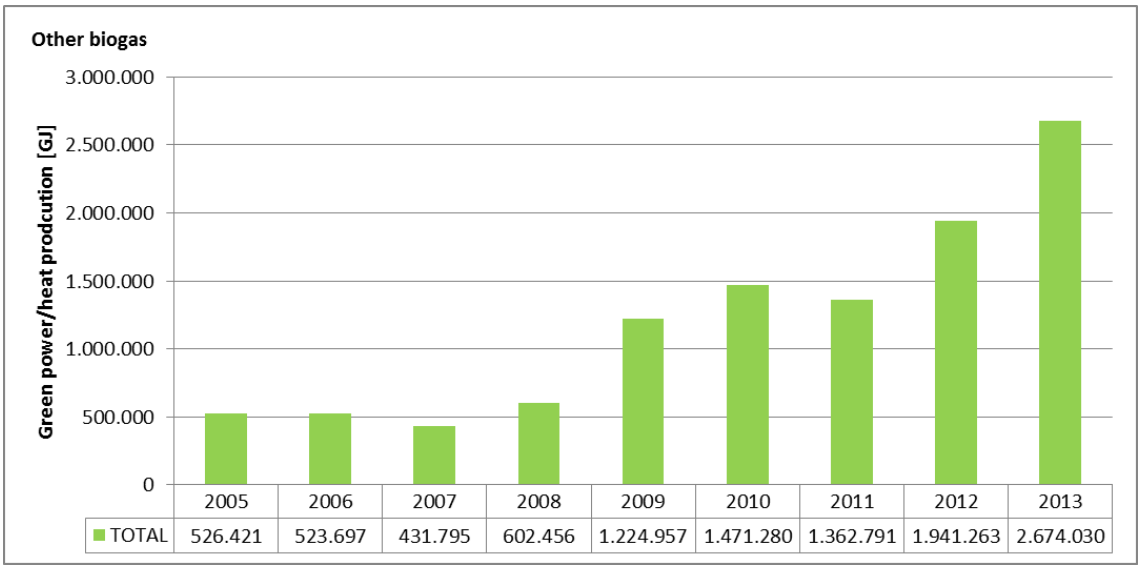


Figure 10: Green heat production by biogas installations with combined electricity & heat production and installations which only product heat

In 2013, the green heat production from the other biogas installation was 11,6% of the total green heat production. The green heat production increased significantly with 38% in comparison with 2012.
The share of green power production by waste incineration is declining from 20% in 2004 till 8,3% in 2013 due to the high increase of other renewables like wind and solar. The green power production in 2013 has increased slightly with 13% in comparison to 2012. The green power production from waste includes the renewable fraction of waste (and sludge, animal meal, wood waste).

2.4. GEOGRAPHICAL AND IMPLEMENTATION POTENTIAL

2.4.1. FLANDERS

For the different local biomass streams the potential and where possible also the geographical availability is given.

→ **Wood**

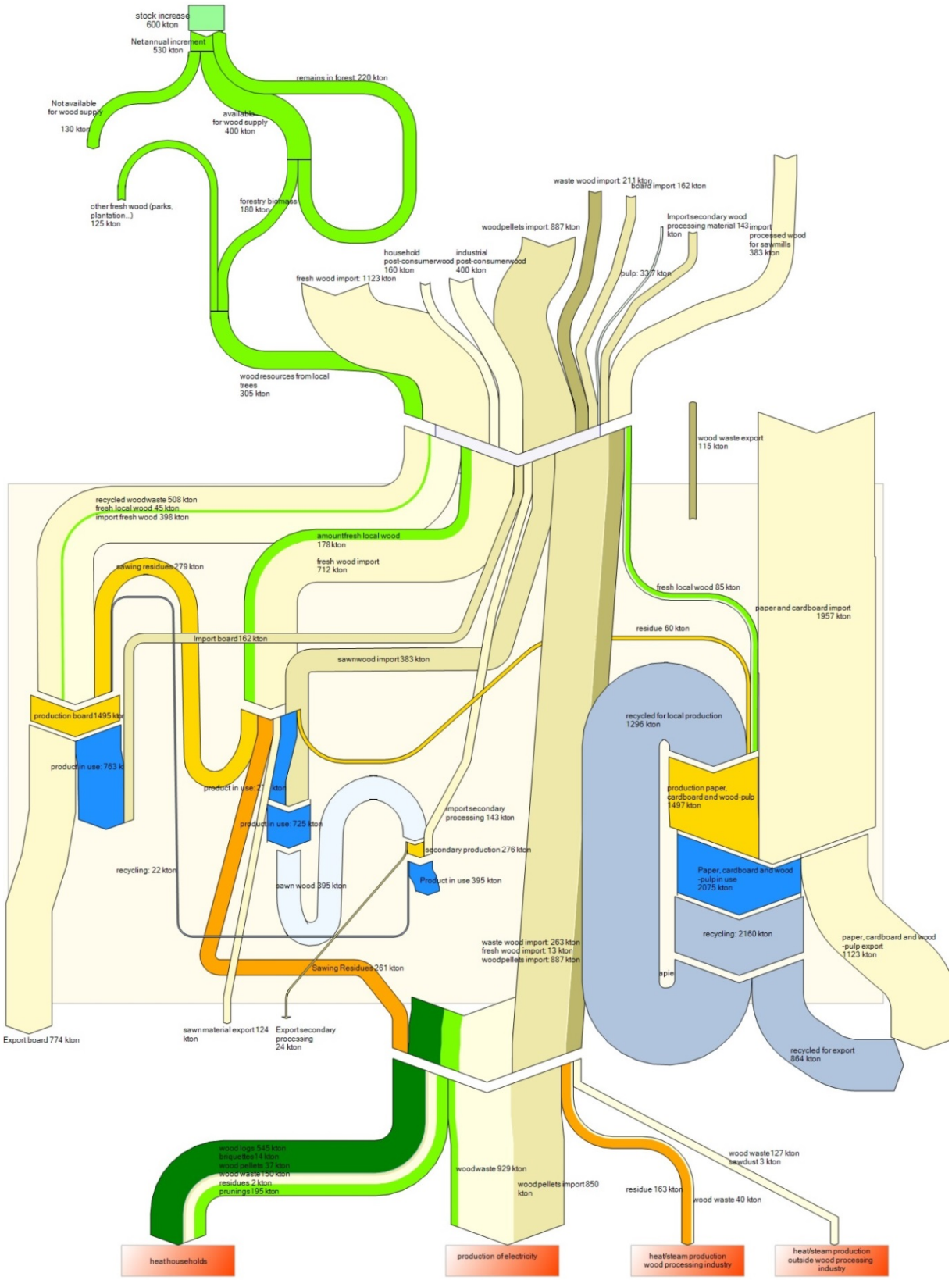


Figure 11: Sankey diagram of wood flows in Flanders. Source: Vito-OVAM, Impactanalyse beleidsvoorstellen voor het duurzaam gebruik van houtafval, 2015)

In the Sankey diagram, an overview is given of the pathways the different wood flows follow in Flanders. As can be detected on the top of the diagram, Flanders has only a small supply of local fresh wood (light green arrows). Most of the wood needs to be imported in the form of fresh wood but also processed or even waste wood is imported.

On the left of the diagram can be seen that the panel board industry is an important wood processing sector using fresh local and imported but also a large amount of waste wood streams. On the right side of the diagram, the pulp-and paper sector is dominantly present. The specific characteristics of this sector are that they rely mainly on recycled paper as feedstock. Second specific characteristic is the fact that the pulp- and paper industry of Flanders is specialised in the production of certain high-end paper and cardboard products exporting them over the world, but for basic paper products Flanders needs to import.

On the bottom of the diagram, the ultimate end-use of different wood streams can be seen. There are two main wood users, namely the residential sector and the electricity sector. It is not clear where the wood for the households is coming from (dark green arrow), the amount of wood used in this sector does not appear in any statistics. No suitable explication is yet found especially because Flanders is a low in forest area.

Branch and top wood potential in Flanders

The map below is showing the geographical spread of the potential of branch and top wood in Flanders. The east of Flanders has the most forest as can be seen.

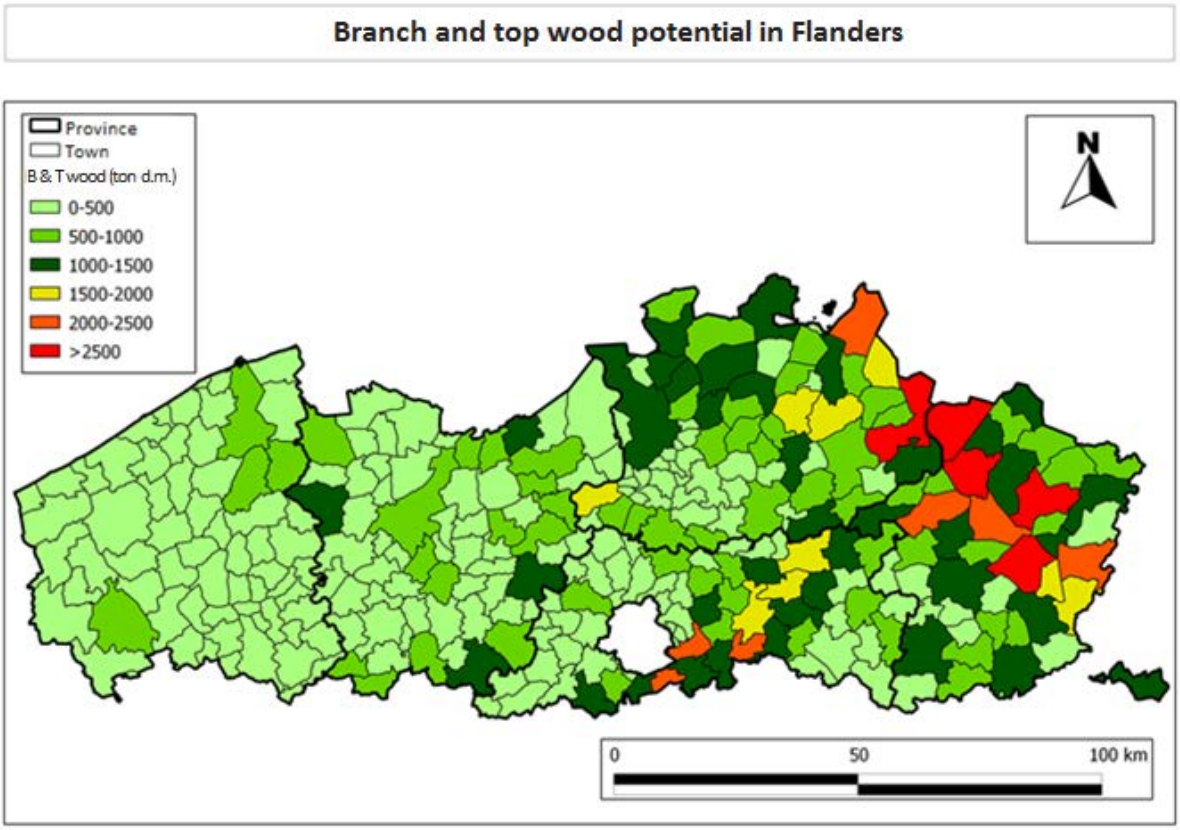


Figure 12: Geographical overview of branch and top wood in Flanders in dry matter (Source: Bio-GIS; R.Guisson, A.Ugarte)

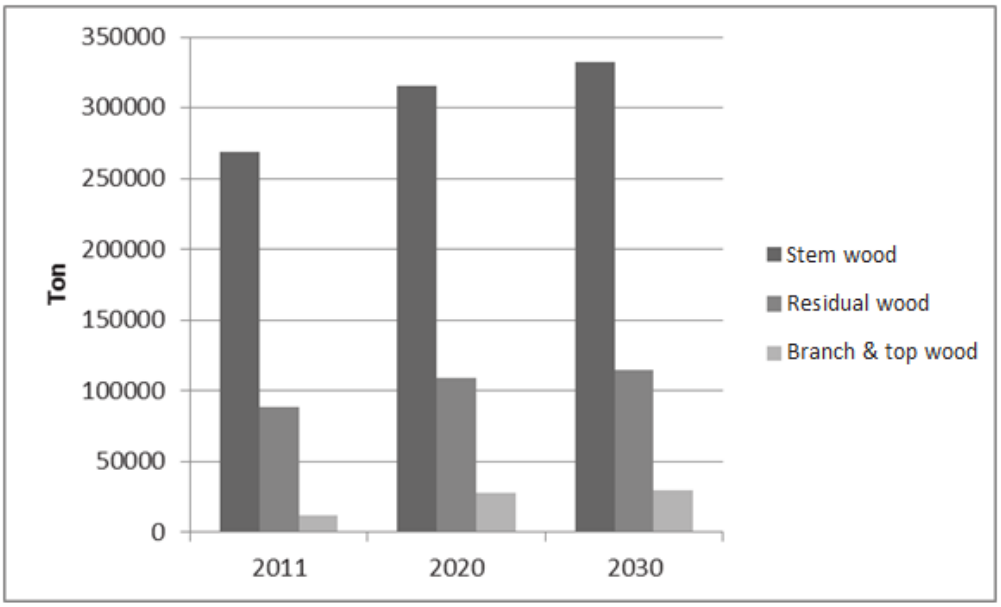


Figure 13: Wood potential in tons in Flemish woods (Source: OVAM, Biomassarestromen aanbod, 2014)

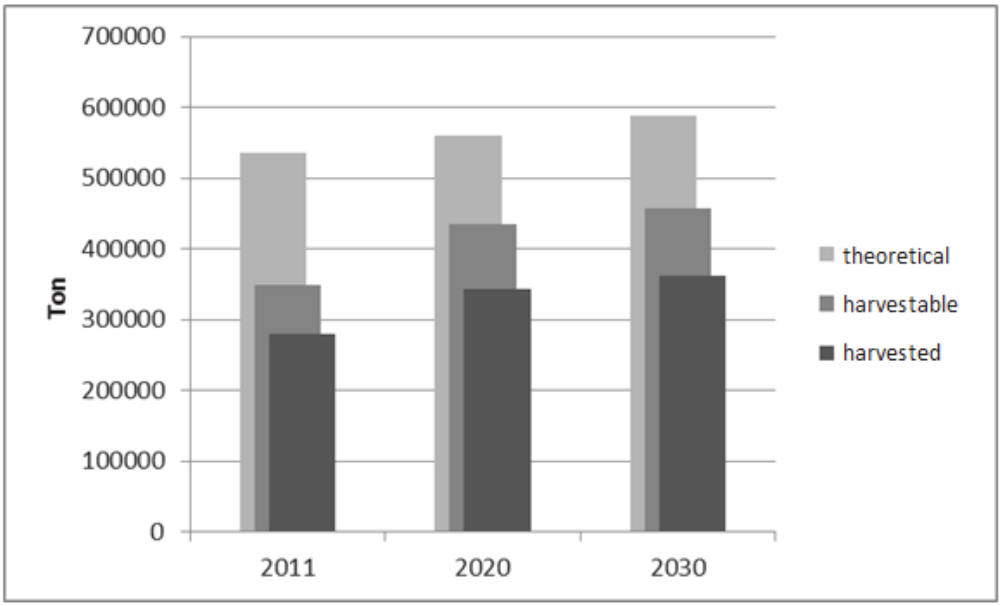


Figure 14: Wood harvest (theoretical potential, potential harvest, harvested) in 2011, 2020 and in 2030. (Source: OVAM, Biomassarestromen aanbod)

The amount of effective harvested wood has still potential to increase. A more activating policy towards private forest owners could be realised (70% of the forest owners is private owners). The Flemish Government stimulates private owners to join on voluntary basis in an association called 'Bosgroepen' to manage the private owned forest in a more structured larger sized area and professionalised way. This has resulted in more well managed and more professionally harvested forests, the latter unlocking new professional markets for the small holders. In addition, privately owned forest is also used increasingly for recreation (www.bosgroepen.be).

→ **Biomass waste streams**

An important part of the local available biomass in Flanders is biomass waste. The Flemish Public Waste Agency makes up circa every 3 years an biomass inventory. Also a forecast of the availability of biomass waste streams for all uses is made up for 2020 and 2030.

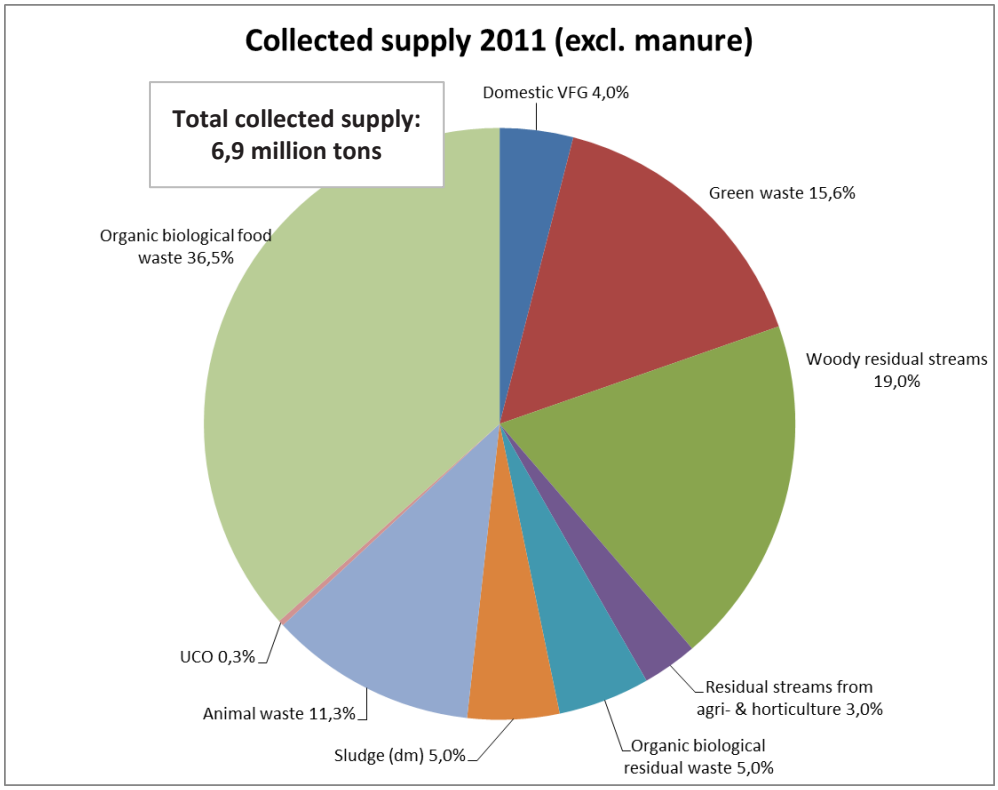


Figure 15: Inventory of supply of biomass waste streams in Flanders in 2011 in percentage of a total of 6,9 million tons. Source: OVAM, Aanbodprognoses Vlaamse biomass-reststromen en verkenning verwerkingsmogelijkheden naar 2030, dec 2013

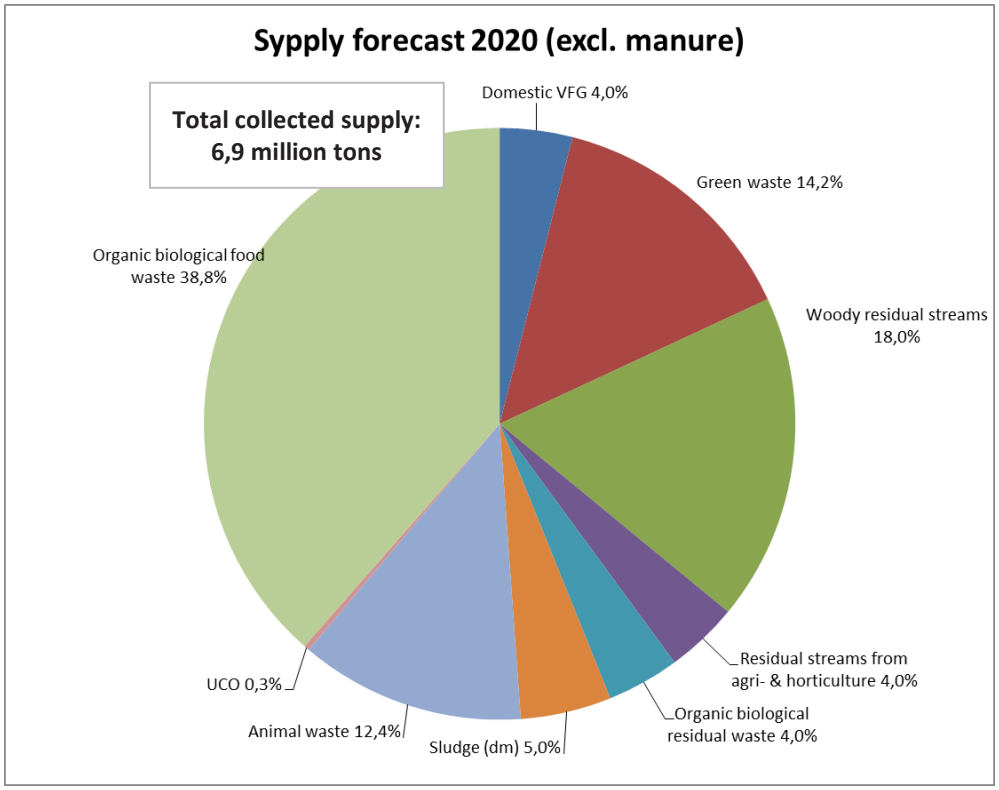


Figure 16: Forecast potential biomass waste streams in Flanders in 2020. Source: OVAM, Aanbodprognoses Vlaamse biomass-reststromen en verkenning verwerkingsmogelijkheden naar 2030, dec 2013

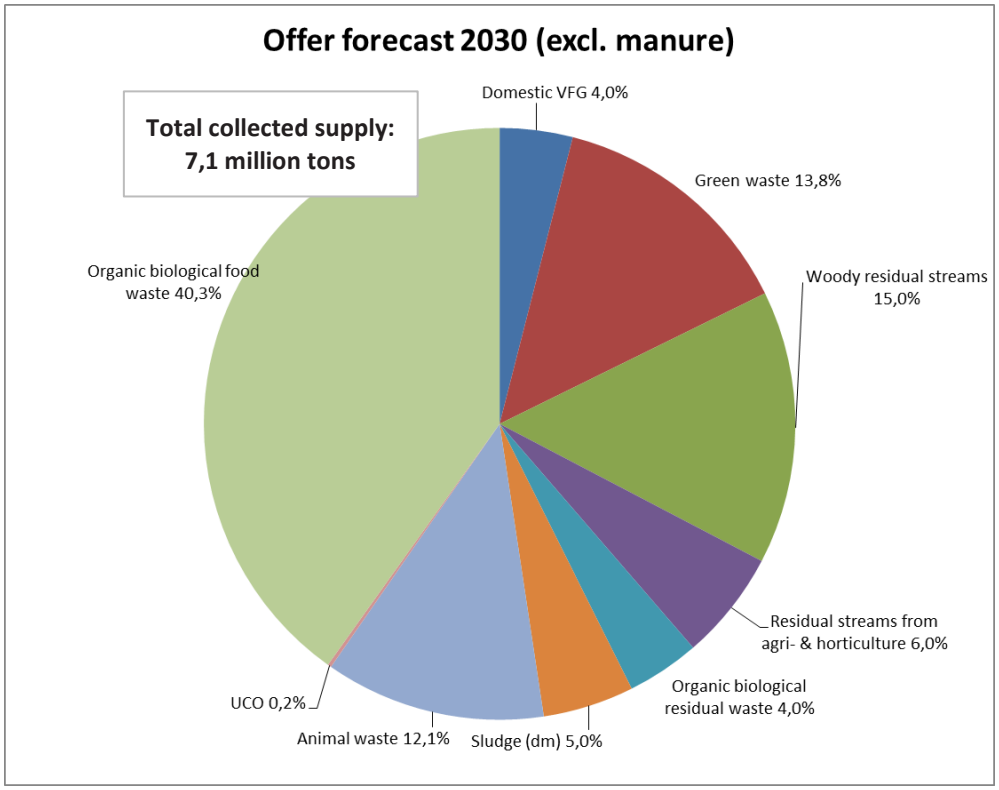


Figure 17: Forecast potential biomass waste streams in 2030 in Flanders. Source: OVAM, Aanbodprognoses Vlaamse biomass-reststromen en verkenning verwerkingsmogelijkheden naar 2030, dec 2013

Table 9: Forecast collected supply of biomass waste streams (exclusive manure). Source: OVAM, Aanbodprognoses Vlaamse biomass-reststromen en verkenning verwerkingsmogelijkheden naar 2030, dec 2013

	Organic-biological residual stream (ton)	Offer 2011	Forecast offer 2020	Forecast offer 2030	Influencing factors
Woody residual streams	Residual wood from forests	89.000	109.000	115.000	Forestry policy, market price of (residual) wood
	Primary wood waste from wood industry	690.000	575.000	470.000	Prevention, cyclicality of furniture industry
	Domestic post-consumer wood waste	160.000	146.000	132.000	Prevention, wood use in goods & packaging, domestic combustion consequently to energy prices, waste tariffs
	Industrial post-consumer wood waste	400.000	382.000	364.000	Prevention, wood use in goods & packaging, cyclicality construction industry
Green waste	Wood prunings & tree trunks	111.000	85.000	77.000	Garden surface and completion, ageing, prevention campaigns, desired & undesired evasive behaviour, waste tariffs, collection by intermediary traders
	Domestic mixed garden waste	352.000	268.000	242.000	
	Company green waste	334.000	320.000	304.000	Surface and completion company green, collection by intermediary traders
	Road side prunings	98.000	127.000	172.000	Characteristics landscaping policy, wood demand, solving of harvest bottlenecks
	Verge prunings	186.000	186.000	186.000	Infrastructure policy, legislation and practical verge policy
VGT	VGT (vegetable/fruit/garden waste)	282.000	257.000	257.000	Garden surface and completion, ageing, prevention campaigns, desired & undesired evasive behaviour, waste tariffs, loss of food
Organic biological food waste	Loss primary sector	349.000	340.000	308.000	Area expansion, development of harvest & sorting techniques, prevention
	Distribution waste	116.000	116.000	116.000	Increase of production, prevention
	Industrial losses	1.778.000	1.944.000	2.148.000	Sector growth, prevention food loss
	Unsold food	129.000	141.000	156.000	Increase of production, prevention
	Hospitality industry (Horeca)	166.000	152.000	137.000	Prevention
UCO	Collected UCO (domestic)	7.000	9.000	7.000	Reduction in fat consumption because of health reasons and efficiency increase, organisation and communication collection channels
	Collected UCO (professional	13.000	11.000	9.000	
Animal waste	C1-C2	174.000	190.000	190.000	Evolution cattle breeding because of manure policy, milk quota system, meat & milk prices, diseases, crises
	C3	614.000	671.000	671.000	
Sludge (dry matter)	Food sludge	30.000	30.000	3.000	Increase of production in food industry, prevention
	Wastewater treatment sludge from paper industry	29.000	26.000	24.000	Competitive position in sector, increase of efficiency
	Sedimentation sludge	134.000	155.000	155.000	Increase share of recycled paper
	Public wastewater treatment sludge	145.000	152.000	159.000	Weather conditions, increase of water use, degree of sewing system, degree of treatment
Organic biological residual waste	Organic biol. fraction of household waste	287.000	244.000	244.000	Increase of domestic composting, evasive behaviour, prevention food loss
	Organic biol. fraction of comparable company waste	36.000	36.000	36.000	
Crop residue agriculture	Sweetcorn grain residue (stalks, ...)	0	0	0	Area decrease, increase of return
	Straw (cereal)	240.000	240.000	240.000	
	Sugar beet loaf	0	0	0	Sugar quota
	Crop residue (cabbage & turnip seed)	500	1.150	780	Cultivation rotation, energy policy
	Potato loaf	0	0	0	
	Potato residue	0	0	0	
	(sprout) cabbage residue	0	28.000	134.000	Increase of demand for local vegetables, food safety, social pressure
	Leek residue	0	5.000	24.000	
	Crop residue (other vegetables in full soil)	0	0	0	
	Crop residue (greenhouse cultivation, other crops)	0	0	0	
Manure	Animal manure	23.000.000	25.155.000	25.155.000	Growth of livestock, use of low-nutrient cattle feed
	OVERALL TOTAL	**29.949.500**	**32.101.150**	**32.235.780**	

Wood waste is an important local biomass waste stream and will be important in the future. The origin of the collected wood waste is given in the figure below.

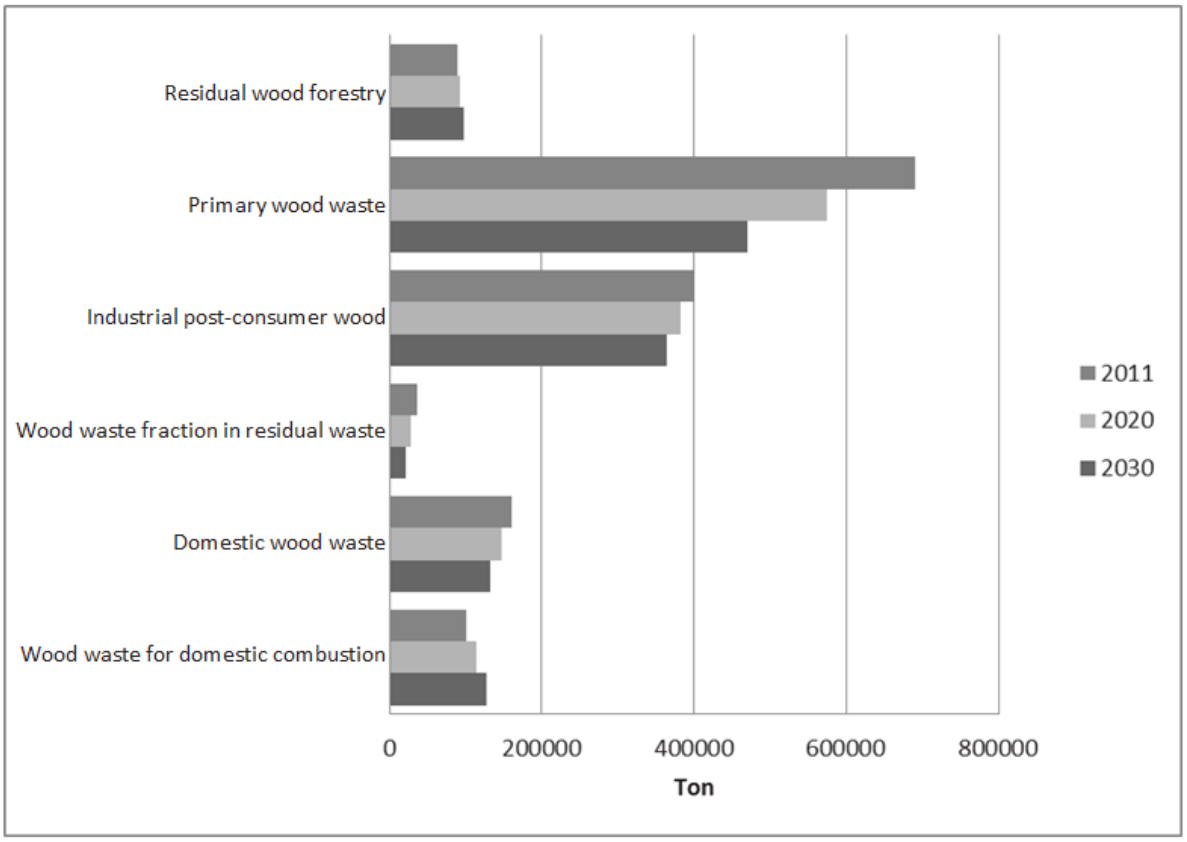


Figure 18: Collected and incinerated household wood waste. Source: OVAM, Aanbodprognoses Vlaamse biomassa-reststromen en verkenning verwerkingsmogelijkheden naar 2030, dec 2013

Green waste (prunings of gardens, public domains, etc.) is collected in Flanders. The geographical availability is given in the map below in ktons.

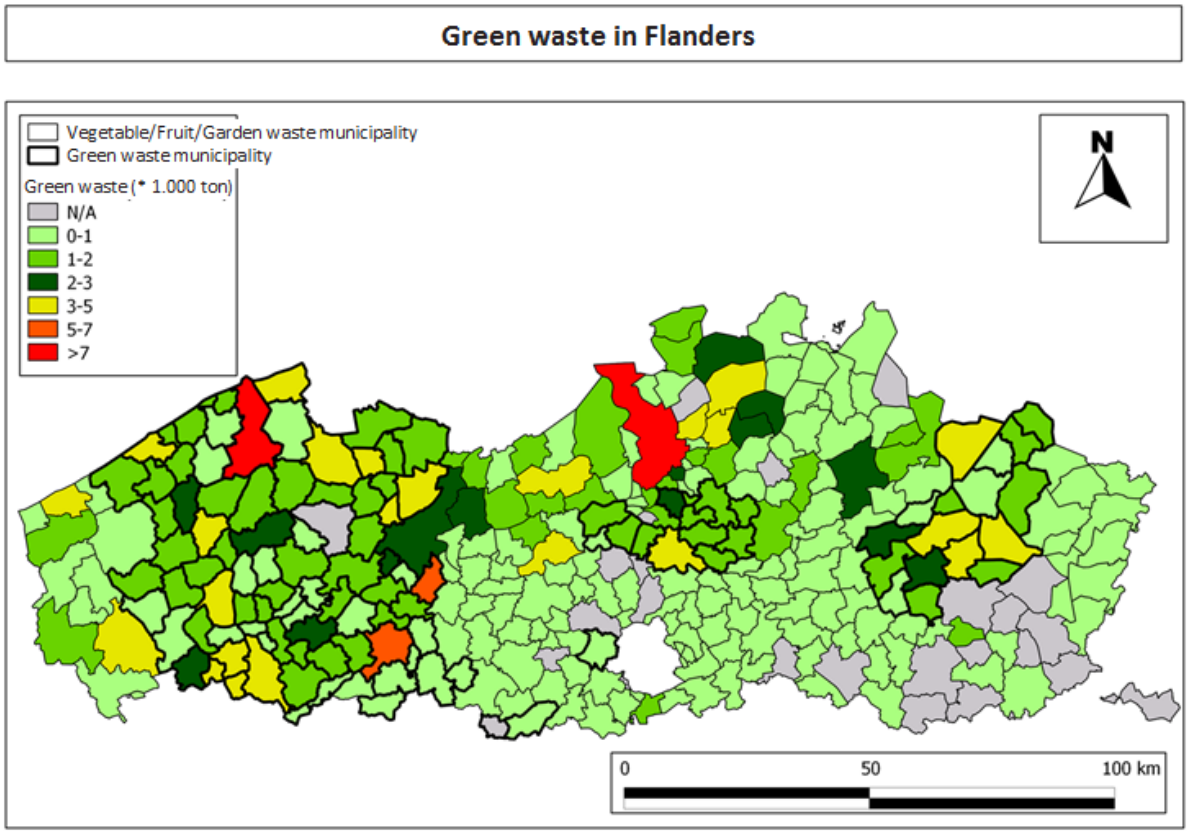


Figure 19: Overview map Flanders of de geographical spread of collected green waste in the Flemish municipalities in 1000 ton/municipality. (Source: Bio-GIS, R.Guisson; A. Ugarte)

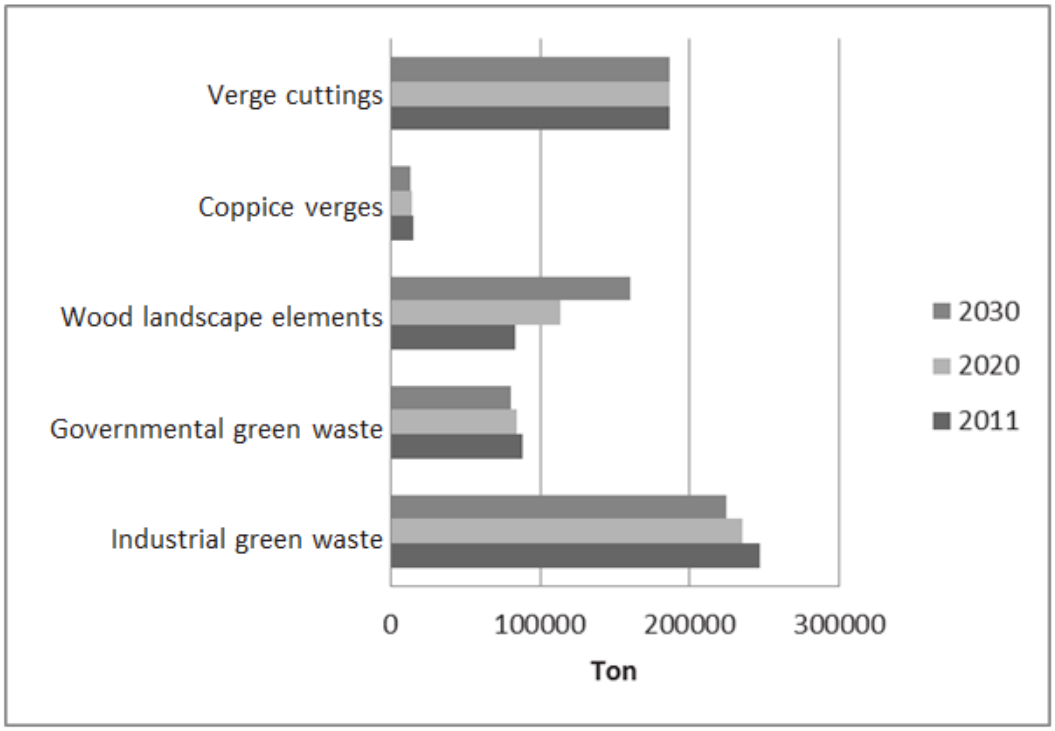


Figure 20: Inventory and forecast of road side cuttings grass and wood, green waste residues in Flanders for 2011, 2020 and 2030 in tons. Source: OVAM, Aanbodprognoses Vlaamse biomass-reststromen en verkenning verwerkingsmogelijkheden naar 2030, dec 2013

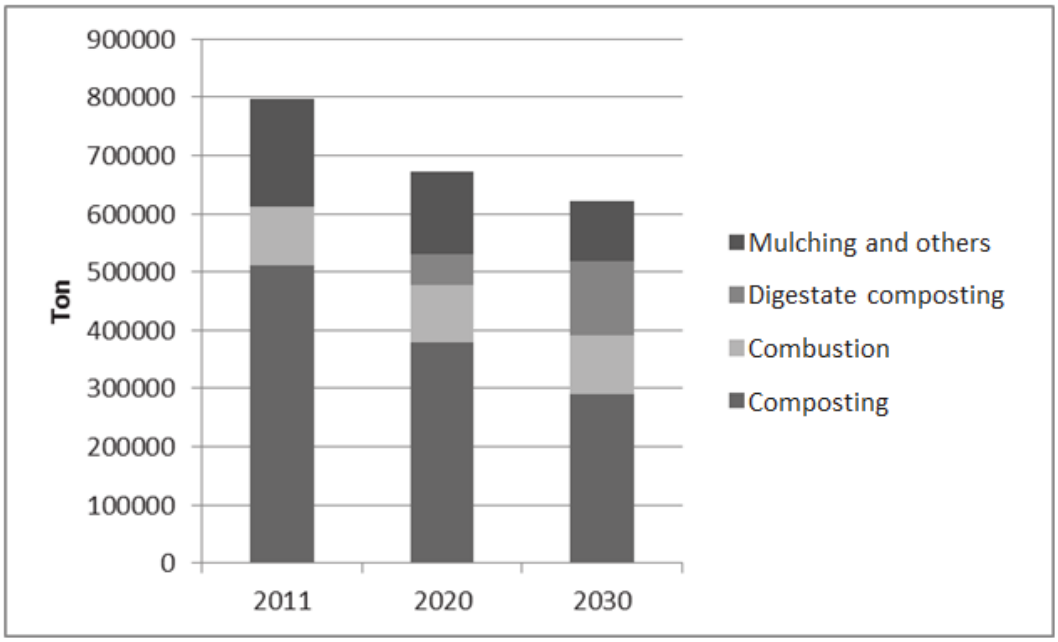


Figure 21: Use of green waste in 2011 and expected use in 2020 and 2030 in Flanders. Source: OVAM, Aanbodprognoses Vlaamse biomass-reststromen en verkenning verwerkingsmogelijkheden naar 2030, dec 2013

As can been seen in Figure 21, the use of green waste for energy in 2011 amounts for 100.000 ton staying stable over the years. Most of the green waste is used to produced different kinds of soil improvements product (mulching, composting, digestate).

The fruit, vegetable and garden waste of households is collected in different municipalities in Flanders. The geographical spread is given in the figure below.

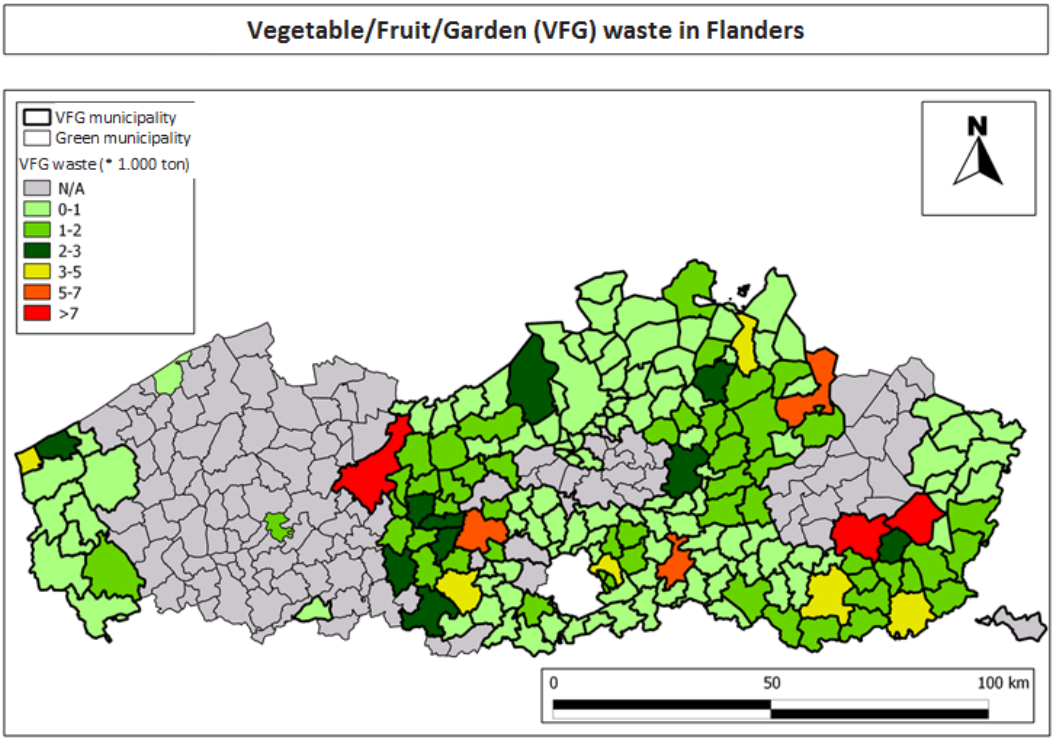


Figure 22: Overview map of the geographical spread of GFT in the Flemish municipalities in 1000 ton/municipality. Source: Bio-GIS; R.Guisson, A. Ugarte

In 2011, about 50.000 tons of the fruit, vegetable and garden waste was used for anaerobic digestion. This could increase to 250.000 tons a year by 2030.

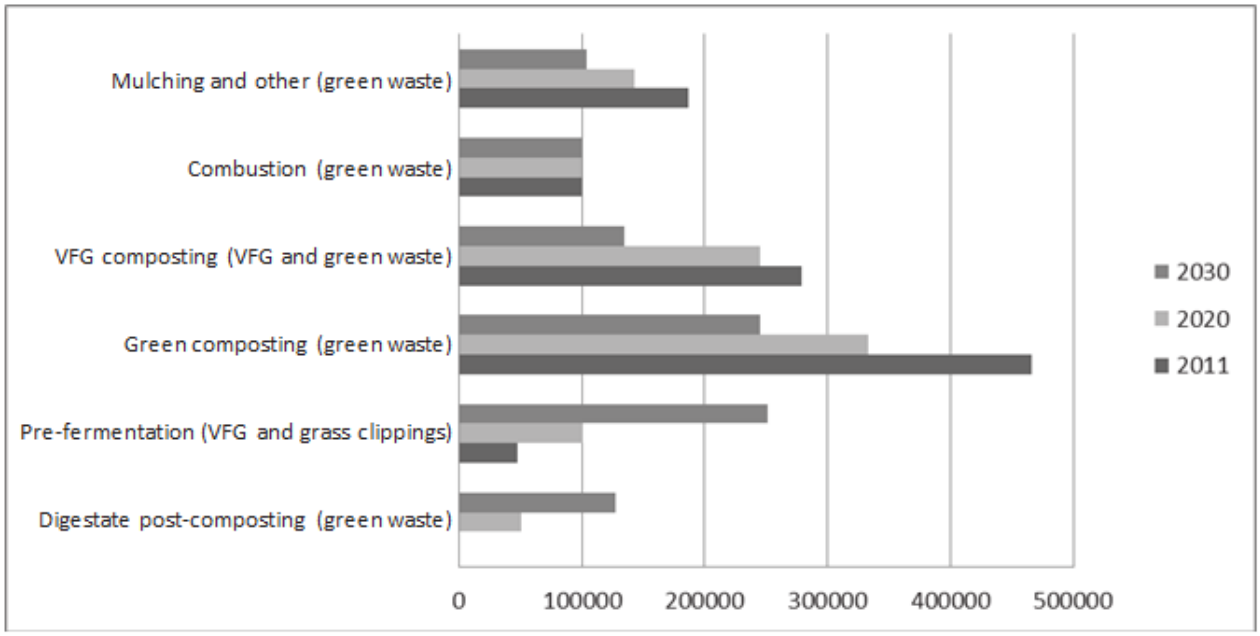


Figure 23: Use of green waste; fruit, vegetable and garden waste and road side cutting in 2011 and forecast for 2020 and 2030. Source: OVAM; Aanbodprognoses Vlaamse biomassa-reststromen en verkenning verwerkingsmogelijkheden naar 2030, dec 2013

In Flanders also the liquid biomass waste streams are intensively collected and used. The amount of used cooking oils in 2011 was about 20.000 tons, the potential available 30.000 tons. The forecast for 2030 is that the potential will decrease but the collected percentage of the used cooking oils will be higher.

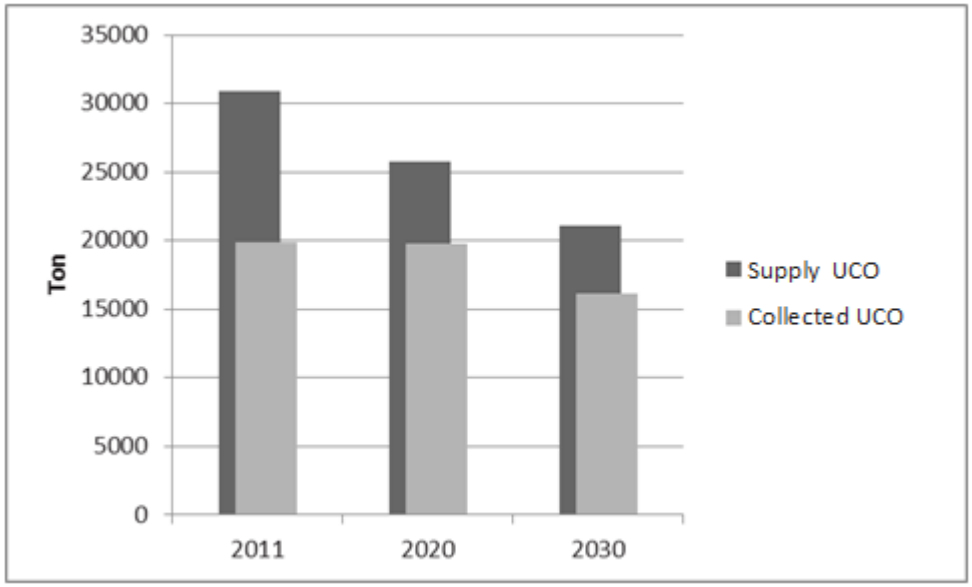


Figure 24: Available used cooking oils and collected used cooking oils for 2011 and forecast for 2020 and 2030. Source: OVAM; Aanbodprognoses Vlaamse biomass-reststromen en verkenning verwerkingsmogelijkheden naar 2030, dec 2013

2.5. BIOENERGY PLANTS

2.5.1. FLANDERS

The location and capacity of the biogas plants are being monitored by Biogas-E in Flanders. Biogas-E is the NGO dealing with the promotion and concerns of anaerobic digestion installation. Biogas-E statistics show that the amount of installations is stagnating the last couple of years. New installations are stated-up (2 installations under construction in the period 2012-2014) but on the other side also old installations are shutting down (4 installation in the period 2012-2014). This shows that the biogas sector has reached their maximum capacity with the current subsidy system. The installed capacity (input tons) has increased with 138% in comparison to the reference year 2007-2008 in comparison with a triple increase of the electrical power capacity installed. An increase in installed electrical power and in capacity can be seen over the last years.

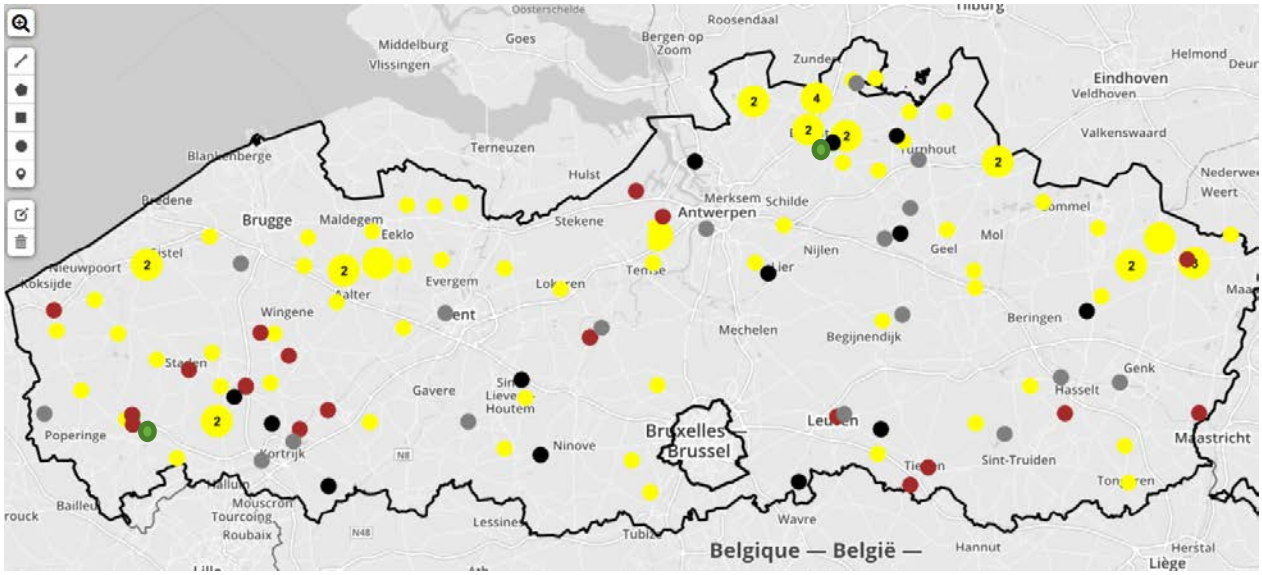


Figure 25: Geographical spread of biogas installations in Flanders (yellow: mainly agricultural input, green: garden-fruit-vegetable waste, grey (water treatment plant sludges), black (landfill gas), red (others) (source: https://biogis.vito.be/)

Table 10: Installed electrical power (kWe) and permitted input capacity (tons/year) of anaerobic digesters in Flanders (August 2014). Source: Voortgangsrapport 2013 Biogas-E.

Company	Town	Province	Installed power (kWe)	Licensed capacity (ton/year)
Agrikracht Moorslede	Moorslede	West-Vlaanderen	1.486	48.000
Agrikracht Rumbeke	Rumbeke	West-Vlaanderen	835	35.000
Agri-Power bvba	Malle	Antwerpen	3.854	60.000
Agro Energiek bvba	Zomergem	Oost-Vlaanderen	1.038	60.000
Agrogas	Geel	Antwerpen	2.978	60.000
Ampower	Egem	West-Vlaanderen	7.445	180.000
Arbio	Arendonk	Antwerpen	3.280	60.000
Barts Potato Company	Vleteren	West-Vlaanderen	1.666	60.000
BIO 7 NV	Rijkevorsel	Antwerpen	2.905	24.000
Bio-Electric bvba	Beernem	West-Vlaanderen	2.461	60.000
Bio-Energie Herk	Herk-de-Stad	Limburg	1.000	45.000
BioEnergy nv	Lommel	Limburg	5.384	225.000
Biogas Boonen	Meerhout	Antwerpen	1.922	30.000
Biogas Bree	Bree	Limburg	2.380	45.000
Biogas De Biezen	Arendonk	Antwerpen	3.278	36.000
Biogas-Boeye bvba	Haasdonk	Oost-Vlaanderen	2.233	60.000
Biomass Center (Ieper) bvba	Ieper	West-Vlaanderen	2.085	50.000
BIO-N.R.G(overname Wittevrongel-Eneco begin 2014)	Aalter	Oost-Vlaanderen	2.830	60.000
Biopower Tongeren bvba	Tongeren	Limburg	2.826	65.000
Calagro Energie bvba	Zomergem	Oost-Vlaanderen	2.860	60.000
Digrom Energy nv	Ardooie	West-Vlaanderen	1.486	44.000
Greenergy bvba	Herselt	Antwerpen	2.486	52.500
GSL bvba (Groene Stroom Lievens)	Halle	Vlaams-Brabant	1.131	27.000
Guilliams Green Power	Neervelp	Vlaams-Brabant	1.248	60.000
IGEAN 1&2 (Dranco 1 & 2)	Sint-Lenaarts	Antwerpen	2.353	65.000
IVEB NV	Brecht	Antwerpen	1.095	130.000
IVVO	Ieper	West-Vlaanderen	1.408	50.000
Leiestroom nv	Menen	West-Vlaanderen	4.500	95.000
NPG BIO II (DP WORLD)	Beveren	Oost-Vlaanderen	2.974	60.000
NPG Bocholt	Bocholt	Limburg	2.800	60.000
Op De Beeck NV	Kallo (Beveren)	Oost-Vlaanderen	2.978	100.000
Quirijnen Energy Farming nv	Merksplas	Antwerpen	3.570	60.000
Senergho bvba	Hooglede	West-Vlaanderen	1.064	45.000
Shanks Vlaanderen	Roeselare	West-Vlaanderen	4.024	40.000
Storg bvba	Houthalen-Helchteren	Limburg	2.000	24.000
Van Remoortel	Verrebroek	Oost-Vlaanderen	1.200	50.000
VC-Energy	Deinze	Oost-Vlaanderen	3.511	60.000
Veurne Snack Foods	Veurne	West-Vlaanderen	732	7.500
Waterleau New Energy	Ieper	West-Vlaanderen	3.192	120.000
Wauters Plan LV	Vliermaal	Limburg	4.064	40.000

An interesting new trend in the utilisation of local biomass waste streams is the introduction of the pocket digesters also followed up by Biogas-E. In 2011, the first pilot was constructed by the company Biolectric. In 2012, 35 new installations were build, in 2013 again 13 new installations have started up. In 2014, it is estimated by Biogas-E that circa 10 new installations have started up.

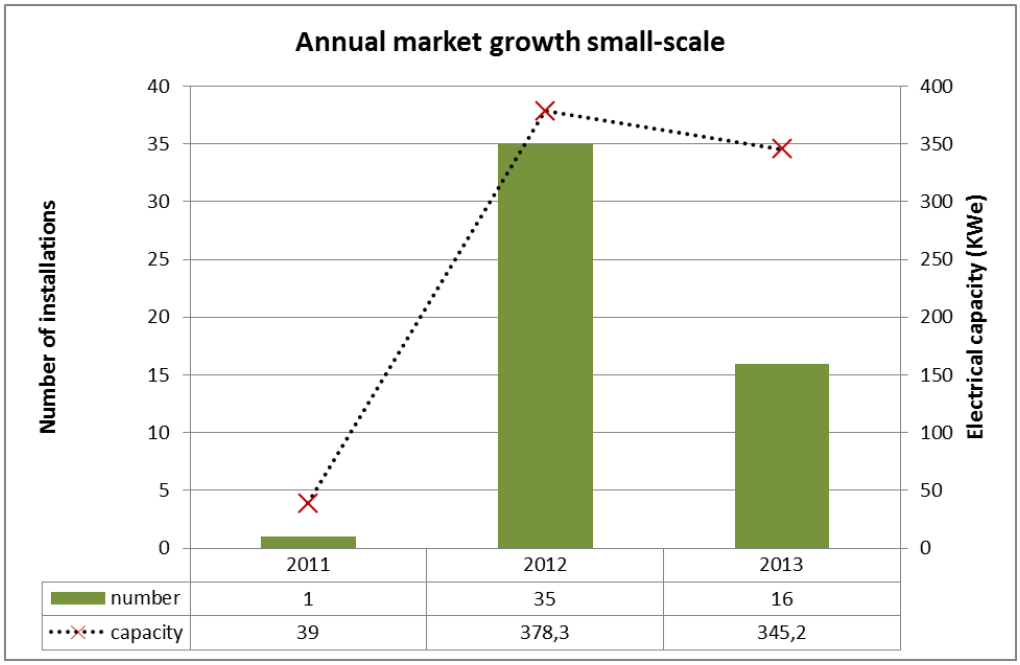


Figure 26: Yearly increase of amount and installed power of small scale biogas installations in Flanders. Source: Voortgangsrapport 2013, Biogas-E

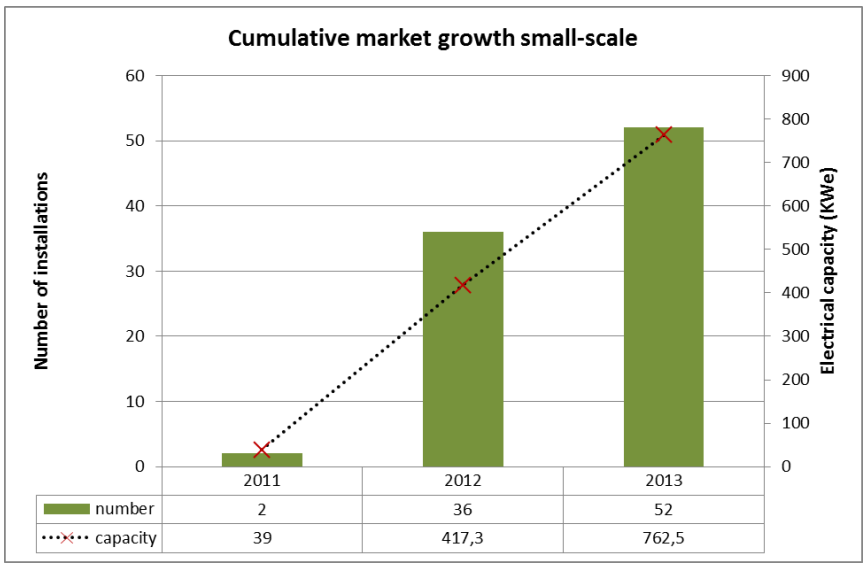


Figure 27: Cumulative market growth of small scale biogas installations in Flanders for the years 2011-2012-2013. Source: Voortgangsrapport 2013, Biogas-E

CHAPTER 3 POLICY SUPPORT AND EXPECTED BIOMASS USE IN 2020 (AND BEYOND)

3.1. TARGETS AND SUPPORT MEASURES FOR RENEWABLE ENERGY

3.1.1. BELGIUM

Table 11: Evolution share renewable energy Belgium (Source: NREAP Belgium 2010, Progress report 2013)

Share of energy from renewable sources in gross final consumption of energy in 2005	2,20%
Share of energy from renewable sources in gross final consumption of energy in 2011	5,17%
Share of energy from renewable sources in gross final consumption of energy in 2012	6,81%
Target of energy from renewable sources in gross final consumption of energy in 2020	13%
Expected total adjusted energy consumption in 2020 (ktoe)	41,301
Expected amount of energy from renewable sources corresponding to the 2020 target (ktoe)	5,369

Table 12: Targets renewable energy Belgium (Source: NREAP Belgium 2010, Progress report 2013)

%	2005	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
RES Heating & Cooling	2.3%	4.68%	6.64%	5.1%	5.9%	6.6%	7.5%	8.5%	9.6%	10.7%	11.9%
RES Electricity	2.7%	8.83%	11.12%	9.5%	11.3%	12.7%	14.8%	16.5%	18.2%	19.6%	20.9%
RES Transport	0.0%	4.00%	4.46%	4.8%	5.7%	5.8%	6.3%	6.5%	7.9%	9.0%	10.14%
Overall RES share	2.2%	5.17%	6.81%	5.8%	6.8%	7.5%	8.6%	9.5%	10.7%	11.9%	13.0%

Table 13: Targets renewable energy Belgium (NREAP Belgium 2010)

	2013-2014	2015-2016	2017-2018	2020
RES minimum trajectory (%)	5.44	7.06	9.22	13
RES minimum trajectory (ktoe)	2,232	2,901	3,797	5,370

The renewable energy targets for Belgium are divided over the regions and the federal level.

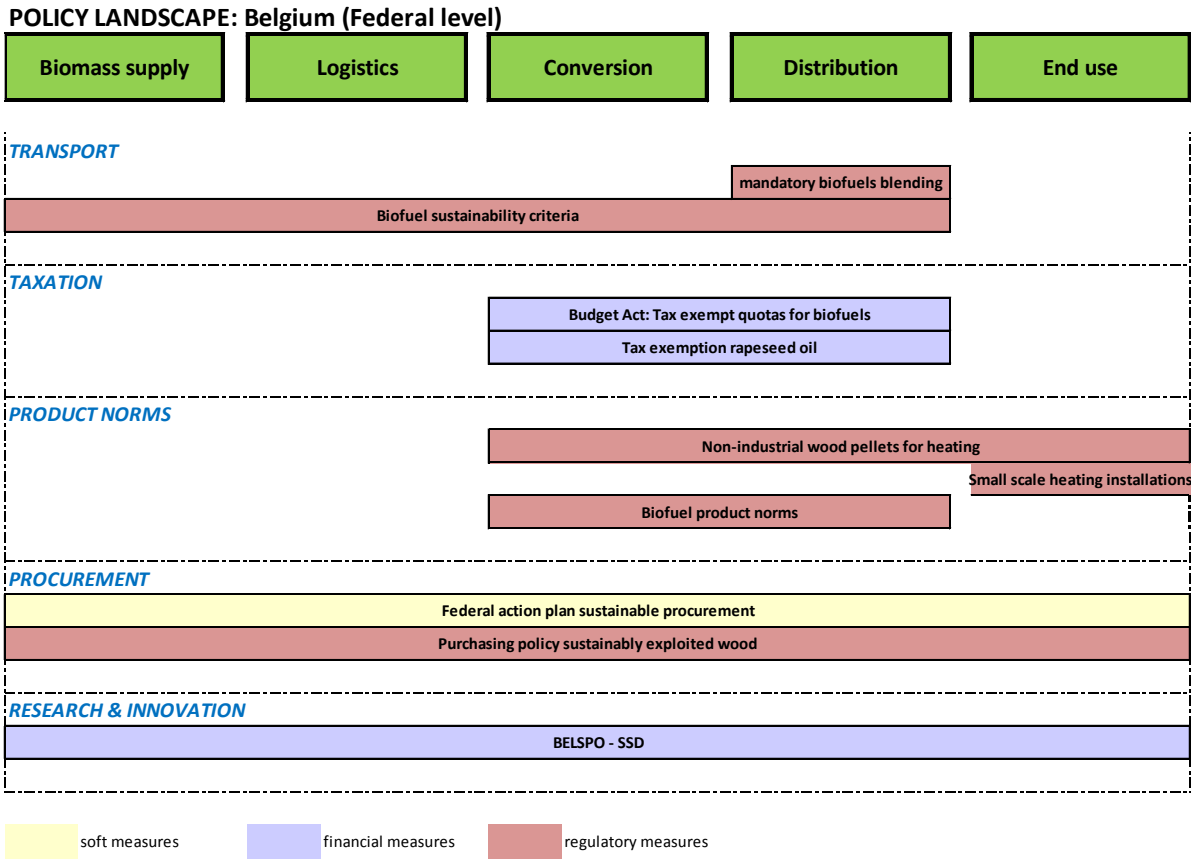


Figure 28: Policy landscape: Belgium (Federal level). Source: IEE Biomass Policies, L.Pelkmans 2014

The main responsibility on federal level for Renewable Energy is the renewable energy target for transport, tax exemptions and product norms.

The different decrees that are implemented are summarized below.

Biofuels are supported by means of a tax-exempt quota and mandatory incorporation.

Federal: Law of 17 July 2013 on the mandatory nominal blending of sustainable biofuels

The legal basis is the Act on the mandatory blending of biofuels in fossil fuels for consumption. This act replaced the former act of 1 July 2009, the new act was published on 17th of July 2013.

The Act states that any registered oil company offering petrol and/or diesel products for consumption must also — in the same calendar year — offer a quantity of x% v/v of sustainable biofuels for consumption;

- FAME (fatty acid methyl ester) at a rate of a maximum percentage fixed in the norm NBN EN 590, at the moment 7% v/v of the quantity of diesel products offered for consumption
- Bioethanol, pure or in the form of bio-ETBE, at a rate of a maximum percentage fixed in the norm NBN 228, at the moment 5% v/v of the quantity of petrol products offered for consumption.

Any registered oil company that does not observe the fixed percentage will be subject to an administrative fine of EUR 900 per 1000 l at 15°C of biofuel that was not mixed into the annual quantity of petrol or diesel products offered for consumption.

Federal: Tax regulation mechanism

Tax exemptions for biofuels is a scheme of state aid leading to a reduced rate of excise duty for petrol containing the biofuel. These excise duty rates are applied if the biofuels originate from a production unit approved by the Belgian state. Due to an increase of the excise duty on fossil fuel, it is a 'budget neutral' measure. A tender procedure for approval of the biofuel volumes specified in the quota will be launched for every year. Biofuel production will be granted in 10 lots van 9 750 000 liter bio-ethanol, 6 lots of 30 250 000 liter FAME of vegetable origin and 2 lots of 30 250 000 liter of animal fats and Used Cooking Oils.

The Act of 22 May 2014, a change of the Act of 10 June 2006 sets out the reduction of the excise rate for the rate of biofuels contained in petrol and diesel products and produced by production units authorised by the Belgian Government and following different technical and sustainable criteria/preconditions.

For petrol products containing at least 5% v/v bioethanol (following Act of 17 july 2013):

- excise : € 245.4146 per 1 000 litres at 15 °C;
- special excise : € 324.2211 per 1 000 litres at 15 °C;
- contribution for energy: € 28.6317 per 1 000 litres at 15 °C;

For diesel products containing at least 7% v/v of FAME (following Act of 17 july 2013):

- excise: € 198.3148 per 1 000 litres at 15 °C;
- special excise: € 197.2987 per 1 000 litres at 15 °C;
- contribution for energy: € 14.8736 per 1 000 litres at 15 °C

Federal: Tax regulation mechanism

Biofuel from rapeseed oil produced by a natural or legal person who directly sells its production to the end consumer without intermediary can be exempted from excise duty (Act of 10 March 2006). The exemption of rapeseed oil equals the excise rate of the fuel it replaces.

Federal: Royal Decree of 26 November 2011 on product norms for biofuels, including sustainability criteria

This decree sets out the product standards for biofuels and lays down the provisions in terms of the national certification plan demonstrating the sustainability applying to biofuels in accordance with directive 2009/28/EC and directive 2009/30/EC.

This Decree is in line with European Renewable Energy Directive & Fuel Quality Directive.

3.1.2. FLANDERS

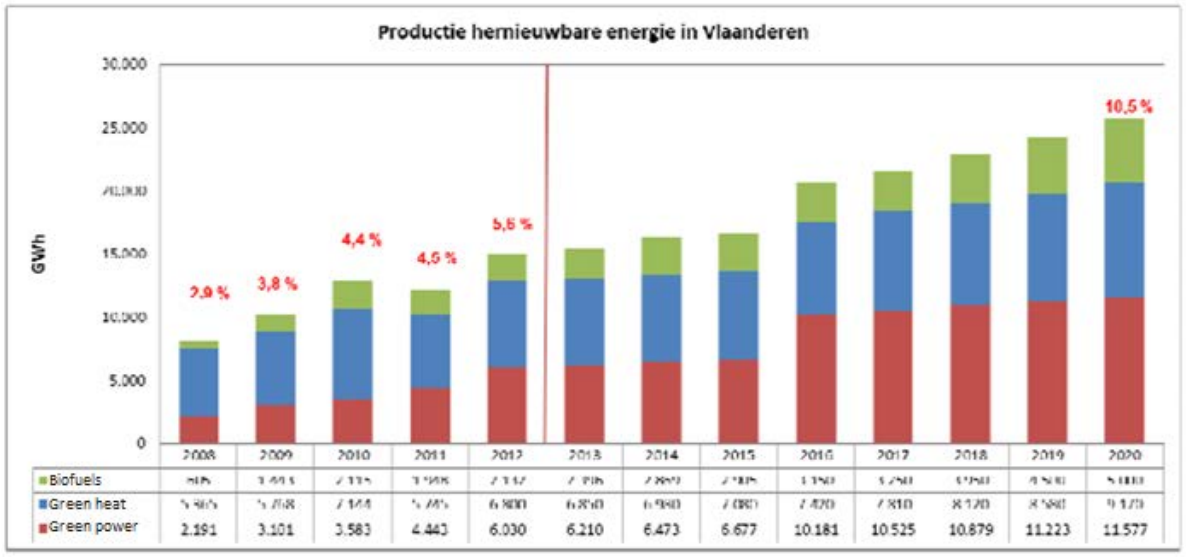


Figure 29: Production and forecast renewable energy in Flanders by energy carrier in GWh. Source: VEA reporting 2013

In 2012, the amount of renewable heat was responsible for 45% of the total production of renewable energy. In 2020 it is foreseen that renewable electricity will be the main carrier (45%). It is forecasted that the renewable electricity will double by 2020. Green heat will grow by 1/3. Biofuels for transport will support the target by 20%, production need to be increased by 135% to reach this amount.

Biomass will stay the most important renewable energy source, although the Flemish region will try to reduce the percentage from 82% in 2012 to 77% in 2020. To do so they hope to stimulate wind energy (triple the amount by 2020) and also stimulate energy production from soil and air with heat pumps. Production of solar energy need to double by 2020.

A more detailed insight in the targets for renewable electricity is given in Figure 30.

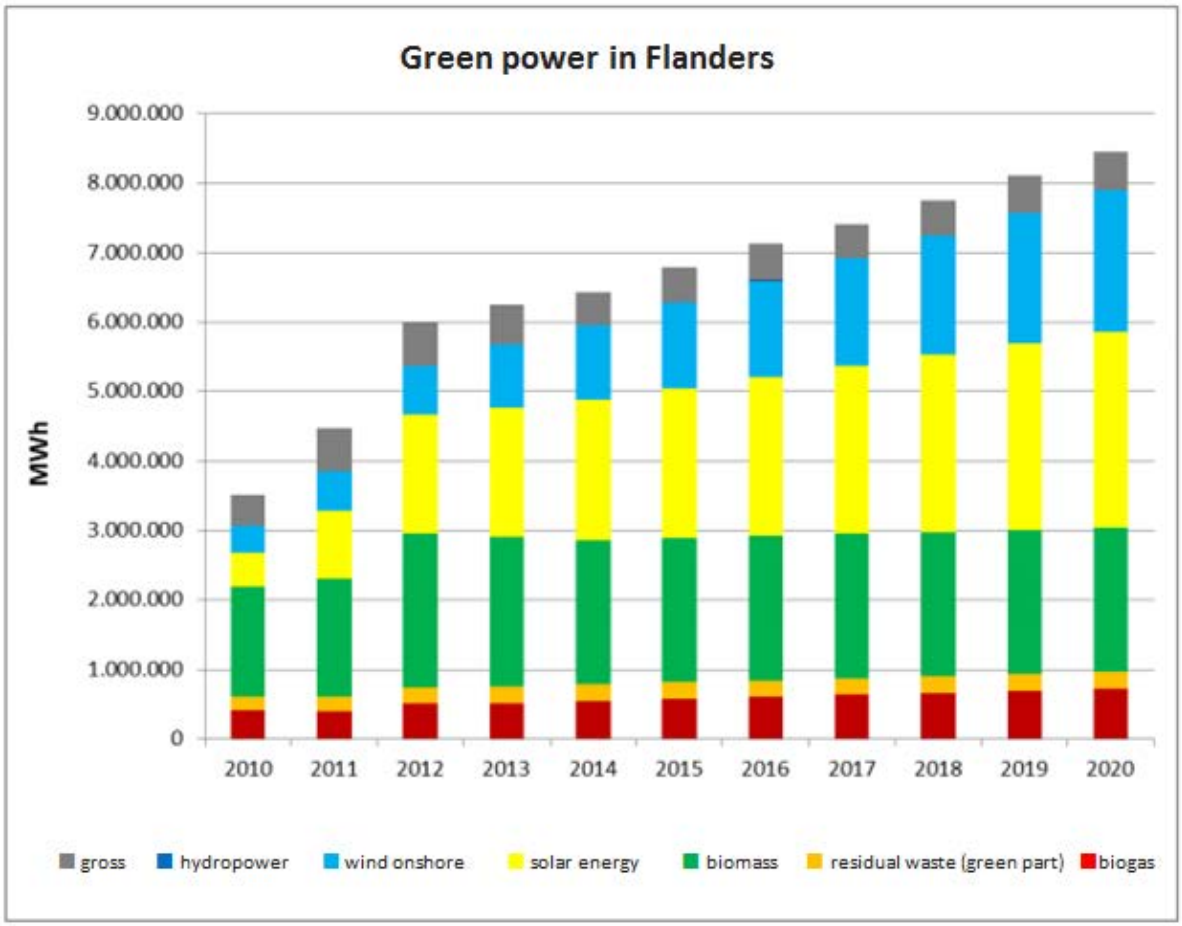


Figure 30: Expected production of renewable electricity in Flanders from 2010 till 2020. Source: VEA reporting 2013

For (solid) biomass (green bar in Figure 30) the shutting down of the Ruien cofiring installation is taken into account. In the Flemish region investment plans for 2 major dedicated biomass-to-energy installations were made up. One by the company BEE Power in the harbour of Gent with a yearly amount of 1.550.000 of green certificates to produce for a period of 15 years. The other was by EON in Langerloo (east of Belgium) for a revamping of a coal fired installation to a dedicated biomass-to-energy installation, this scenario is put on-hold at EON. The installation of EON is for sale at the moment. The table below is calculating with only the production of the BEE installation and it can be seen that the compensating the shutdown of Ruien with the opening of BEE Power is not enough to reach the subtargets sets out for biomass.

Table 14: Overview of gross electricity production from renewable energy and production of heat/cold from renewable energy. Source: VEA reporting 2013

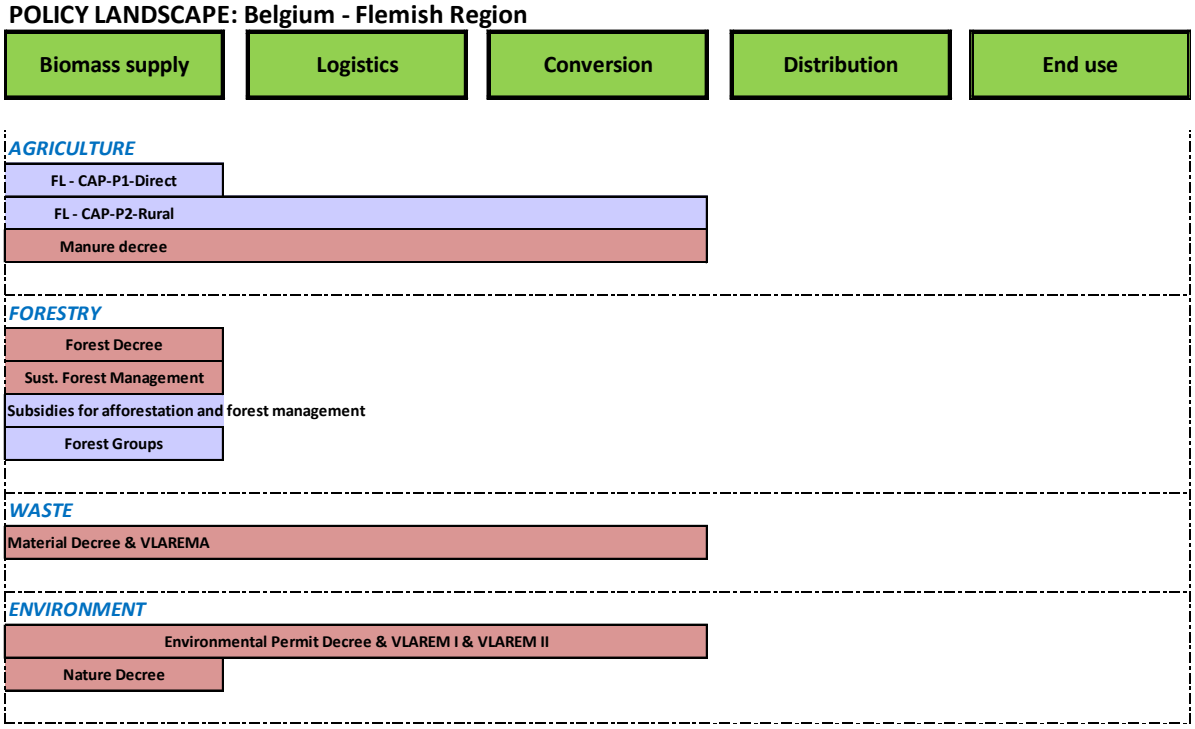
Gross green power (GWh)	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Solar	1890	1960	2070	2220	2370	2520	2670
Wind on land	1100	1264	1428	1592	1756	1920	2094
Hydropower	3	3	3	3	3	3	3
Biomass	2640	2580	5780	5780	5780	5780	5780
Residual waste	270	270	270	270	270	270	270
Biogas	570	600	630	660	700	730	760
Total green power	**6470**	**6664**	**10178**	**10522**	**10866**	**11020**	**11564**
Total green heath	**6980**	**7080**	**7420**	**7810**	**8120**	**8580**	**9170**

Also from biogas, a growth is expected by 2020. Given the current stagnation of the biogas market, the sector federations (Biogas-E, VVP and Febiga) are forecasting this as not realistic with the current policy framework. They predict a growth of only 4 MWe a year, resulting in 20 MWe extra by 2020 and not the 200 MWe extra by 2020 as is expected by the Flemish Government.

Green heat from biomass is produced by households and other sectors. In households in 2012 3252 GWh (11.7 PJ) was produced by wood stoves, open fires and boilers. It is expected that this amount will stay constant over the coming years. In other sectors, 3.292 GWh (11.9 PJ) is produced, and an increase could be possible.
For biofuels, the main driver is the obligation for minimum levels of biofuels in the fossil fuel.

The implementation of the renewable energy directive and other related biomass related legislations together with the coupled actions in Flanders are given in the policy landscape below.

POLICY LANDSCAPE: Belgium - Flemish Region



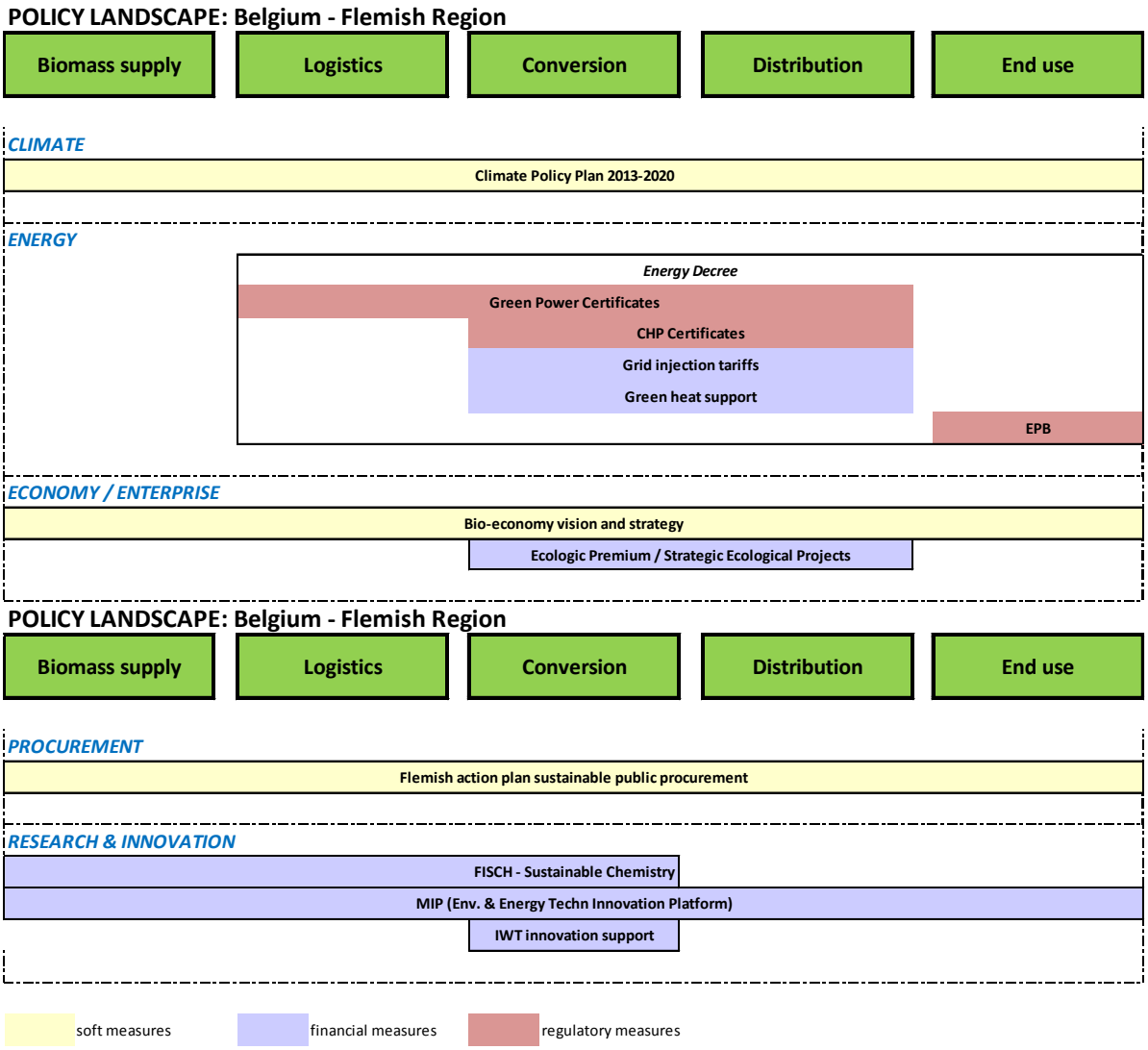


Figure 31: Policy Landscape of Flanders over the whole biomass value change. Source: IEE-Biomass Policies, L. Pelkmans.

The main legislations are summarized below.

<u>Flanders: Energy Decree - Decree of 8 May 2009 concerning general provisions related to energy</u>

The Energy Decree bundles all prior energy related decrees, e.g. electricity and gas decree, and stipulates general conditions for energy policy in Flanders. The following relevant parts can be identified:

- Green power certificates
- CHP certificates
- Grid injection tariffs
- Green heat support
- Renewable heating in buildings obligation

Green Power Certificates

The region of Flanders uses a quota system and a certificate trading scheme to support renewable electricity. In general, all renewable electricity generation technologies are eligible for the quota

system - waste streams or woody material which can be recycled or used by processing industries (e.g. the paper or wood industry) are not entitled to receive green power certificates. The green electricity certificates are issued by the Flemish regulatory authority (VREG). The amount of electricity to be produced for 1 certificate varies across technologies and is based on a technology-specific banding factor. This so called banding factor accounts for the specific technology costs and efficiencies for amortisation. Energy for pretreatment and transport are subtracted from green power certificates (only certificates for net power production). The electricity suppliers are obliged to meet their quota obligations, i.e. present green certificates for the quota defined by law, every year by 31 March. The certificates are for an installation are limited in time.

CHP Certificates - Decision of the Flemish Government of 7 July 2006 for the promotion of electricity produced in qualitative cogeneration installations
In Flanders, each electricity supplier has been obliged since 2005 to contribute to the saving of a specific quantity of primary energy by means of qualitative cogeneration. CHP producers are eligible for CHP certificates and they can sell these certificates to electricity producers that need to fulfil their certificate obligations. The amount of CHP certificates granted for 1000 kWh of primary energy saved in a qualitative CHP-facility compared to a situation in which the same quantity of electricity or heat were produced separately is multiplied with the respective banding factor. If an electricity supplier submits too few certificates, they have to pay an administrative fine of 45 euros per missing CHP-certificate. The most important difference with the green certificates is the following: The CHP certificates decrease in value: They have a maximum value during the first 4 years, with a linear reduction to 0 after approximately 10 years. The minimum support is EUR 27 for installations connected to the distribution system. There is no partial reduction for large-scale consumers.

CHPs on biomass are also entitled to receive CHP certificates (next to green power certificates). Depending on the type of biomass, different reference efficiencies (cfr. European reference efficiencies) are used to calculate if it is a qualitative CHP.

Grid injection tariffs – Decree of 23 Dec 2010 to avoid the use of injection tariffs for electricity produced by renewable energy sources and quality combined heat and power
The grid operator performs all the tasks necessary for the injection of electricity produced by renewable energy sources and qualitative combined heat and power free of charge, except for the connection to the distribution network.

Green heat support - Decision of the Flemish Government of September 13, 2013 regarding the establishment of a support system for green useful heat
Support for green heat produced from large-scale facilities using biomass (> 1 MW). The system works with calls. For the call, projects that inject biomethane into the gas network are also taken into account. The projects will be rewarded a premium per MWh of heat produced (or gas injected). The maximum support is 6 Euro per MWh. Project proposals are selected on the cost effectiveness per MWh and following the available budget per call. The same sustainability criteria are applied for the generation of heat from biomass as for electricity.

EPB - Renewable heating in buildings obligation
From January 2014, every new building, office or school in Flanders needs to obtain part of its energy from renewable sources. Biomass heating (covering at least 85% of the gross heating energy needs) qualifies for this, district heating as well (if these are at least 45% renewable).

3.1.3. WALLONIA

The implementation of the renewable energy directive and other related biomass related legislations together with the coupled actions in Wallonia are given in the policy landscape below.

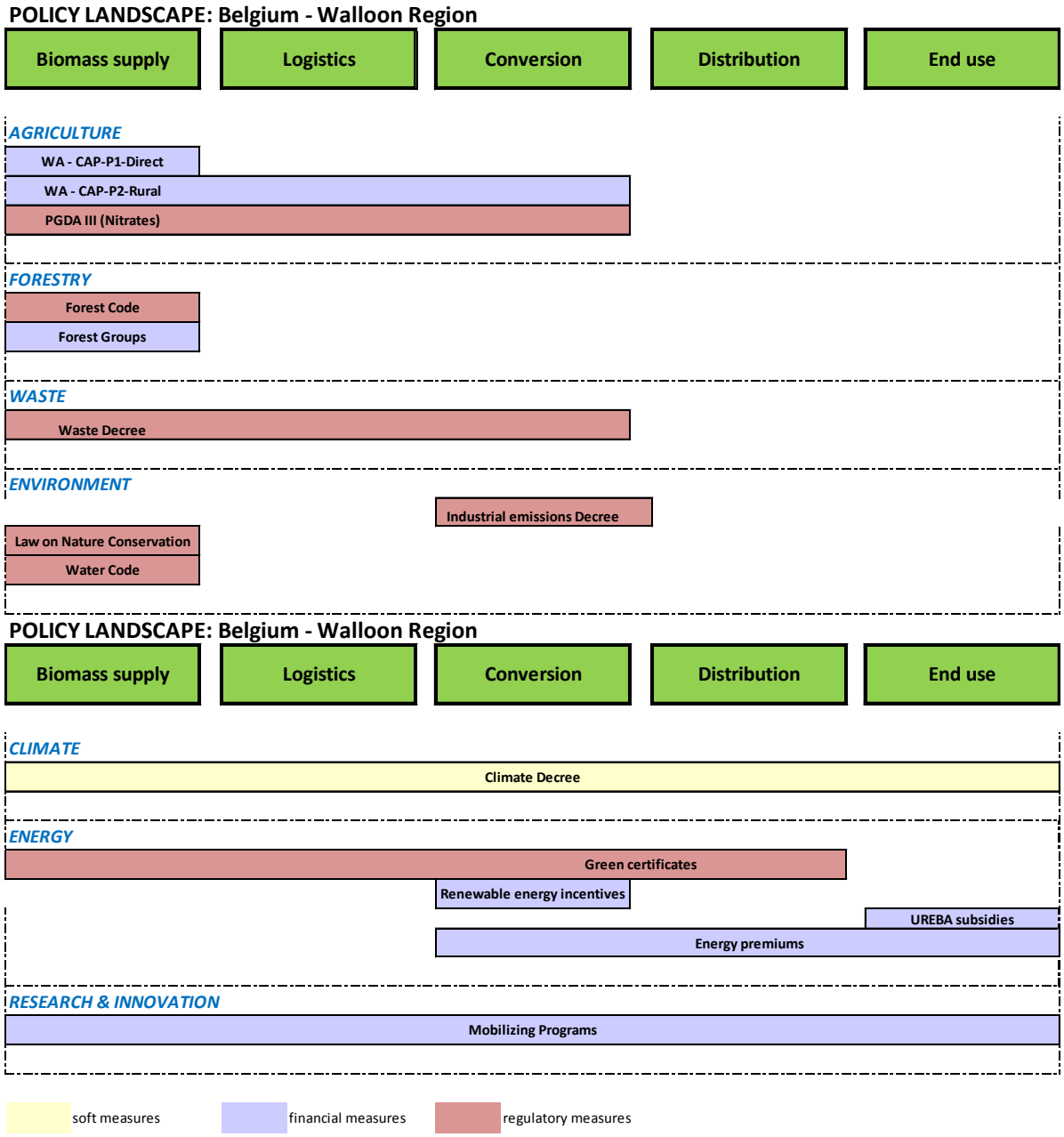


Figure 32: Policy Landscape Wallonia over the whole biomass value chain. Source: IEE- Biomass Policies. L. Pelkmans

The main policy drivers are summarized below.

<u>Walloon Region: Green certificates - Decree of the Walloon Government of 30 November 2006 on Support for Renewable Energy and Combined Heat and Power Generation</u>

In the Walloon region, renewable electricity generation is promoted through quota obligations. Electricity suppliers are obliged to prove, by submitting certificates, that a certain statutory and continuously increasing proportion (quota) of the electricity they supply was generated from

renewable sources. One certificate is issued for every MWh divided by the amount of **CO_2 saved over the full value chain** and economic profitability (since 2011 a correction factor 'k' is applied). The minimum price per certificate is guaranteed by statutory law.

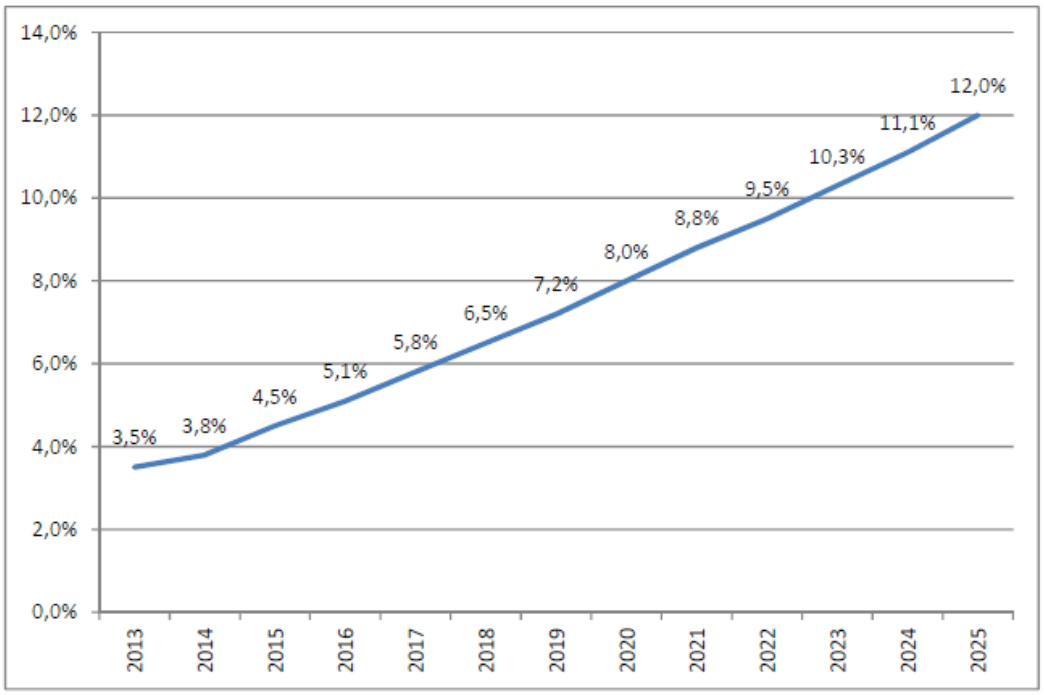


Figure 33: Renewable energy targets for Wallonia till 2025 in percentage. Source: CWAPE

Walloon Region: Decree of 11 March 2004 on incentives intended to promote environmental protection and sustainable use of energy

The Walloon Region provides investment assistance for companies which develop projects aiming at developing the sustainable use of energy, including investments in renewable energy plants. The production of heat and electricity through biogas CHP plants with an electrical power less than 10 kW is eligible. Heat production through biomass heating plants as well as heat and electricity production through biomass CHP plants are eligible, except solid biomass CHPs with electric power >1 MW, or plants using liquid biomass.

Walloon Region: UREBA - Decree of 28 March 2013 on the granting of subsidies to public bodies as well as non-commercial bodies for projects aiming at improving the energy performance of their buildings.

Within the bounds of its available budget, the Walloon region provides UREBA subsidies, which aim at supporting public bodies such as towns and provinces in their initiatives to reduce the energy consumption of their buildings. Projects using renewable energy sources are subsidised. The hard ware as well as the installation of renewable energy plants for the production of heat for the exclusive use of the building are eligible. The subsidy amounts to 30 % of the investment costs.

Walloon Region: Energy premiums 2012-2013

The installation of heating plants through biomass, shallow geothermal energy (heat pumps) and solar thermal energy (solar water heaters) is eligible for the energy premiums. Moreover, CHP plants using biogas or biomass are also eligible.

Biogas and biomass CHP plant: The amount of the subsidy amounts to 20 % of the installation costs and cannot exceed € 15,000. In case the CHP installation is a central heating plant, the amount of

the subsidy is increased by € 100 per meter of piping. This additional premium cannot exceed 50 % of the installation costs and is limited to € 100,000 per district heating.

Biomass: Depending on the capacity of the installation, the subsidy amount is between € 1,750 for installations under 50 kW and € 10,700 for installations above 500 kW. Moreover, above 50 kW the subsidy is increased by € 8 to 35 per kW depending on the capacity of the installation. The amount of the subsidy for biomass heating plants cannot exceed 50 % of the total installation costs, with a maximum subsidy amount of € 15,000.

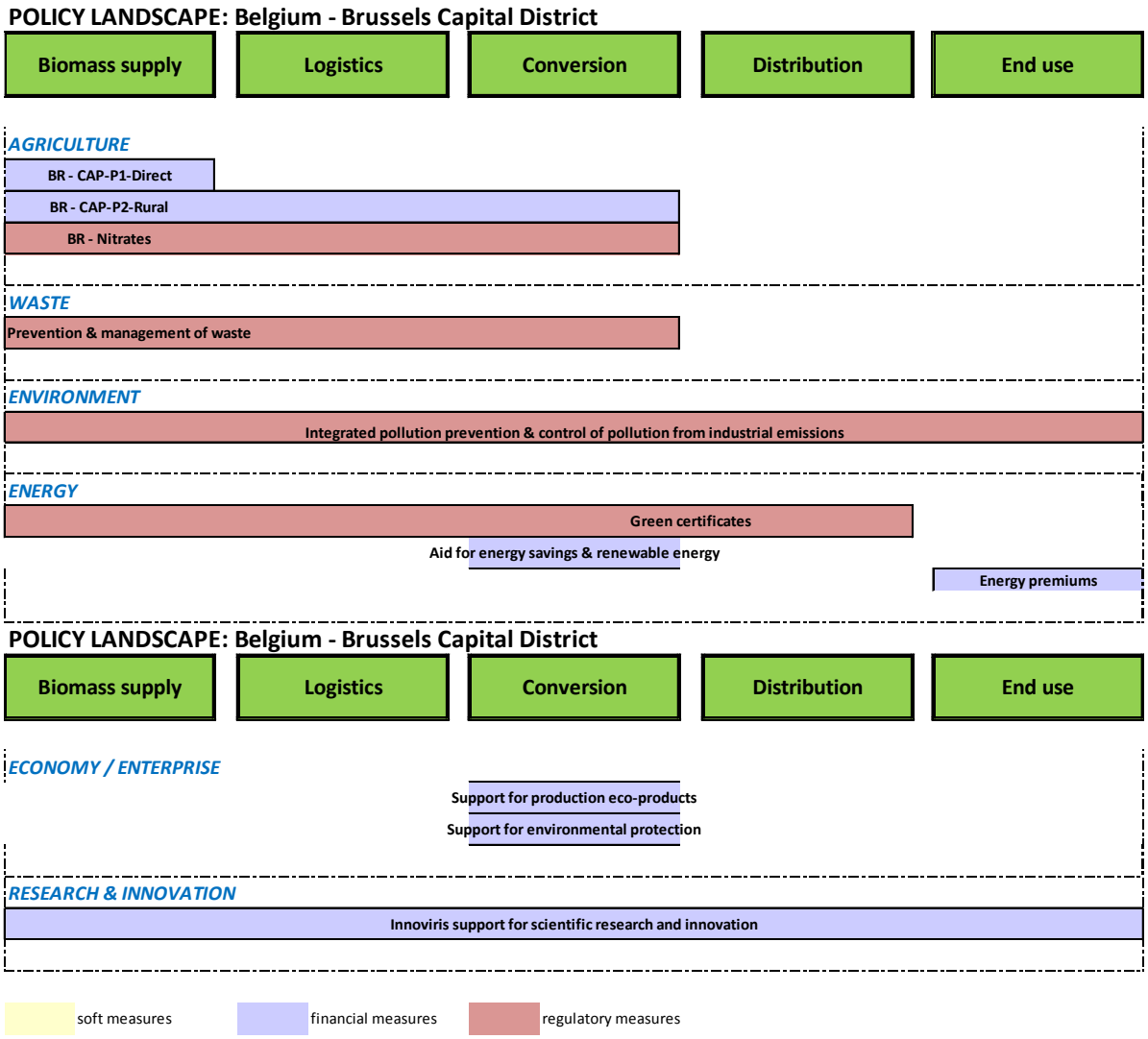
Loan (Ecopack)

Households willing to improve the energy performance of their houses may benefit from the Ecopack, which consists of a zero-percent interest loan combined with the allocation of subsidies for the realisation of several refurbishment works, including the installation of certain renewable energy devices. From 1 January 2015, applicants will only be entitled to the zero-percent interest loan without additional subsidy. The installation of biomass heating plants is eligible under certain conditions. The amount of the loan is determined according to cost of the works to be covered by the loan. The repayment period of the loan depends on the taxable income of the applicant, and varies from 12 years (for a yearly taxable income under € 18,700) to 5 years (for a yearly taxable income between € 51,301 and € 91,300).

Important remark! On 21 October 2014, the Minister of Energy announced that the Walloon Region will reform its energy subsidies in order to simplify and harmonize the support mechanism for renewable energies and housing. As a result, most energy subsidies will be suspended from 1 January 2015 during the first quarter of 2015, until the reform of the support mechanism is elaborated and implemented. The new support system is expected to combine both the allocation of subsidies and the granting of a zero percent interest loan (so-called “Ecopack”). Thanks to the reform, the Walloon government will place greater emphasis on low-interest loans in order to limit windfall effects observed with the allocation of subsidies.

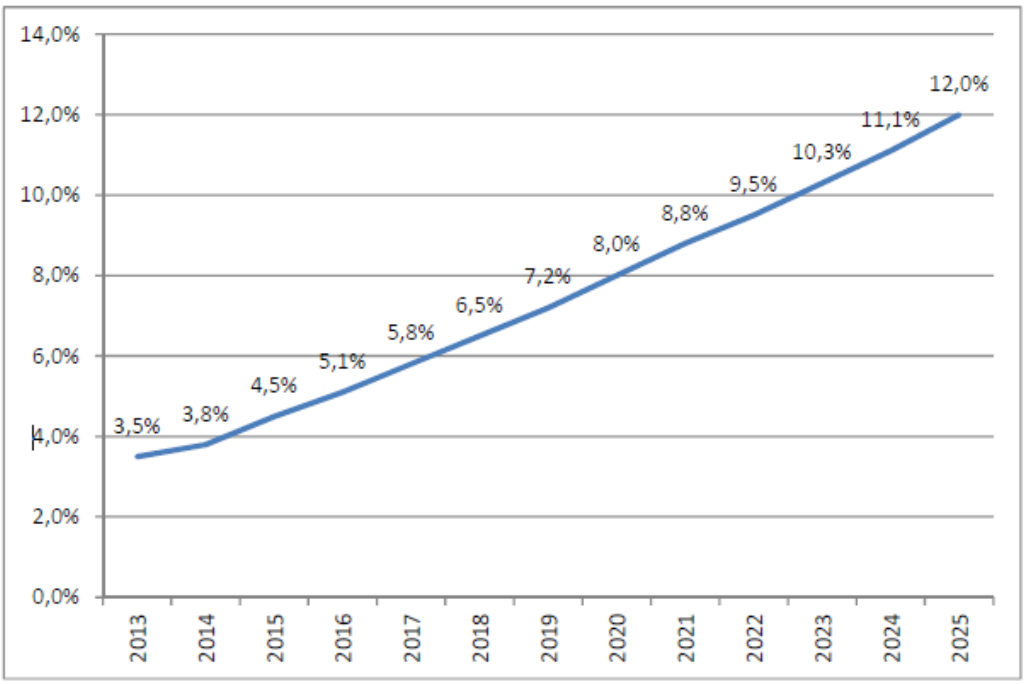
3.1.4. BRUSSELS CAPITAL DISTRICT

The implementation of the renewable energy directive and other related biomass related legislations together with the coupled actions in the Brussels Capital District are given in the policy landscape below.



Brussels Capital Region: Decree of 6 May 2004 on the promotion of green electricity and cogeneration quality: green certificates

The Brussels-Capital region introduced the quota system to increase the proportion of renewable energy in total energy generation. In Brussels-Capital, green certificates are allocated by the Brussels regulatory authority Brugel. The number of certificates depends on the amount of electricity generated (in kWh) in proportion with the CO_2 saved: one certificate is issued for every 217 kg of CO_2 saved. Annex IV of the Decree specifies the sustainability criteria of liquid and solid biomass.



Référence légale : 29 NOVEMBRE 2012. -Arrêté du Gouvernement de la Région de Bruxelles-Capitale fixant les quotas de certificats verts pour les années 2013 et suivantes (MB : 13/12/2012)

Figure 34: Renewable energy targets for the Brussels Capital district till 2025. Source: CWAPE

Brussels Capital Region: Decree of 2 April 2009 on aid for energy saving and energy production from renewable energy sources

Within the bounds of its available budget, the Brussels-Capital provides investment assistance for companies which develop environmental projects, including investments in renewable energy plants. Investments in biogas or biomass CHP and trigeneration plants are eligible under condition that CO2 savings of the plant are at least 5 % compared with conventional installations producing separately heating, cooling and electricity.

Brussels Capital Region: Energy Premiums 2013/2014 for residential, industrial and service sector buildings

Within the bounds of its available budget, the Brussels Capital region provides energy subsidies for residential, industrial as well as service sector buildings located in the Brussels region. Moreover, energy subsidies can also apply for renovation works in buildings older than 10 years. The energy subsidies are defined each year and apply from 1 January to 31 December. The hard ware needed for the installation of biogas or biomass CHP plants as well as the installation itself are eligible under certain conditions.

3.2. TARGETS FOR BIOBASED ECONOMY

3.2.1. FLANDERS

Flanders: Bio-economy vision and strategy

The bio-economy applies by definition at cross-sector, cross-policy and cross-border level. Such a complex concept demands a long-term vision, supported by the entire Flemish government. In 2012 the Interdepartmental Working Group for the Bio-economy (IWG BE) was set up. The working group published a 'Flemish vision and strategy for a Flemish bio-economy', which was as approved by the Flemish Government on 19 July 2013. The vision and strategy was developed in consultation with various stakeholders.

Starting points for the bioeconomy in Flanders are the following:

- The bioeconomy is necessary because of the major societal challenges.
- The bioeconomy must form part of a more sustainable economy, and thus be economically, ecologically and socially sustainable.
- The switch to an economy based on renewable raw materials requires a transition
- Biomass as a factor in the energy mix.
- In the Flemish bioeconomy the available biomass streams will be used according to an accepted cascade.
- The European strategy and action plan for a bioeconomy serves as a framework for the vision and strategy of the Government of Flanders.
- Learning from cooperation opportunities and inspiration from the strategies of other countries and regions.

Five strategic objectives have been formulated:

1. Development of a coherent Flemish policy that supports and facilitates a sustainable bioeconomy
2. To put Flanders at the top for education and training and research and innovation in future-oriented bioeconomy clusters.
3. Biomass is optimally and sustainably produced and used across the entire value chain.
4. Strengthening of markets and competitiveness of bioeconomic sectors in Flanders.
5. Flanders is a key partner within European and international joint ventures.

Flanders: Draft Action plan Renewable Energy

Transform our energy system to a system with more renewable energy, asks for a broad partnership. Every citizen is responsible for the achievement of this transformation.

The Flemish Energy Agency has done a consultation with different partners of the community to build up an action plan for 2020. The agency is also preparing in parallel a long term vision (2030/2050) on our energy system. To balance the economic, social and ecologic interests experts, experienced pioneers and stakeholders from inside and outside the policy makers to participate in different fora.

This resulted in an action plan (19th June 2014) Renewable energy, defining 16 actions. One specific action is very relevant for bioenergy, namely action 7: Align the vision on bio-economy, sustainability and renewable energy within Flanders.

Flanders: Draft action plan Sustainable management of biomass(waste)streams 2015-2020.

This action plan focusses on prevention and the sustainable management of biomass(waste)streams. The processing of biomass and –waste streams needs a clear and aligned framework, choices needs to be made for the use of biomass waste streams for materials and energy. The action plan will be the new framework for policy makers and sectors to implement the sustainable management of biomass waste streams.

The goal of this action plan is to close the cycle and to keep the biomass (waste) streams as long as possible in the production and consumption value chain. Also has the action plan the ambition to align the diverging policy goals and initiatives that impact the use of biomass (waste) streams. The aligned vision has the goal to make future application clear combining the material hierarchy and the cascading principle steering the choices. The action plan formulates goals for every action defined and an ambition to use biomass in a sustainable and integrated way. The action plan uses 3 cycling loops:

- The cycling loop of the organic-biological (waste) streams from the chain agriculture-food-consumer.
- The cycling loop of management of open space and green areas.
- The cycling loop of wood (waste) streams from industry to households.

CHAPTER 4 BIOMASS PRICES

The Belgian Biomass Federation Valbiom has published a comparison of biomass prices and fossil prices. The price evolution since December 2010 till December 2014 is given in the figure below.

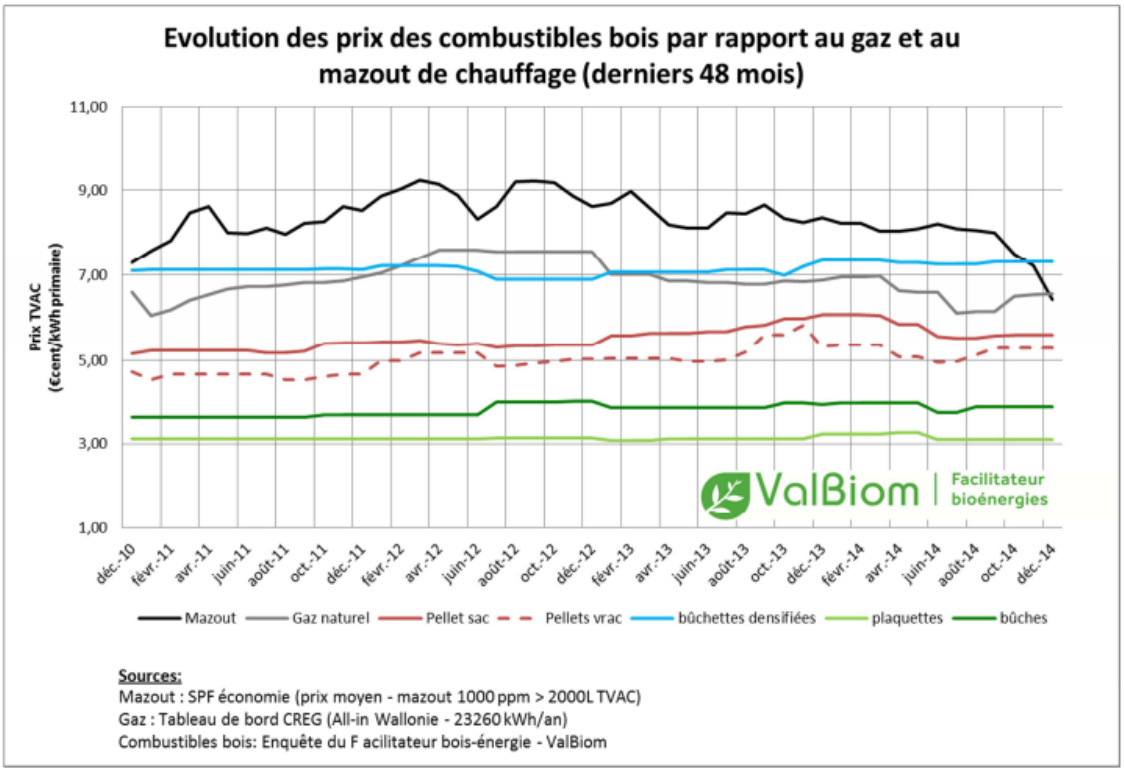


Figure 35: Evolution of woody biomass prices in comparison to natural gas and fuel oil from December 2010 till December 2014. Source: Valbiom.

Biodiesel and bioethanol are blended in low volume percentages in fossil diesel and gasoline. By law they are exempted from taxes. With this tax exemption the biodiesel and bioethanol can keep in line with the fossil transport fuel prices. The evolution of the maximum fossil prices are given in the figure below.

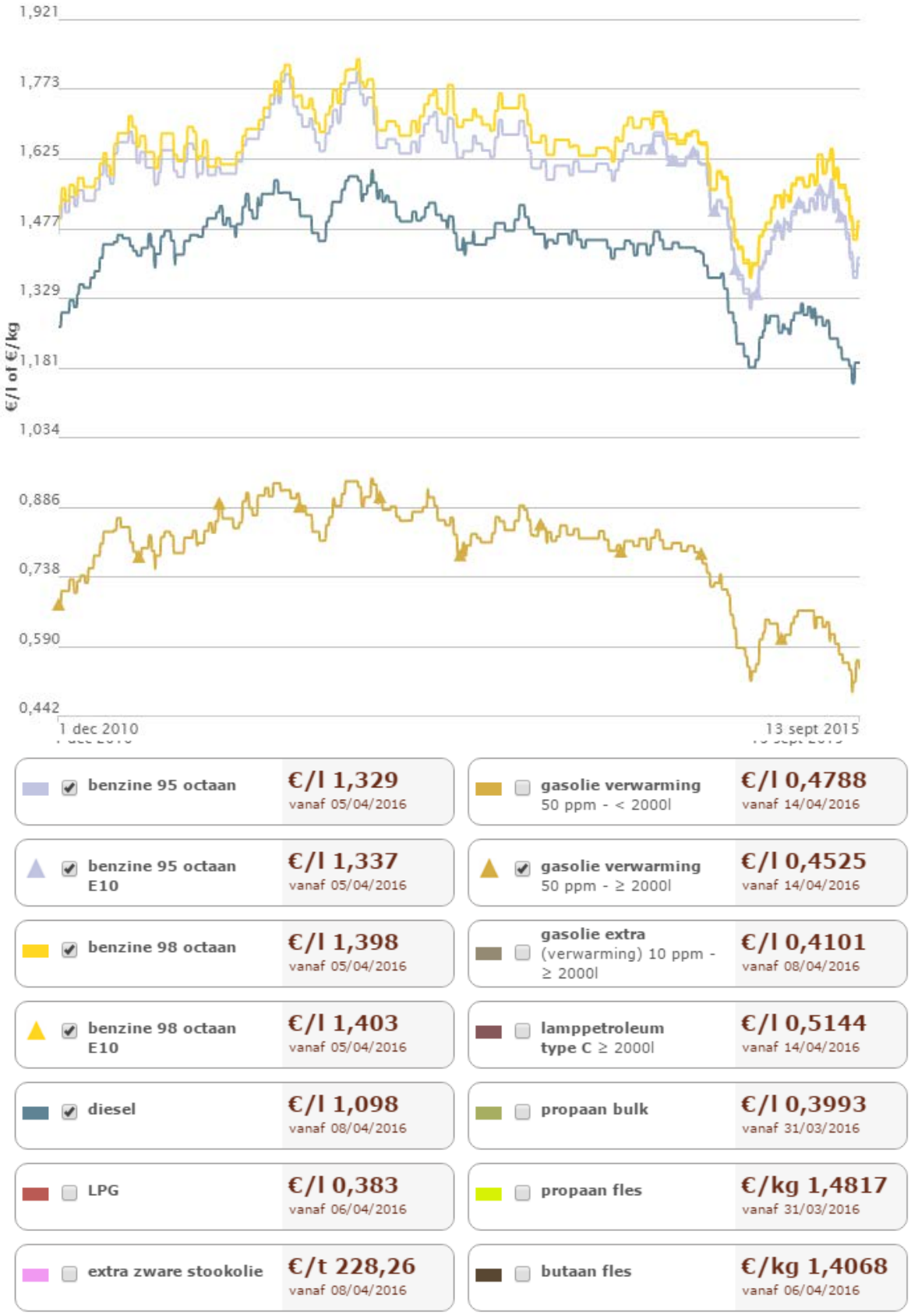


Figure 36: Evolution diesel and gasoline maximum prices for end-consumers (set out by federal Programme policy measure) from December 2010 till September 2015. Source: Petrolfed.be.

CHAPTER 5 INTERNATIONAL BIOMASS TRADE FOR ENERGY (BOTH IMPORT AND EXPORT)

5.1. TRADE (IMPORTED AND EXPORTED) OF BIOMASS FEEDSTOCK FOR ENERGY PURPOSES

5.1.1. BELGIUM

Table 15: NREAP table 4

	Domestic quantity raw materials [m³ for forestry, tonnes for agriculture and waste]		Primary energy production with domestic materials (PJ)		Quantity imported raw materials from EU [m³ for forestry, tonnes for agriculture and waste]		Primary energy production with materials imported from EU (PJ)		Quantity of imported raw materials from outside EU [m³ for forestry, tonnes for agriculture and waste]		Primary energy production with imported materials from outside EU (PJ)	
	2011	**2012**	**2011**	**2012**	**2011**	**2012**	**2011**	**2012**	**2011**	**2012**	**2011**	**2012**
Energy supply from biomass for heating & electricity			72,47	77,87			10,84	10,13			8,96	16,54
Direct supply of biomass from wood and other forest area material for energy production (forest cuts, …)	2.746.494	3.424.360	15,57	19,43	-	-	-	-	-	-		
Indirect supply of biomass (wood) (residues and by-products from wood industry)	4.626.880	4.613.094	28,39	28,26	1.325.938	1.251.390	8,12	7,66	858.859	1.635.134	8,58	16,24
Energy crops (grass, …) and fast growing trees (specify)	147.227	132.666	2,05	2,05	2.171	1.721	0,04	0,00	59.472	43.797	0,38	0,25
By-products/processed residues from agriculture and by-products from fishery	558.697	728.283	3,64	3,94	22.664	9.156	0,29	0,13				
Biomass from waste (domestic, industrial, …)	4.748.603	5.334.009	20,39	21,86	-	-	-	-	-	-	-	-
Other … (e.g. Alternative fuels in cement industry)	179.206	187.993	2,43	2,34	179.206	187.993	2,43	2,34	-	-	-	-
Energy supply from biomass for transport			1,00	1,00			13,44	13,82				
Normal agricultural crops as biofuel (wheat, sugar beet, rape seed)	238.030	240.292	1,00	1,00	1.150.869	1.178.242	13,44	13,82	-	-	-	-

In Table 15, an overview of domestic and imported raw material from inside the EU and outside is given for 2011 and 2012 (NREAP table 4). As can be seen, wood is the main imported biomass source from inside and outside the EU. Agricultural crops are imported from within the EU. Import is more important for biofuels than local produced crops for biofuels.

No domestic production or import of energy crops for biofuels nor other biomass streams in the cement sector are used in 2011 and 2012.

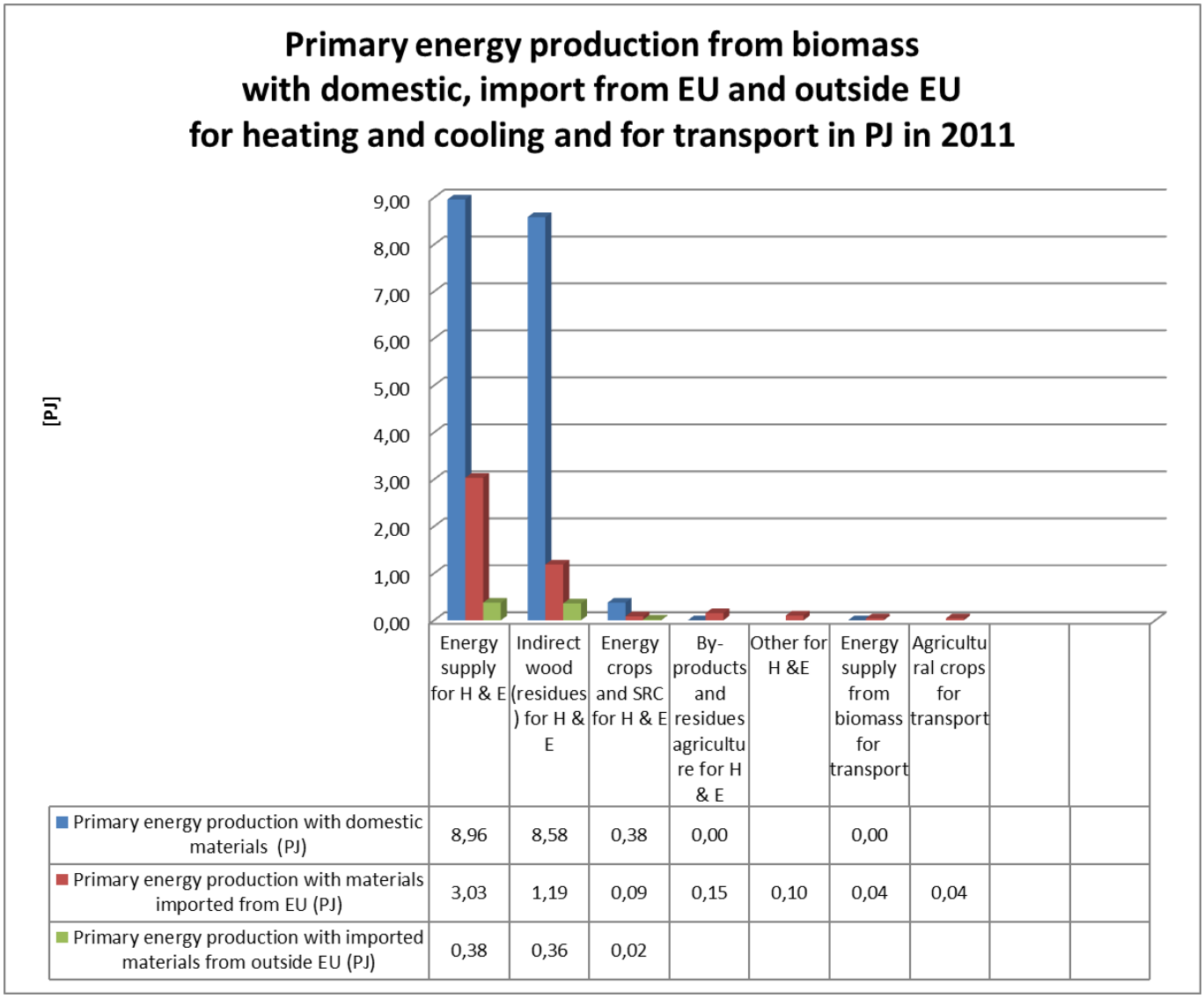


Figure 37: Primary energy production from biomass with domestic, import from EU and outside EU for heating and cooling and for transport in PJ in 2011. Source: NREAP table 4 for Belgium.

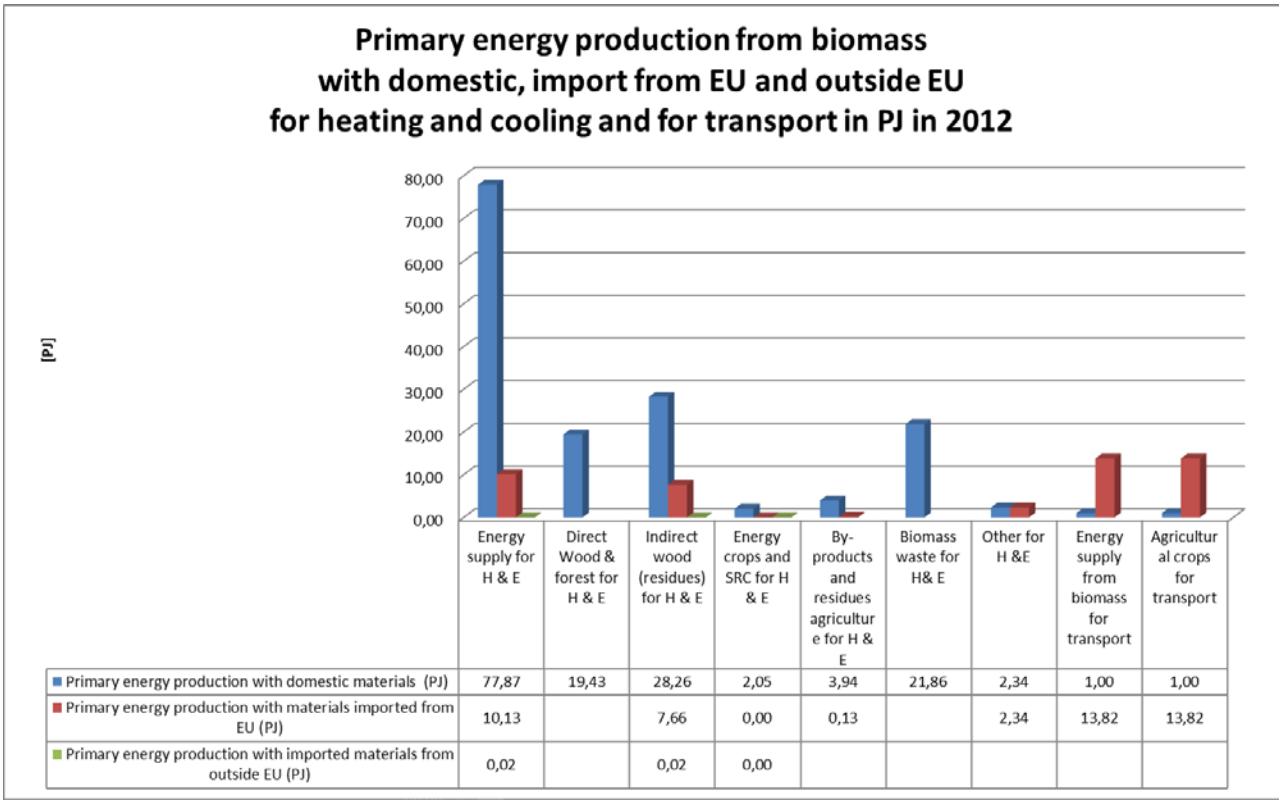


Figure 38: Primary energy production from biomass with domestic, import from EU and outside EU for heating and cooling and for transport in PJ in 2012. Source: NREAP table 4 for Belgium.

Table 16: Domestic use of agricultural area for the production of energy crops (ha). Source: NREAP update report Belgium

	Surface (ha)	
	TOT	
	2011	2012
1. Land used for regular standard agricultural crops (wheat, sugar beet, …) and oil seeds (rape seed, sunflowers, …) (specify most important kinds)	14.818	16.674
Wheat	9.433	9.589
Sugar beets	1.804	2.006
2. Land for short rotation crops (willows, poplars) (specify most important kinds)	145	165
Willows	63	68
3. Land for other energy crops like grasses (reed grass, finger grass, miscanthus), sorgho (specify most important kinds)	138	190
Miscanthus	83	105

5.1.2. FLANDERS

Of the 68.857 TJ of biomass used in 2013 in Flanders is estimated that 31% was imported: 19% outside Europe and 12% from other European Countries (Source: Inventaris hernieuwbare energie 2013).

5.2. TRADE OF CERTIFICATES

5.2.1. FLANDERS

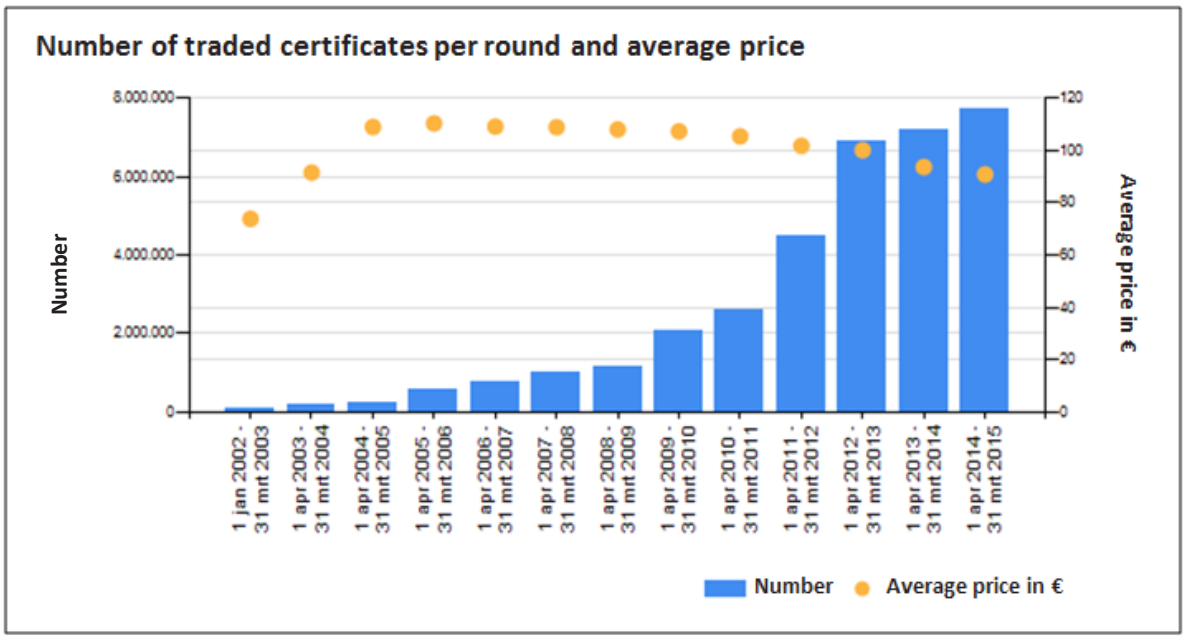


Figure 39: Amount of traded certificates for every round and average price. Source: VREG reporting 2015

The Flemish green certificates traded are monitored by VREG in the Flemish Region. Nevertheless, no data is available for traded Guarantees of Origin within and abroad the Flemish borders.

5.3. TRADE ROUTES OF THE MAIN BIOMASS FEEDSTOCK TYPES FOR ENERGY (QUALITATIVE)

The main biomass commodity for energy that is traded are wood pellets. In Table 17, the actual production of Belgian production is given for the years 2009 till 2012. About 350 kton was produced in 2012 by 10 pellet installations. This is only 20% of the total Belgian pellet consumption of circa 1.700.000 tons/year. The total Belgian pellet consumption for power production (see Table 18) is 1.500.000 tons/year.

Table 17: Belgian wood pellets production (2009-2012)

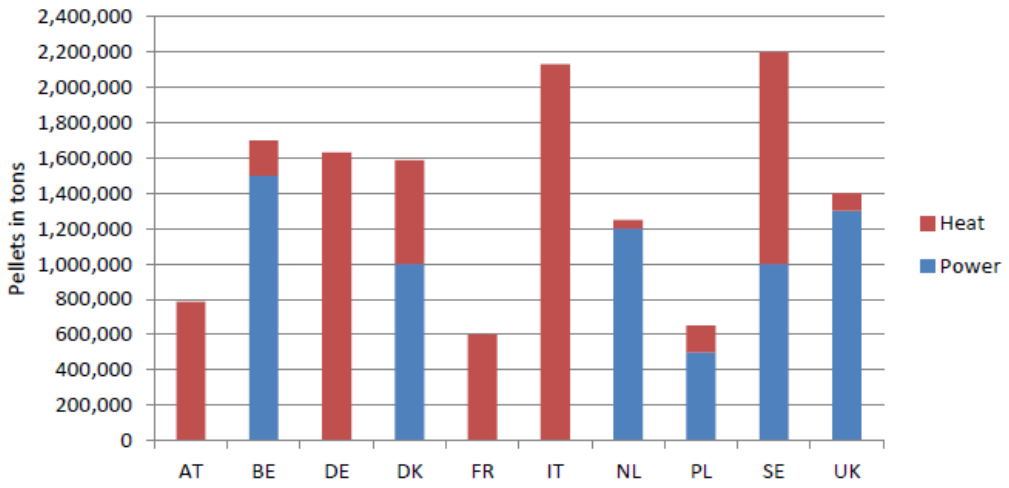
Country	2009	2010	2011	2012		
	Actual production (tons)	Actual production (tons)	Actual production (tons)	Number of operating production plants	Production capacity (tons)	Actual production (tons)
BE	222.779	285.180	261.817	10	535.000	353.765

Table 18: Belgian pellet consumption for power plants (2012-2013)

2012	2013
1.500.000	1.500.000

Source: Hawkins Wright

As can be seen in Figure 36, Belgium is using most of the wood pellets for power production and only a fraction for heating purposes.



Source: EPC 2013, Hawkins Wright

Figure 40: Share of heat/power pellet consumption in the highest consuming EU countries (2012)

In Table 19, the countries and amounts of pellets that Belgium is importing in 2012 are given. Latvia is an important supplier and also Russia.

Table 19: Belgian pellet import (2012). Source: AEBIOM reporting statistics 2013

Import from	Quantity (tons)
LV	586.254
RU	347.962
EE	292.422
Other countries	749.868
Total import	***1.976.506***

5.4. SUSTAINABILITY REQUIREMENTS (TO RECEIVE SUPPORT/COUNT FOR POLICY TARGETS)

5.4.1. FLANDERS

In Flanders, sustainability criteria are coupled to the support system of green certificates. For solid biomass the user of the solid biomass for electricity (especially for wood) should prove that the used biomass for energy is not a feedstock for material ex. Pulp- and paper, wood panel, furniture. Also arguments/proof that the price paid for biomass for energy is not disturbing local biomass markets (in country of origin) needs to be given. Secondly, the fossil energy used in the logistic chain (for the preprocessing and transport of biomass to the end user) is deducted from the amount of certificates. Therefore, green certificates are only provided for the net reduction of greenhouse gas emissions compared to fossil fuels.

The current sustainability requirements and demanded reporting are heavily debated by the different sectors (energy, paper, wood processing industry) during the last years. Even to the point that an installation of Max Green or Engie was temporarily shut down due to the fact that no more certificates could be given to an installation producing electricity using wood. The dispute has been solved in the meantime, and a fragile balance is in place, but the tension is tangible on the market.

CHAPTER 6 DRIVERS, BARRIERS AND OPPORTUNITIES

6.1. CURRENT DRIVERS, BARRIERS AND OPPORTUNITIES

6.1.1. BELGIUM

Belgium has a limited resource potential. Biomass imports will play a major role to reach national targets. In this situation, setting up sustainable and quality criteria is necessary. Such a system (which would require certificates as proof to comply with the criteria) could be a trade barrier if they are too restrictive as well as an opportunity by ensuring a good image. Despite the limited domestic biomass resource potential, raw materials are exported due to a lack of demand to use these resources at a certain price level or a restrictive waste or/and environmental policy (i.e. domestic wastes or used oils valorisation).

One of the most important biofuel market is wood pellets trade. In Belgium, wood pellets are used to produce electricity in big Electrabel power plants (Wallonia: Les Awirs, Flanders: Max Green in Rodenhuize) or to produce heat (public bodies, householders, etc.). Due to electricity production, wood pellets imports are huge in Belgium from Russia, Canada, North America and Germany principally. Wood pellets are mainly imported by boat.

Renewable Energy policy (Green Certificates, Obligation biofuels, Tax exemption, etc.) is still the driving force for biomass use in Belgium.

In transport the main renewable contribution is coming from biodiesel and bioethanol. The policy instruments are focussing on blending of the biofuels into the fossil fuels. No policy drivers are existing towards high or pure biodiesel and/or bioethanol use for transport. Because of the lack of these policy drivers no action is taken by any of the stakeholders.
Recently CNG as transport fuel gained attention, this market is taking off in Belgium and is creating opportunities for using biomethane as transport fuel. Stakeholders are interested in this opportunity, no transport policies are yet in place for biomethane as trnasportfuel. Next coming years will be show if the window of opportunity will be used for going into the direct of biomethane to transport. At the moment the renewable heat and electricity policy measures are being adapted for the use of biomethane.

6.1.2. FLANDERS

This driver of RE Policies has pushed the renewable energy sectors the last years forward to an increase. Adaptations and chances are being made in the Renewable Energy policies the last couple of years (implementing a banding factor, making support technology dependent, etc.), making the support more cost effective but less stimulating for the sector. An increase in bioenergy installation, except from the announced installations, is not expected.

A specific challenge for bioenergy is also the overdependence of Flanders on bioenergy, more specific the region is dependent on a large amount of imported biomass.. A (small) decrease has

been foreseen by 2020 in the targets for renewable energy. Flanders want to develop other renewable sources to tackle this 'problem'.

Additional pressure on the use of biomass is also coming from the insights developed on biomass use in biobased economy. The biobased economy is seen as the way forward for Flanders. The cascading use of biomass / use of biomass in a biorefinery is being seen as the future sustainable use of biomass.

The biomass availability in Flanders is rather limited. The potential of local biomass is situated in the biomass waste collection. The Flemish Public Waste Agency (OVAM) was already very focused on unlocking this resource, and is trying to unlock and explore even more the local available biomass (waste) streams. Focus of this unlocking is to keep the biomass as long as possible in an production and consumption (material) value chain/cycling loop. An Action plan on Biomass Waste streams was made up in 2014 to stress the importance of biomass waste streams as material/feedstock of the future. They promote the use of these waste streams to recycle them to new feedstock in an efficient and effective way as possible. The cascading use of biomass waste streams is seen as the way forward.

The principles of such a cascading use of biomass are becoming clear, the practical implementation is still unclear.