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REPORT

IEA BIOENERGY – TASK40 Sustainable International Bioenergy Trade Securing Supply and Demand Country report Belgium

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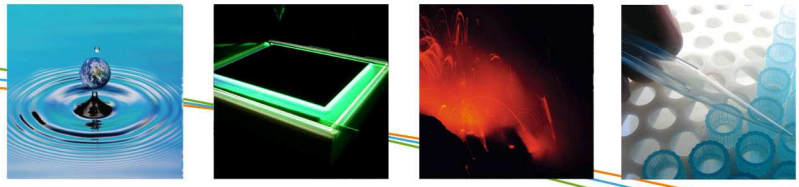

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ABSTRACT

In the past forty years constitutional reforms have changed Belgium from a unitary state to a federal state consisting of 3 regions: the Flemish Region, the Walloon Region and the Brussels-Capital. At the same time there was a gradual transfer of responsibilities to the regions which, among others, gained responsibility for rational energy use and renewable energy.

As a result main data related to natural resources (e.g. forests) and renewable energy are collected following regional methodologies. Consequently data presented in this Belgian country report are presented separately for the Flemish Region and the Walloon Region. When data were available at a federal level, they are presented accordingly.

In 2007, the Flemish Region used 29.1 PJ biomass for energy purposes, and the Walloon Region 33.8 PJ. The total green electricity (biomass + other renewables) production in Flanders was 1640 GWh in 2007 (2.7% of total gross inland electricity consumption), and 1609 GWh in Wallonia (6.3%). The 2007 Flemish sustainable energy inventory indicates the use of renewable heat of 9.7 PJ. Heat from renewables in Wallonia represented 19.5 PJ for the same year.

Two power plants yearly use about 700 000 tons pellets of which the greater part is being imported. An other important consumer of pellets is the residential sector where an increasing amount of stoves and boilers were installed in the past few years. Nowadays, the total pellets production capacity in Belgium is estimated to be 500 000 ton per year.

Main financial support schemes are described for the three Regions, with a special focus on green certificate systems.

The situation regarding sustainability criteria is described both for Flanders and Wallonia, illustrated by the Supplier Declaration Form of GDF-SUEZ/Electrabel.

Figures related to land use, agriculture and forests are given both for Flanders and Wallonia. It appears that the amount of biomass produced in Belgium is very low in comparison with the country needs. The Flemish Region has a rather low biomass production potential from agriculture and forestry. The Flemish Region therefore focuses on the valorisation of its biomass-waste stream potential. Nevertheless, both Regions have to import an important amount of biomass for material and energy purposes.

Belgian industries having biomass resources (by-products) to their disposal are already producing bio-energy from their by-products (e.g. wood industry) when profitable or are waiting for a better economic context to invest.

Belgian data on biomass energy trade volume are generally not available. To overcome this situation, it will be useful to implement a "biomass monitoring system". This can be done; preferably at federal level or, at least, at regional level sharing the same methodology. The main responsibilities of such a system (the exact structure is to be implemented) should be: to evaluate annually biomass (energy) trade volume (import / export) classified by origin of wood, to survey annually the market of domestic biomass heating systems (e.g. wood stoves, wood boilers) classified by type of solid biomass.

ACKNOWLEDGEMENT AND DISCLAIMERS

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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, or of Belgian policy makers (federal and regional level).

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CHAPTER 1 GENERAL INTRODUCTION

This report relates to Task 40 of IEA Bioenergy and is a follow-up report on the 'Country report of Belgium of 4 September 2006', and an update of the 2008 report.
IEA Bioenergy is an international collaborative agreement, set up in 1978 by the International Energy Agency (IEA) to improve international cooperation and information exchange between national bio-energy research, development and demonstration (RD&D) programs. IEA Bio-energy aims at realizing the use of environmentally sound and cost competitive bio-energy on a sustainable basis, thereby providing a substantial contribution to meeting future energy demands. IEA Bio-energy currently has 12 Tasks, all of which are supervised by the IEA Bio-energy Executive Committee. Each Task has a defined work program and is led by one of the participating countries (Operating Agent). A Task Leader, appointed by the Operating Agent, directs and manages the work program.
The aim of **Task 40** (Sustainable International Bioenergy Trade – Securing Supply and Demand) is to investigate what is needed to create a "commodity market" for bio-energy. The future vision on global bio-energy trade is that it develops over time into a real "commodity market" which will secure long term and sustainable supply and demand of bio-energy. Through the participation of interested parties e.g. industrialists, governmental bodies and NGO's (producers and consumers), this task contributes to the development of sustainable bio-energy markets on short and on long term, at different scale levels e.g. local, regional, international, to global. Task 40 planned activities take into account several stages of development of the biomass markets in different regions of the world. Furthermore, the aim is that this platform can set the agenda and initiate a host of new activities relevant for developing biomass potentials worldwide.

1.1 The Belgian fuel mix

The Belgian gross inland energy consumption amounts to 59.04 Mtoe of which 1.93 Mtoe or 3,2% is renewable (source: hardcopy 2007, DGTREN EU energy & transport in figures, statistical pocketbook)

Based on the final energy consumption which amounts to 36.40 Mtoe, 0.54 Mtoe is renewable or 1.4% (source: hardcopy 2007, DGTREN EU energy & transport in figures, statistical pocketbook).

Based on the final energy consumption which amounts to 38.44 Mtoe, 0.65 Mtoe is renewable or 1.7% (source: update online version of the aforementioned hardcopy 2007).

At the same time the 'Belgium renewable energy fact-sheet' published on the DGTREN website (23/01/2008[1]) mentions the a 2,2% renewable share for Belgium in 2005

[1] Same data as the publication of DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources

based on final energy consumption. The Belgian target for renewable energy in 2020 being 13%, based on final energy consumption.

This immediately stresses the need of reliable and uniform statistics regarding to energy use and renewable energy use in particular. The clear setting of definitions, for example, on what is 'final energy consumption' and what is 'gross inland energy consumption' is a starting point to do this. With this in mind all following data must be interpreted with this connotation, since (until now) different data and different definitions are applied on different (and even the same) levels of authority (EU, national, regional, sectoral).

Main characteristics and key indicators in the energy related field are given in Table 1 and Table 2 below.

Table 1: Key indicators for Belgium (source: http://www.iea.org/)

Indicator	Unit	2005	2006
Population	(million)	10.47	10.54
GDP	(billion 2000 US$)	249.35	258.10
GDP (PPP)	(billion 2000 US$)	293.67	313.97
Energy Production	(Mtoe)	13.90	15.48
Net Imports	(Mtoe)	50.89	53.87
TPES	(Mtoe)	56.65	60.99
Electricity Consumption	(TWh)	89.17	91.60
CO_2 Emissions	(Mt of CO_2)	111.70	117.24

Table 2: Energy statistics for Belgium, 2007 (source: http://ec.europa.eu/)

Energy Statistics for Belgium

Mtoe	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Production	13.11	12.81	12.62	12.08	12.40	12.70	13.11	14.55	14.12	15.48	15.43	14.97	14.95	15.14	15.27	15.45	15.29
Solid fuels	1.08	0.86	0.60	0.48	0.32	0.27	0.24	0.18	0.13	0.15	0.19	0.11	0.09	0.07	0.09	0.06	0.02
Oil									0.01	0.01			0.01	0.01	0.01	0.01	
Gas	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00						
Nuclear	10.71	10.72	10.74	10.42	10.20	10.34	10.69	11.96	11.39	12.64	12.42	11.96	12.22	12.22	12.20	12.28	12.03
Renewables	0.65	0.66	0.66	0.53	0.50	0.60	0.58	0.59	0.64	0.63	0.64	0.72	0.67	0.90	0.96	1.18	1.33
Industrial waste	0.66	0.57	0.63	0.65	1.38	1.49	1.60	1.82	1.94	2.04	2.18	2.18	1.97	1.94	2.01	1.93	1.91
Net imports	39.63	42.37	43.68	42.03	45.62	46.86	49.42	49.32	52.09	49.16	50.81	51.27	49.34	53.24	53.94	53.78	53.49
Solid fuels	9.49	9.17	9.28	7.80	8.24	9.34	7.96	8.09	8.54	7.34	7.57	7.55	5.73	6.07	6.17	5.51	4.97
Oil	22.24	24.70	25.25	24.50	27.18	26.67	29.11	29.57	30.92	28.16	29.49	29.70	29.17	32.22	32.33	32.62	32.18
Gas	8.22	8.66	9.14	9.47	9.78	10.42	11.88	11.28	12.43	13.48	13.28	13.13	13.65	14.24	14.56	14.82	15.03
Electricity	-0.32	-0.16	0.01	0.19	0.34	0.35	0.36	0.28	0.12	0.07	0.37	0.78	0.65	0.55	0.67	0.54	0.87
Renewables				0.07	0.08	0.09	0.10	0.09	0.08	0.11	0.10	0.10	0.14	0.16	0.21	0.28	0.43
Derived heat																	
Gross Inland Consumption	48.61	50.81	51.76	50.39	53.90	54.90	57.79	58.99	60.06	61.04	61.39	60.25	58.34	61.48	61.39	61.15	60.41
Solid fuels	10.24	9.97	9.61	8.74	8.89	8.55	8.17	8.36	8.44	7.42	8.20	7.08	6.65	6.22	6.09	5.45	5.16
Oil	18.50	20.32	21.06	20.38	22.63	22.88	24.47	24.62	24.97	24.78	24.10	24.25	22.67	25.09	24.68	24.75	23.67
Gas	8.17	8.73	9.05	9.41	9.67	10.61	11.82	11.26	12.47	13.33	13.37	13.18	13.38	14.40	14.57	14.74	14.99
Nuclear	10.71	10.72	10.74	10.42	10.20	10.34	10.69	11.96	11.39	12.64	12.42	11.96	12.22	12.22	12.20	12.28	12.03
Renewables	0.65	0.66	0.66	0.59	0.58	0.68	0.69	0.68	0.72	0.74	0.75	0.82	0.80	1.06	1.16	1.46	1.77
Other (****)	0.34	0.41	0.64	0.84	1.72	1.84	1.96	2.10	2.06	2.11	2.55	2.96	2.62	2.50	2.68	2.48	2.78
Elec. Generation (TWh)	70.85	71.95	72.26	70.65	72.24	74.43	76.15	78.89	83.24	84.52	83.89	79.70	82.06	84.62	85.44	87.03	85.54
Coal (TWh)	17.10	16.51	16.01	16.30	16.98	16.52	15.55	13.75	14.19	9.94	12.92	9.94	10.03	9.64	9.15	8.20	6.85
Oil (TWh)	1.31	1.83	1.54	1.48	1.62	1.31	1.29	1.42	2.58	1.04	0.80	1.66	0.97	1.01	1.68	1.74	1.38
Gas (TWh)	8.17	8.94	9.19	9.24	10.88	12.94	13.67	14.07	17.74	21.82	19.09	18.61	20.50	23.58	23.81	25.14	25.39
Nuclear (TWh)	42.72	42.86	43.46	41.93	40.62	41.36	43.34	47.41	46.17	49.02	48.16	46.35	47.36	47.38	47.31	47.60	46.65
Renewables (TWh) (*)	0.77	0.77	0.88	0.78	0.87	0.95	0.86	0.86	0.93	1.18	1.33	1.42	1.58	1.67	1.98	2.63	3.73
Other (TWh) (***)	0.78	1.03	1.18	1.12	1.26	1.35	1.45	1.38	1.64	1.53	1.60	1.72	1.62	1.34	1.51	1.72	1.85
Final Energy Consumption	32.07	33.84	34.52	33.86	35.52	36.04	37.95	38.32	39.00	38.92	39.06	39.29	37.55	39.95	39.34	38.44	38.17
by fuel/product																	
Solid fuels	3.79	3.93	3.75	3.28	3.69	3.31	3.23	3.71	3.27	3.27	3.38	3.30	2.45	2.38	2.33	2.08	2.03
Oil	14.93	16.22	16.91	16.39	16.54	16.43	17.29	17.44	17.68	17.04	16.13	16.34	15.41	17.68	16.69	16.53	15.54
Gas	7.25	7.48	7.45	7.74	7.85	8.52	9.36	8.72	9.20	9.55	10.01	10.07	10.30	10.31	10.58	10.01	10.47
Electricity	4.99	5.20	5.38	5.44	5.71	5.88	6.01	6.18	6.36	6.41	6.67	6.72	6.74	6.85	6.93	6.89	7.10
Renewables	0.33	0.30	0.29	0.25	0.25	0.31	0.32	0.30	0.35	0.36	0.34	0.37	0.36	0.45	0.48	0.65	0.70
Derived heat & industrial waste	0.80	0.71	0.74	0.76	1.48	1.58	1.73	1.98	2.15	2.29	2.53	2.49	2.29	2.27	2.33	2.28	2.32
by sector																	
Industry	12.59	12.93	12.96	12.21	13.69	13.58	13.20	14.39	14.71	15.17	15.69	15.54	14.33	14.57	14.29	13.56	14.43
Transport	7.73	7.87	8.31	8.38	8.51	8.51	8.93	9.23	9.61	9.63	9.71	9.49	9.65	10.18	10.25	9.93	9.63
Households	8.36	9.22	9.20	9.14	8.97	9.32	10.63	9.89	9.91	9.51	9.49	9.87	9.29	9.89	10.04	9.94	8.93
Commerce, etc.	3.39	3.83	4.05	4.14	4.35	4.63	5.19	4.82	4.77	4.61	4.17	4.39	4.28	5.31	4.77	5.02	5.18
Non-Energy Uses	2.75	2.86	3.09	3.05	5.17	5.51	6.09	5.99	5.90	6.29	6.87	6.87	6.68	6.52	6.84	7.50	6.91
CO_2 Emissions (Mt) (**)	135	138	135	135	140	140	147	143	151	142	144	144	149	154	155	152	150
Energy Intensity (toe/M€ '00)	239	245	246	242	250	249	259	256	256	251	244	237	226	236	229	224	216
CO_2 Intensity (tCO_2/toe)	2.78	2.71	2.60	2.68	2.59	2.54	2.55	2.43	2.51	2.33	2.35	2.40	2.56	2.50	2.52	2.49	2.48
Import dependency, %	75.2	77.0	78.1	76.9	78.7	79.7	79.3	77.0	79.6	75.2	76.1	78.3	75.7	77.9	78.1	78.2	77.9
Energy per capita (kgoe/cap)	4876	5078	5151	4996	5328	5416	5691	5795	5886	5971	5991	5860	5648	5927	5893	5838	5730
CO_2 per capita (kg/cap)	13565	13786	13405	13391	13806	13764	14493	14089	14781	13896	14102	14049	14454	14638	14855	14512	14236

Source: Eurostat, May 2008 (*) not including pumping (**) Source: European Environment Agency, June 2008, including Bunkers (***) Pumped Storage Plants and Other Power Stations (****) Electrical Energy and Industrial Waste

The main energy consumers are the residential sector (and equated energy use) (37%), the industry (29%) and the transport (24%) .

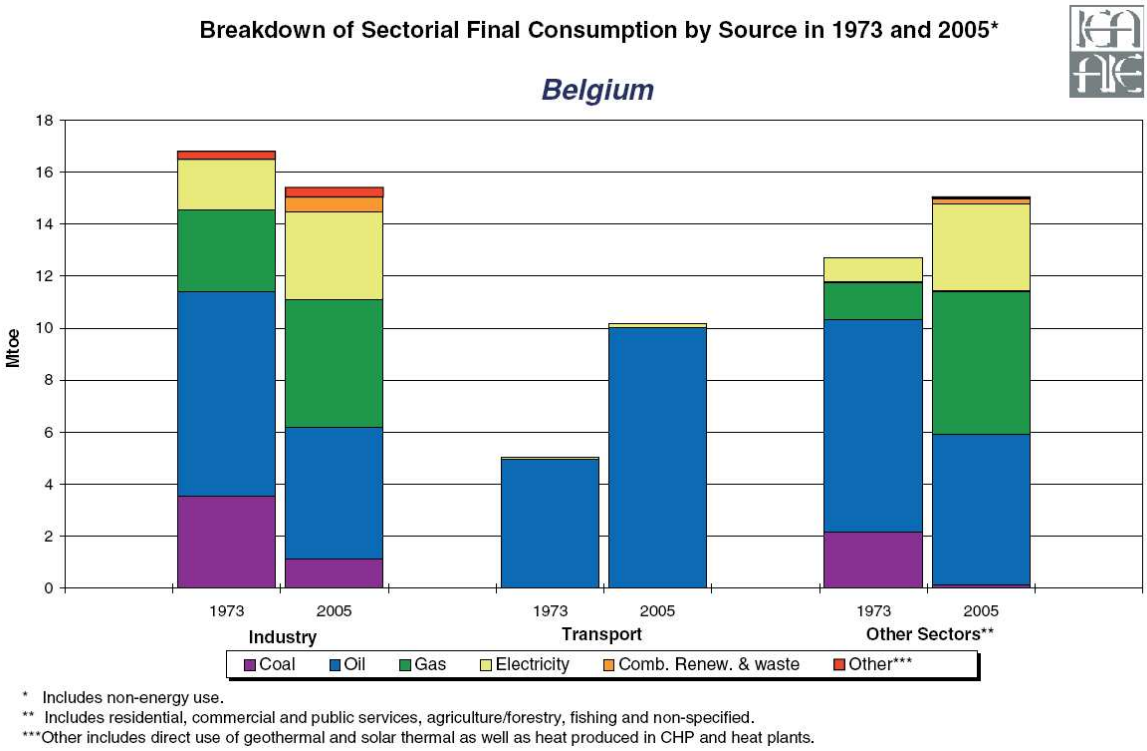


Figure 1: Breakdown of final energy consumption by sector & source (source: http://www.iea.org/)

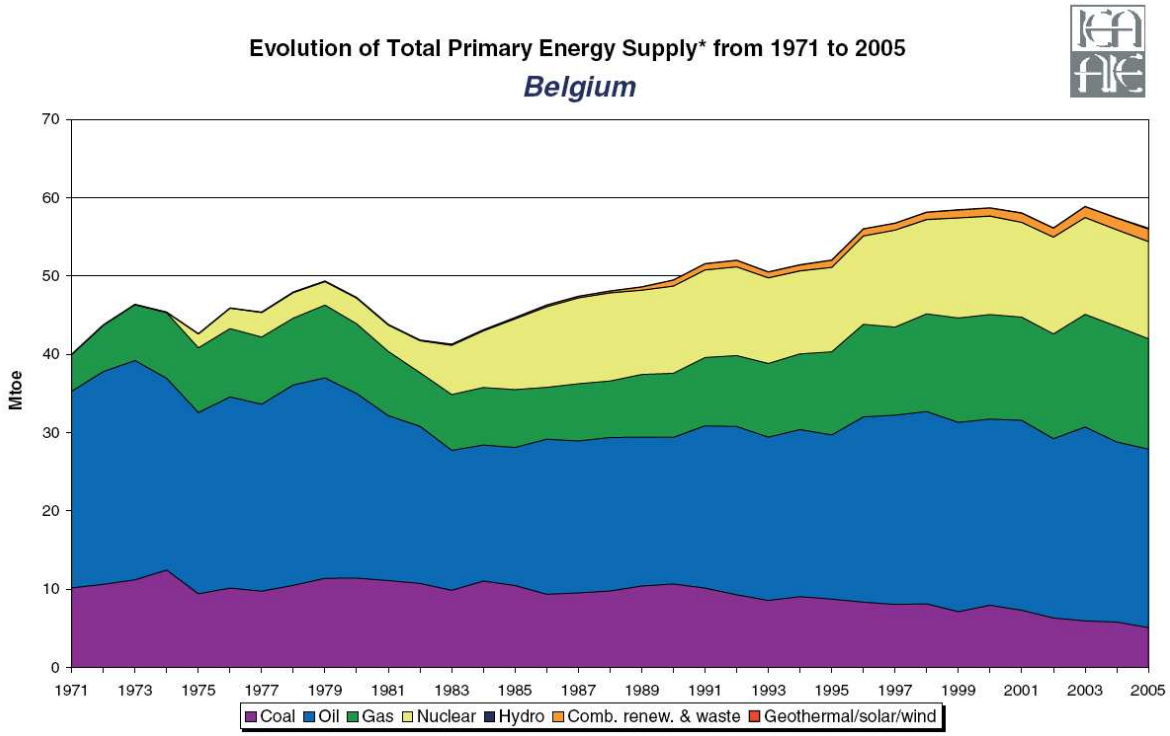


Figure 2: Evolution of TPES (source: http://www.iea.org/)

As far as electricity is concerned, generation is clearly dominated by nuclear power plants making about 55% (Figure 3) of the electricity but which has a more or less stable share since 1990. Natural gas is increasing since the mid-80's while oil has nearly disappeared. Since 2002 renewables are growing rapidly due to the strong support delivered by the green certificate systems (Figure 3). Since 2005, biomass is taking a growing share while coal is decreasing accordingly (Figure 4).

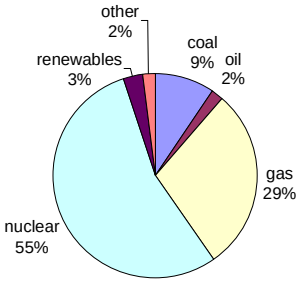


Figure 3: Share of energy sources for electricity production (source: hardcopy 2007, DGTREN EU energy & transport in figures, statistical pocketbook)

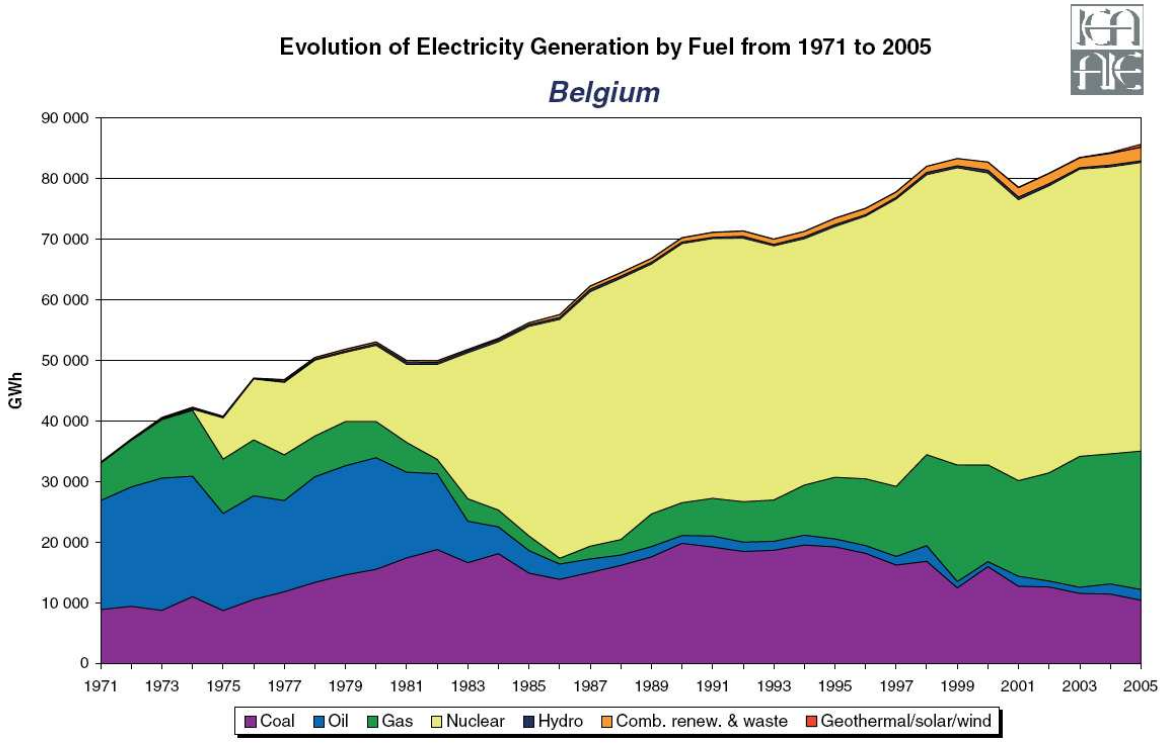


Figure 4: Evolution of electricity generation by source (source: http://www.iea.org/)

1.2 CO_2 reduction requirements

Belgium's Kyoto target is set at 134.8 $MtCO_2eq$ with a base year (1990) of 146,9 $MtCO_2$ eq, a target reduction of -7.5%. The target was further divided over the regions and Federal level. Specific targets for the Flemish and Walloon region and Brussels capital district are respectively -5.2%, -7.5% and +3.5%.

The Kyoto base year for Belgium is 1990 for CO2, CH4 and N20 and 1995 for fluorinated gases. Belgium's 2007 Monitoring Mechanism submission projects total 2010 emissions of approximately 3.7% below the Kyoto base year. Belgium's progress to its Kyoto target of 7.5% below base year emissions (134.8 MtCO2 eq), Belgium is not on track to meet this target with existing measures only. However, Belgium expects to meet its 2010 target with the use of Kyoto flexible mechanisms. With the use of 7.04 MtCO2eq of Kyoto flexible mechanisms, Belgium's emissions are projected to be 8.5% below base year emissions by 2010, thereby meeting and indeed overachieving its target. Belgium foresees at this moment more use of flexible mechanisms than is strictly needed, in order to account for uncertainties.
All sectors, except transport, are expected to have reduced emissions in 2010 compared to 1990 levels. The greatest reductions relative to 1990 emissions are expected to occur in the Waste and Industrial Process sectors. Significant reductions are also expected in the Agricultural sector.

Figure 5 shows an overview of the 2010 projections in Belgium for the years 2006, 2007 and 2008. The red line indicates the Kyoto target of 134.8 Mt CO2-eq. The projections indicate that additional policies/measures and/or use of flexible mechanisms are necessary to fulfil the Kyoto GHG reduction requirements.

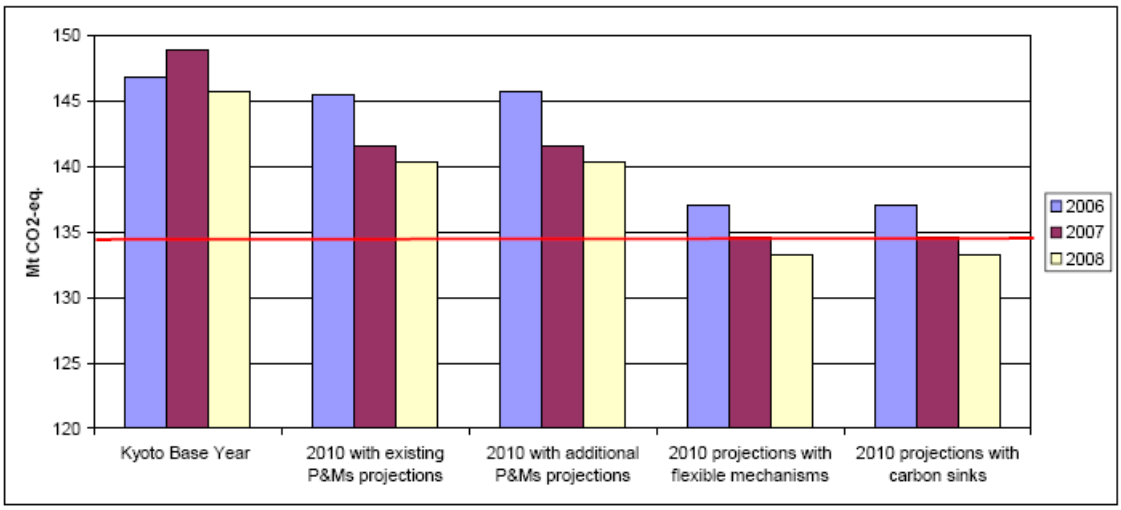


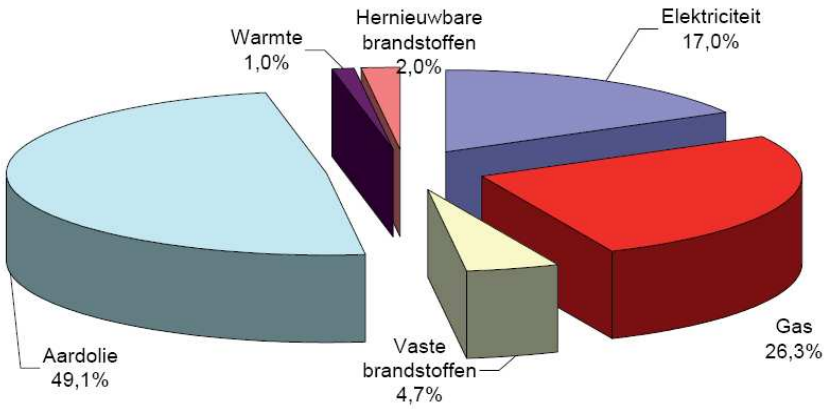
Figure 5: Comparison of 2010 projections reported in 2006, 2007 and 2008 (Source: http://www.eea.europa.eu/themes/climate/ghg-country-profiles/extended-country-profiles/belgium.pdf)

1.3 Renewable energy and biomass energy in the Belgian fuel mix

1.3.1 Belgian energy balance

In the Belgian energy balance 2007 a contribution of 2% of renewable energy is mentioned based on final energy use. Further on in this document the renewable fuels are mentioned together with recuperation energy (= energy from waste including the non-renewable part) as such these figures make it impossible to deduct the biomass related energy.

Table 3: Final energy use by energy source (source: http://mineco.fgov.be/energy/home_en.htm)



Note: translation Dutch➔	English
• Warmte	heat
• Hernieuwbare brandstoffen	renewables
• Elektriciteit	electricity
• Gas	natural gas
• Vaste brandstoffen	solid fuels
• Aardolie	petroleum

There is no distinction in the figures between the different types of biomass used to produce energy in Belgium. The different users of biomass in Belgium for the year 2003 is given in Figure 6. For an update detailed overview is referred to energy balance of the Regions.

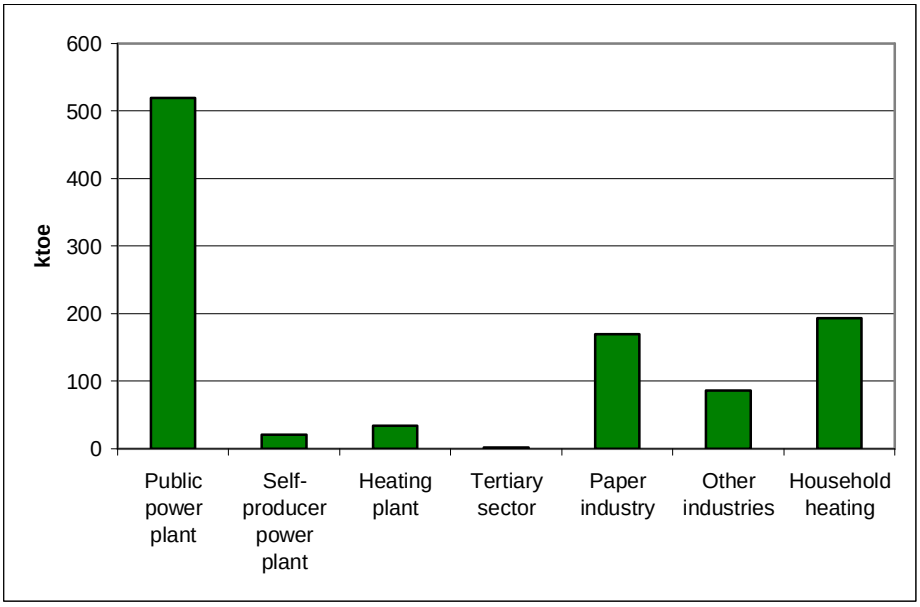


Figure 6: Gross inland energy from biomass consumption in Belgium 2003 (total 1 023 ktoe (source : ICEDD, 2005)

→ ***Green electricity***

The 2004 Belgian green electricity status indicated a 2% proportion of green electricity production in the total electricity balance of which biomass represents 33%.

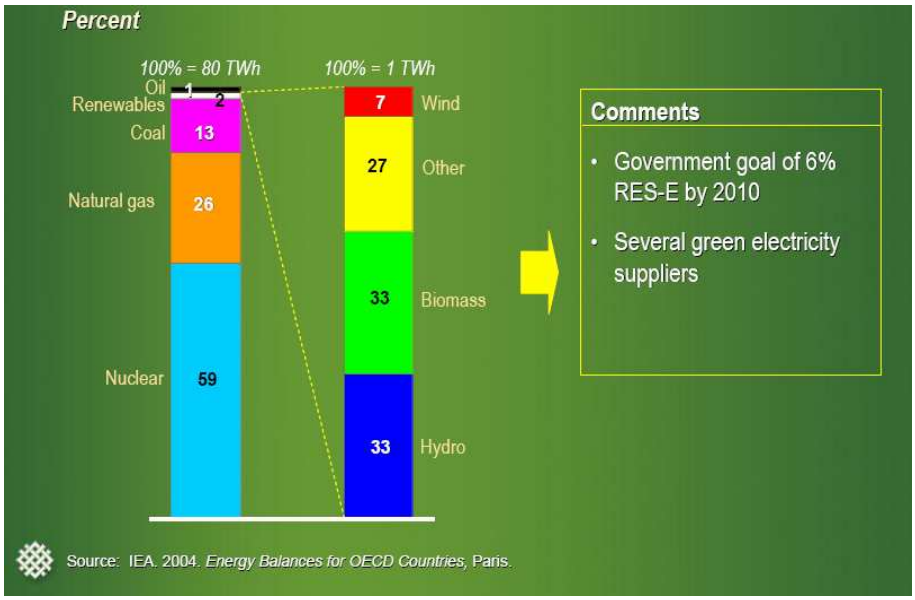


Figure 7: Renewable electricity market in Belgium in 2004 (source IEA 2004)

1.3.2 Flemish energy balance

→ ***Renewable energy***

The main input for the Belgian energy balance comes from the respective regions. These balances provide more detailed information on the produced energy out of renewables in general and biomass in particular.

The following figure shows an overview of renewable energy production for electricity, heat and biofuels in the Flemish region. In 2007 the Flemish Region used **29,1 PJ biomass** of biomass for energy purposes.

Green electricity production MWh	***2005***	***2006***	***2007****
Water	2.283	2.079	2.740
Wind	154.443	237.492	281.376
Solar - PV	1.300	3.122	5.560
Waste (organic fraction)	159.523	208.184	256.120
Biomass	427.080	806.807	842.487
Biogas	222.406	173.475	252.094
TOTAL green electricity (=GE)	**967.035**	**1.431.059**	**1.640.377**
Gross inland electricity consumption (=GIEC)	**58.424.384**	**60.122.525**	**60.398.235**
% Green electricity (GE/GIEC)	**1,7%**	**2,4%**	**2,7%**
Production green heat TJ	***2005***	***2006***	***2007****
CHP installations			3.074
Dedicated installation			6.654
TOTAL green heat production			**9.728**
Total heat production			**463.006**
% green heat production			**2,1%**
Use of biofuels TJ	***2005***	***2006***	***2007****
biofuels for transport	**-**	**-**	**1.901**
TOTAl use of fuels road transport			**179.168**
% biofuels			**1,1%**

Figure 8: Renewable energy production for the energy vectors: electricity, heat & biofuels (source: Sustainable energy inventory Flanders 2007, VITO)

→ ***Green electricity***

Figure 9 shows the evolution of the amount of renewable electricity since 1994 till 2006. Most important trends that can be seen on this figure is the fact that the amount of renewable electricity increased exponential from the year 2002. In 2002 the system of green power certificates was introduced and this was an important help for market growth. It can be seen that already from the nineties the Flemish region has a tradition of using waste streams for energy production, from 2002 biogas and biomass for electricity production took a high flight, together with wind-energy. Solar energy is growing but is not yet at the amount of wind and biomass-energy.

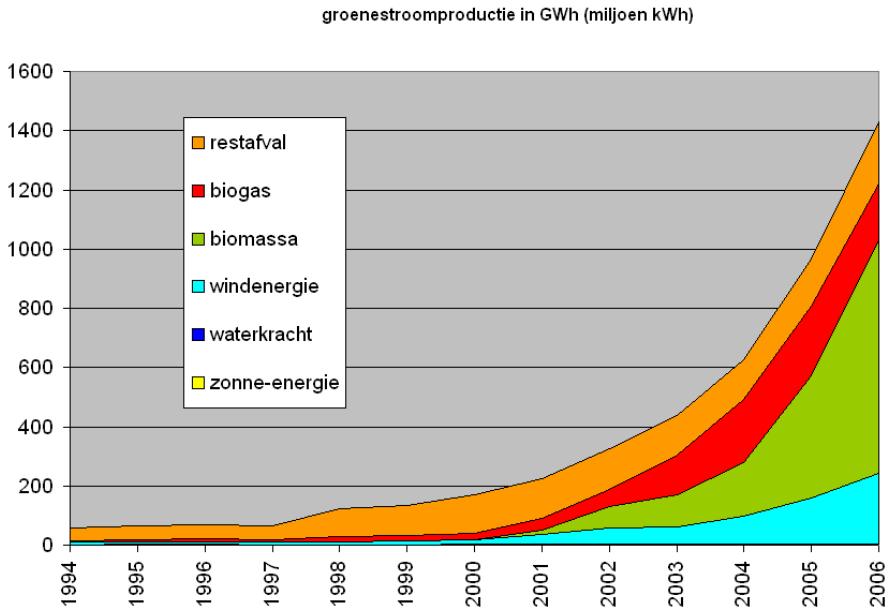


Figure 9: Evolution of the green electricity production in Flanders since 1994 in GWhe (source: www.energiesparen.be)

Note: translation Dutch➔	English
• Restafval	waste products
• Biogas	biogas
• Biomassa	biomass
• Windenergie	wind energy
• Waterkracht	hydro power
• Zonne-energie	solar power

The installed capacity for green electricity in the Flemish region amounts to 522 MWe in 2007 (Table 4). Biomass (organic fraction) based capacity represents circa 66% of the installed capacity with a total power of 350 MWe.

Table 4: Net installed green electric power in the Flemish Region

Net installed green electric power (kWe)	2004	2005	2006	2007*
Water	*643*	*643*	*863*	*871*
Wind	*72.742*	*118.342*	*139.342*	*153.624*
Solar – PV (kWp)	*1.099*	*1.655*	*3.673*	*19.202*
Waste (organic fraction)	*23.387*	*23.305*	*38.384*	*36.377*
Biomass	*68.692*	*138.907*	*245.867*	*242.591*
Biogas	*47.922*	*58.284*	*46.439*	*69.999*
TOTAL	***214.486***	***341.136***	***474.567***	***522.665***

The total green electricity production in Flanders amounts to 1640 GWhe in 2007 which represents 2.7% of the total gross inland electricity consumption of 60.406 GWhe.

When -in the context of the European definition of biomass which is 'the bio-degradable fraction' - also green electricity out of biogas 15% and residual waste (waste-to-energy plants) 16% are taken into account, 83% of the green electricity is from bio-degradable origin. A large fraction of the biomass electricity production is from co-combustion of biomass in coal power plants,

In 2006 the green electricity production amounted to 1431 MWhe which means a 2006-2007 increase of green electricity production of 13%.

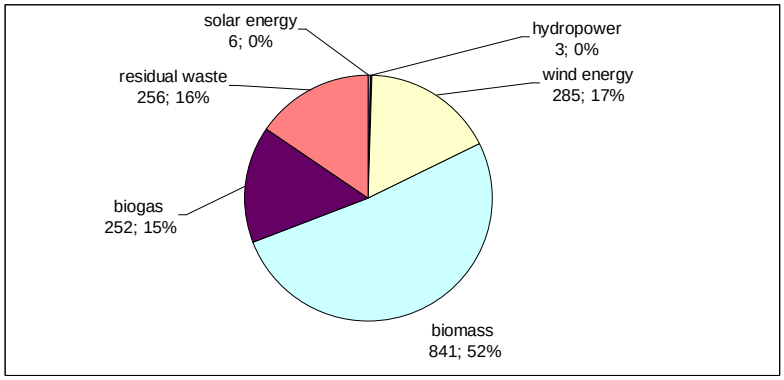


Figure 10: Green electricity production in Flanders 2007 in GWhe and % (source: Sustainable energy inventory Flanders 2007 , VITO)

The realisation of the green electricity targets for Flanders is lagging behind on the targets set for 2010. However the green electricity production out of biomass (yellow bars) is the most important RES in realising the targets set (purple bars). The green electricity production out of all RES is indicated in blue bars (Figure 11).

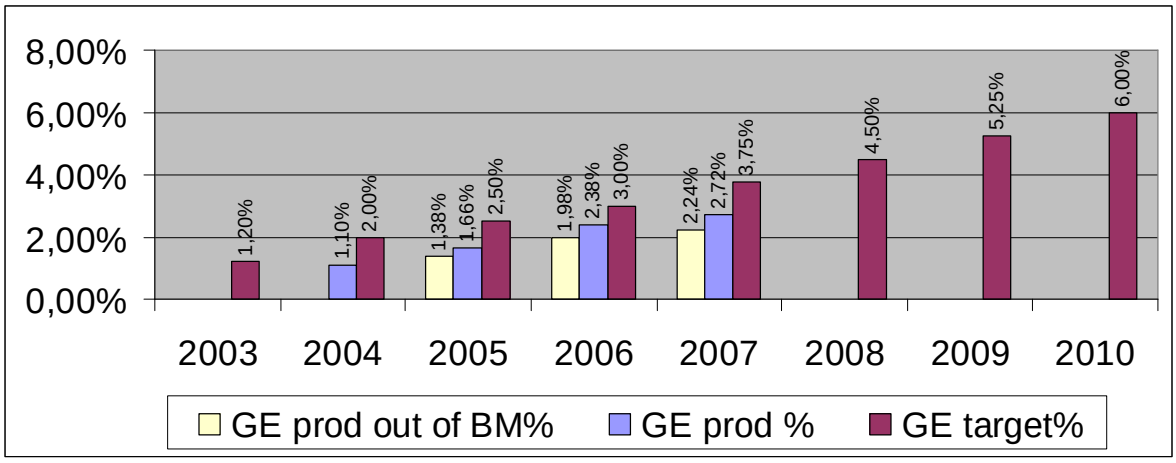


Figure 11: Green electricity production and green electricity targets

→ ***Green heating***

Table 5: Heat production from biomass (Flemish region)

CHP installations (biomass)	3.074
Dedicated heat (biomass)	6.338
TOTAL heat (biomass)	**9.412**
TOTAL heat production	**463.006**
% heat biomass/total heat	**2%**

The 2007 sustainable energy inventory indicates the use of 9.412 TJ heat from biomass of which 6.338 TJ from dedicated installations (only heat) and 3.074 by CHP installations.

The increase of heat pumps and solar boilers was prognosticated by the Flemish Energy Agency.

The total forecast for renewable heat is 35.5 PJ by 2020, were the largest part (95%) will be filled in by biomass with 1/3 out of bio-CHP (blue) installations and 2/3 out of biomass-boilers (dedicated heat) (purple). Solar boilers (yellow) and heat pumps will deliver a marginal proportion of the green heat (Figure 12).

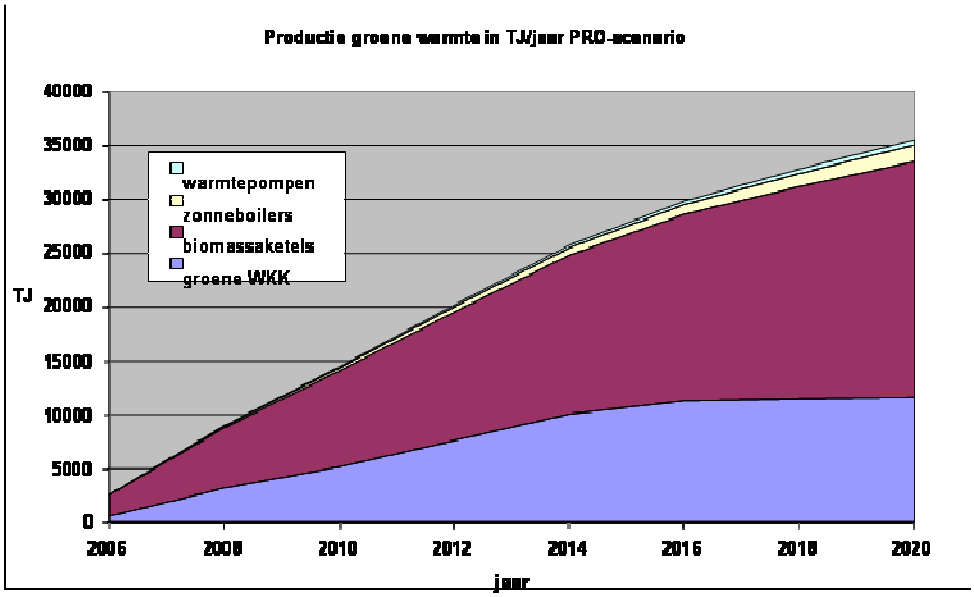


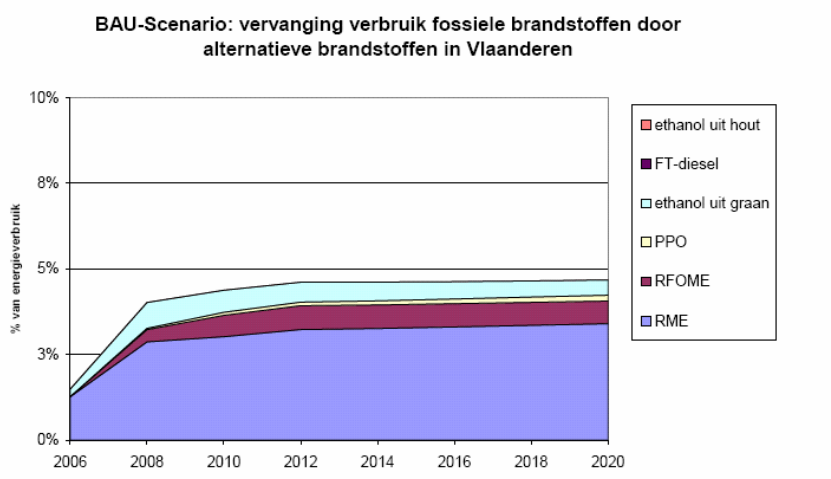
Figure 12: Prognosis green heating production (TJ)

Note: translation Dutch➔	English
• Warmtepompen	heat pumps
• Zonneboilers	solar boiler
• Biomassa ketels	biomass installations
• Groene WKK	green CHP

The use of biomass for heating is forecasted for different sectors where biomass will have the most opportunities to grow in : the residential sector with pellet stoves and boilers, the tertiary sector with pellet boilers, the agricultural sector (greenhouses and stables) and industry with woodchip boilers or bio-liquid boilers. Only for the residential sector a business-as-usual was calculated because in the other sectors biomass heating systems almost did not exist, so only a pro-active scenario was calculated for these installations. In the following figures the increase in amount of installations can be seen.

→ ***Biofuels***

For the Flemish Region a business-as-usual and a pro-active scenario were executed till 2020 for the use of bio-fuels. In a business-as-usual scenario a mix of 4,5% will be reached in 2012 and stabilised, so not reaching the goal of 5,75% of the European Commission in 2012. The introduction of the second generation of biofuels will not be established before 2020 in the business-as-usual scenario. The biggest part of the substitution of biofuels will be done with biodiesel (with an important role for import of biodiesel of other Member States) because of the growing trend of the diesel car park in the region. The production of ethanol can be done internally and PPO will only play a marginal role in the substitution (Figure 13).

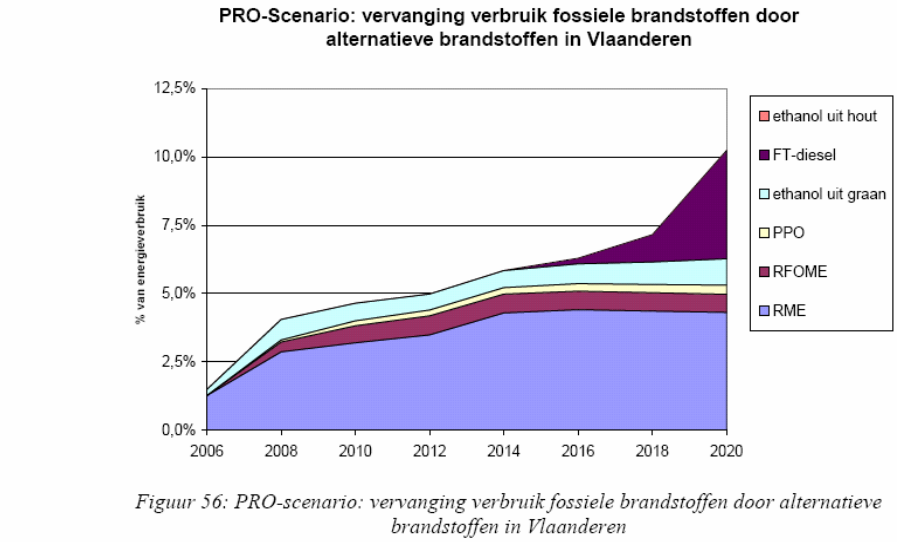


Figuur 52: BAU-scenario: vervanging verbruik fossiele brandstoffen door alternatieve brandstoffen in Vlaanderen

Figure 13: Business-as-usual scenario for the introduction of biofuels in the Flemish region (source: VITO-study)

Note: translation Dutch➔ English
- Ethanol uit hout Wood ethanol
- Ethanol uit graan Wheat ethanol

In a pro-active scenario the substitution till 2014 will be done by the traditional biofuels, again with the most important role for biodiesel. From 2015 second generation biofuels are introduced like FT-diesel and realise an increase in substitution to 10% by 2020.



Figuur 56: PRO-scenario: vervanging verbruik fossiele brandstoffen door alternatieve brandstoffen in Vlaanderen

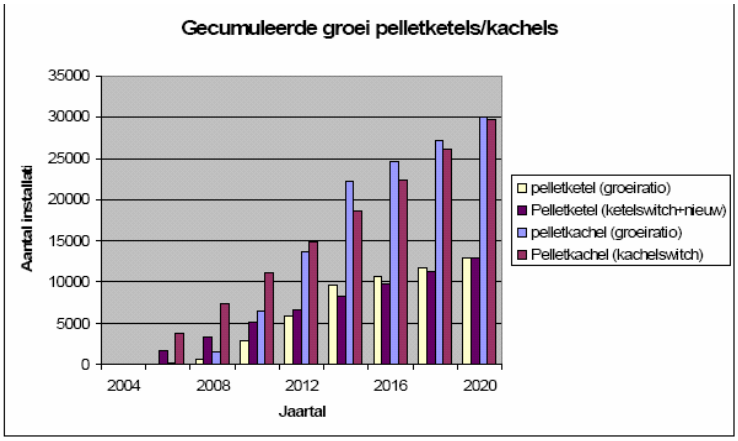
Figure 14: Pro-scenario for the introduction of biofuels in the Flemish region (source: VITO-study

Note: translation Dutch➔ English
- Ethanol uit hout Wood ethanol
- Ethanol uit graan Wheat ethanol

→ ***The pellet sector***

In 2005 VITO performed a study on the pellet potential in the Flemish region. The use of pellets for heating is forecasted for different sectors. The residential sector with pellet stoves and boilers, the tertiary sector with pellet boilers and finally the agricultural sector (greenhouses and stables) and industry with woodchip boilers or bio-liquid boilers. Only for the residential sector a business-as-usual was calculated because in the other sectors biomass heating systems almost did not exist, so only a pro-active scenario was calculated for these installations. However these results need an update because of the changing constraints and the last 3 years more investments are made in biomass heating than was predicted

The prognosis for pellet installations in the **residential sector** are given below for pellet boilers (blue bar) and pellet stoves (purple bar). The smaller bars indicate the yearly growth rate for pellet boilers (yellow bar) and pellet stoves (deep purple bar) (Figure 15). At that time a total number of 3403 pellet boilers and 7448 pellet stoves were forecasted for 2008. The pellet use in the residential sector was forecasted to be 5.000 tons.



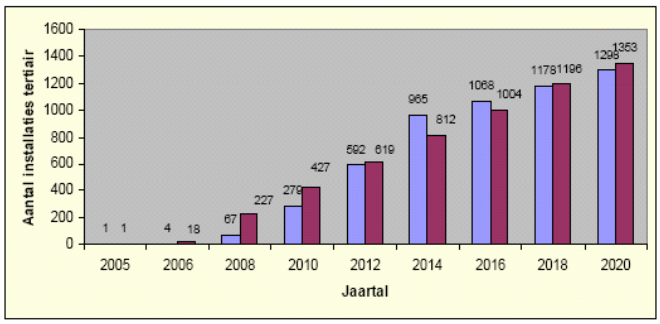
Figuur 42: Gecumuleerde groei pelletketels/kachels

Figure 15: Cumulated increase of pellet stoves and boilers in the residential sector

Note: translation Dutch➔ English

- Pelletketel pellet boiler
- Pelletkachel pellet stove
- Groeiratio growth rate

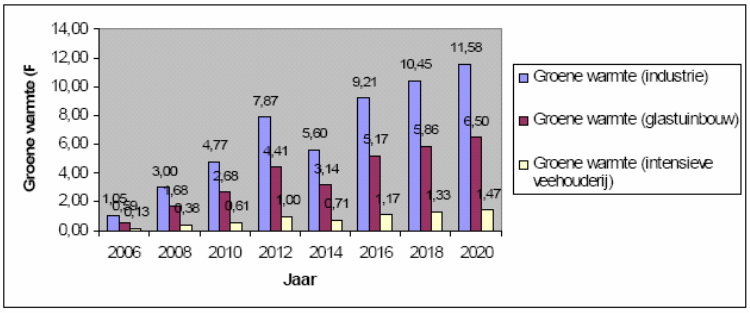
The prognosis for pellet installations in the **tertiary sector** are given below for pellet boilers (Figure 16). At that time a total number of 67 pellet boilers were forecasted for 2008. The pellet use in the tertiary sector was forecasted to be 3.000 tons.



Figuur 43: Aantal installaties tertiair

Figure 16: Cumulated increase of pellet boilers in the tertiary sector

The prognosis for pellet installations in the industry and agricultural sector are given below for pellet boilers (Figure 17); blue bars (industry), purple bars (greenhouses) and yellow bars (intensive cattle husbandry).



Figuur 44: Groene warmte in de industrie, glastuinbouw en in de intensieve veehouderij

Figure 17: Cumulated increase of pellet boilers in the industry and agricultural sector

Note: translation Dutch➔	English
• Groene warmte (industrie)	Green heat (industry)
• Groene warmte (glastuinbouw)	Green heat (glasshouse horticulture)
• Groene warmte intensieve veehouderij breeding)	Green heat (intensive cattle

Huge amounts of pellets are yearly important by **large electricity producers** to be used in dedicated or co-combustion with coal in electricity installations. Energy producer GDF-SUEZ / Electrabel imports, on yearly basis about 400.000 ton of pellets (figures 2008).

		Electrabel						Stora Enso		Linopan		Norbord		
		Ruien		Rodenhuize		Langerlo								
		Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import	
wood	not defined					67.967						26.261	18.463	112.691
	chips	65.927	3.649											69.576
	pellet				399.112									399.112
	dust	74.962	3.937											78.899
	waste							66.917	4.657	18.470				90.044
olive	pith		22.781		1.533									24.314
	pulp						251.445							251.445
Total		140.889	30.367	-	400.645	67.967	251.445	66.917	4.657	18.470	-	26.261	18.463	**1.026.081**

Figure 18: Biomass (co-)combusted in Flemish incineration plants accepting bio-waste from third parties (in tons, 2008)

Table 6 lists the capacity of the main producer in Flanders (figures for Wallonia are given in the following section) i.e. with a capacity > 10 kton/year. Data refer to the capacity and not to the actual production which is not known or not public in most cases.

Table 6: Capacity of major pellet producers in Belgium 2009 (source: VITO 2009 & Bio-energy pelletsmap):

Company name	Location	Capacity (kton/year)
Wonterspan	Deinze	20

Next to these local producers pellets are imported by pellet boiler and stoves suppliers as part of their service. Next to these suppliers there are also pellet traders active on the market. Remark that major imports by electricity producers happen independently from these suppliers & traders through direct abroad contacts.

1.3.3 Walloon energy balance

→ ***Renewable energy***

Final energy consumption in Wallonia for the year 2007 was estimated at 144.2 TWh. The share for renewables was estimated to be 5.1% (electricity : 1.1%, heat : 3.7%, liquid biofuels : 0.3%).

Liquid biofuels production started in 2007. 1.4% liquid biofuel was added to gasoil (diesel), which represented a share of 0.3% for the Walloon final energy consumption.

Regarding primary energy, renewables represented a total amount of 10.1 TWh (biomass : 9.4 TWh, renewables except biomass : 0.7 TWh).

Main renewable energy sources are woody biomass (forest by-products and fire wood), organic household refuse, biogas, hydroelectricity and other sources like wind power. At the present time in Wallonia, biomass is considered as the main renewable energy source.

For the year 2007, substitution fuel (animal flours, impregnated sawdust, textile waste, etc) were also entered in the category « biomass ».

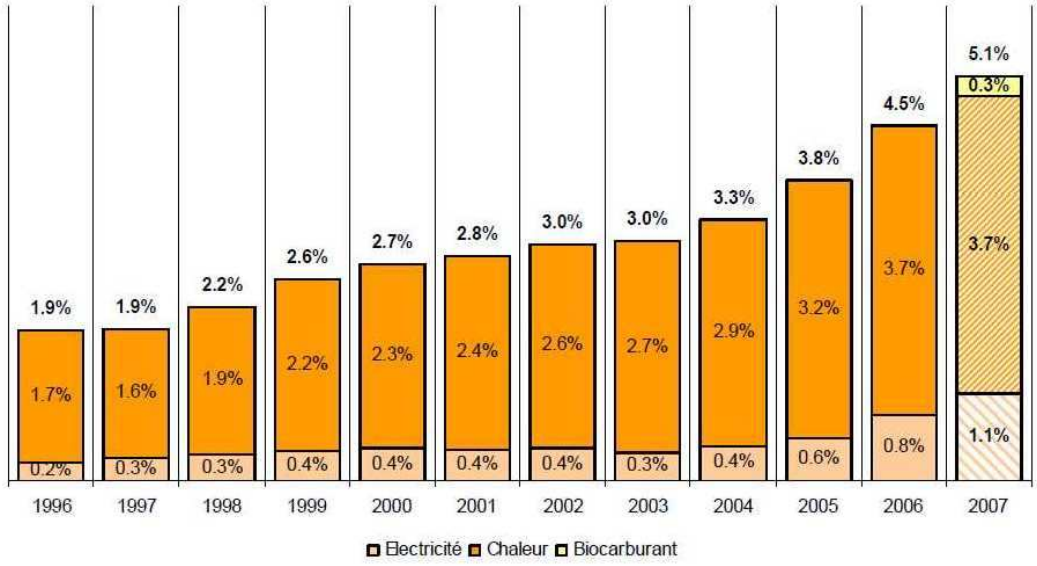


Figure 19: Evolution of renewable energy in final consumption in Wallonia : electricity (electricité), heat (chaleur), liquid biofuel (biocarburant) from 1996 to 2007 (source : ICEDD, 2008)

In 2000, hydroelectricity represented 89.7% of primary energy from renewables (except biomass). For the year 2007, the share for hydroelectricity was only 56.7%, due to important development of wind power which represented 30% of primary energy from renewables.

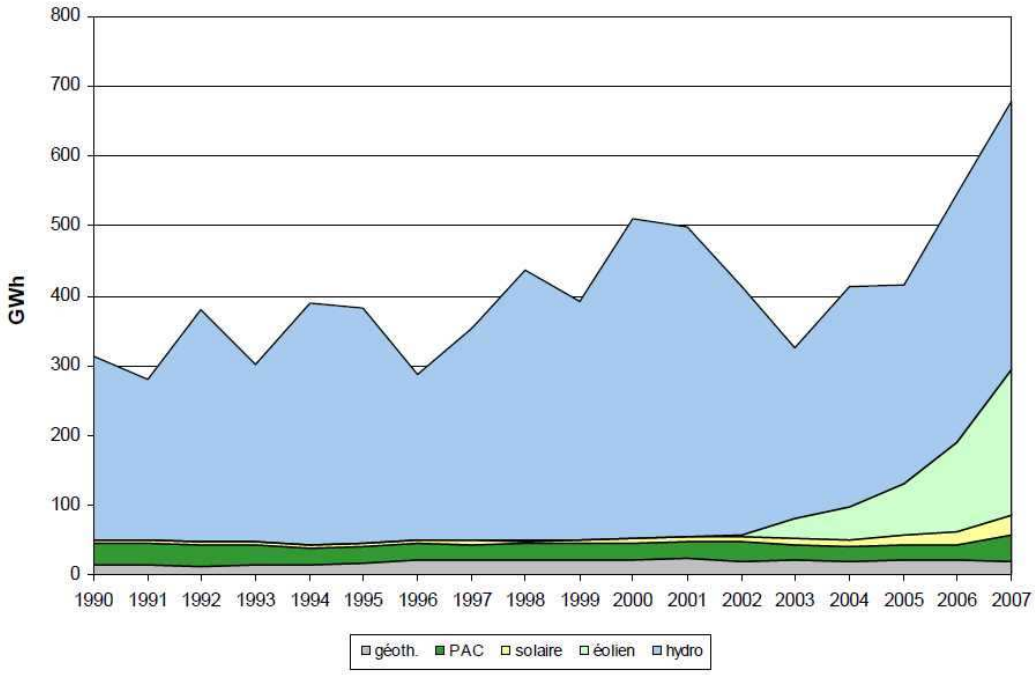


Figure 20: Primary energy sources in Wallonia (except biomass) : geothermal (Géoth), heat pump (PAC), solar (Solaire), wind (Eolien), hydro (Hydro) from 1990 to 2007 (source : ICEDD, 2008)

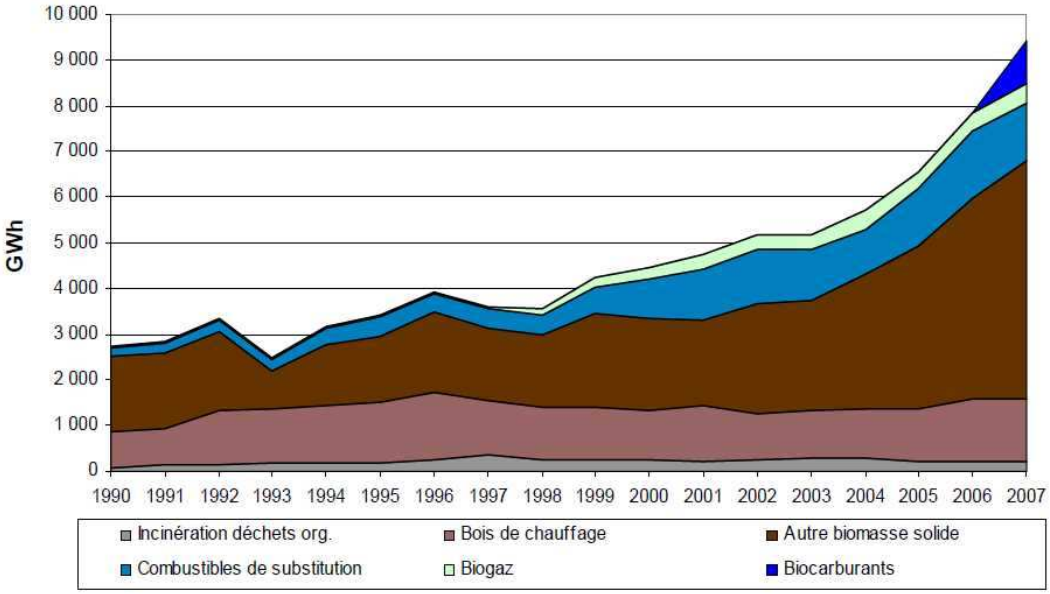


Figure 21: Primary energy sources in Wallonia (biomass) : organic household refuse (Incinération déchets org.), fire wood (Bois de chauffage), solid biomass (Autre biomasse solide), substitution fuel (Combustibles de substitution), biogas (Biogaz), liquid biofuels (Biocarburants) from 1990 to 2007 (source : ICEDD, 2008)

→ ***Green electricity***

Net power generation from renewables was estimated at 1 609 GWh (biomass : 1 019 GWh) for the year 2007, which represented a share of 6.3% in regional electricity consumption. Main sources are hydroelectricity, wind power, forest by-products and biogas.

Hydroelectricity was the main contributor in 2000 (68.5%), while it represented only 23.7% in 2007. For the same period, forest by-products contribution was respectively 18.5% to 52.9%. It's also remarkable to note the evolution for wind power : from 0.2% in 2000 to 13.0% for the year 2007.

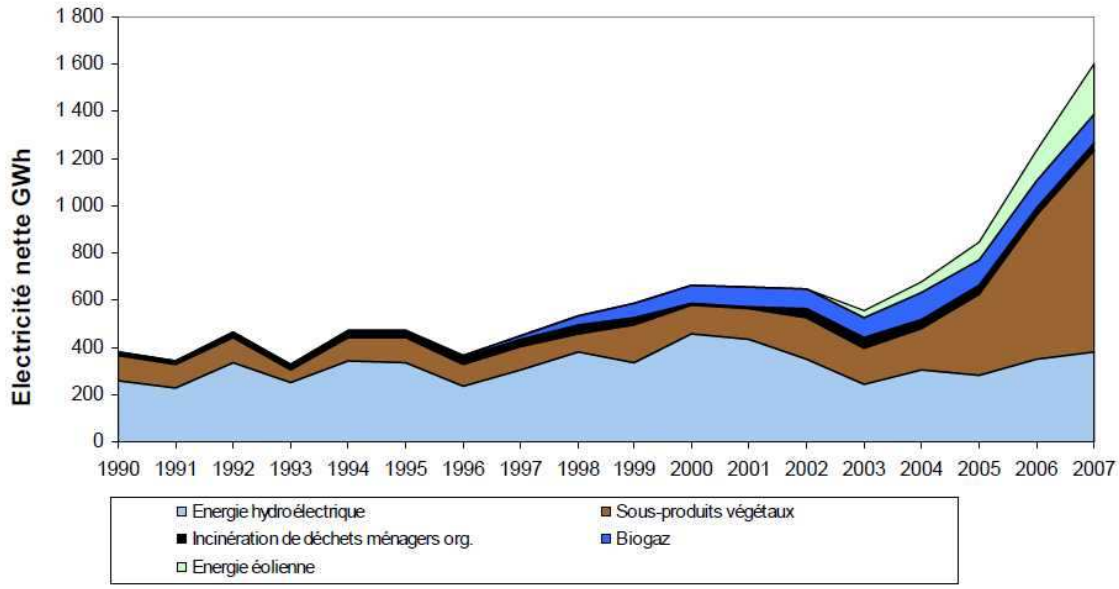
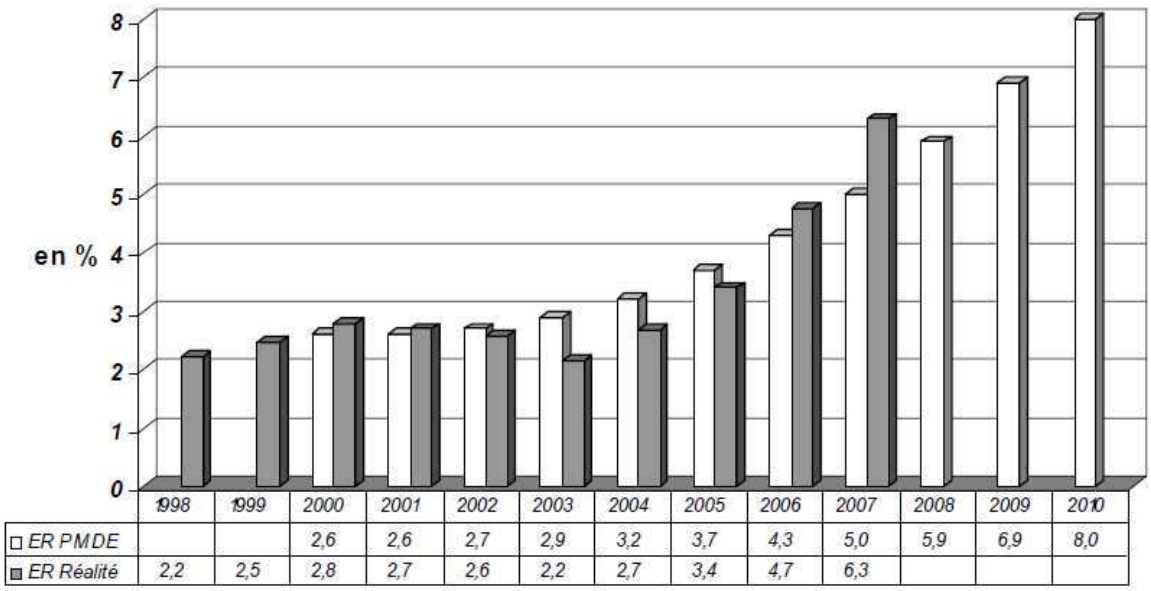


Figure 22: Green electricity production from RES in Wallonia : hydro (Energie hydroélectrique), forest by-products (Sous-produits végétaux), organic household refuse (Incinération de déchets ménagers org.), biogas (Biogaz), wind (Energie éolienne) from 1990 to 2007 (source : ICEDD, 2008)

As defined in the Walloon plan for sustainable management of energy (PMDE : « Plan wallon pour la maîtrise durable de l'énergie », December 2003), the target for the year 2010 is 8% electricity consumption from renewables.

Following the present trend, this target should be reached, and even exceeded.



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ER PMDE			2,6	2,6	2,7	2,9	3,2	3,7	4,3	5,0	5,9	6,9	8,0
ER Réalité	2,2	2,5	2,8	2,7	2,6	2,2	2,7	3,4	4,7	6,3			

Figure 23: Electricity from renewables : noted evolution (ER réalité) and envisaged evolution (ER PMDE) from 1998 to 2010 (source : ICEDD, 2008)

→ ***Green heating***

Heat from renewables in Wallonia represented 5 405 GWh (biomass : 5 342 GWh) in 2007. The share of renewables was estimated at 8.3% in regional heat consumption. Biomass (and especially wood energy) represents the main part of renewables to produce heat.

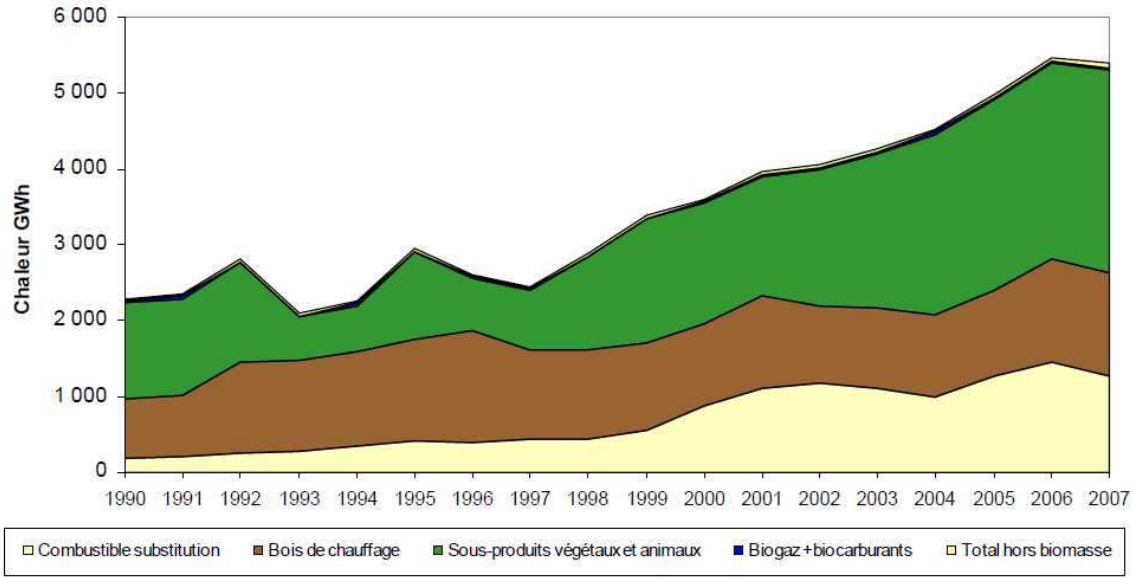
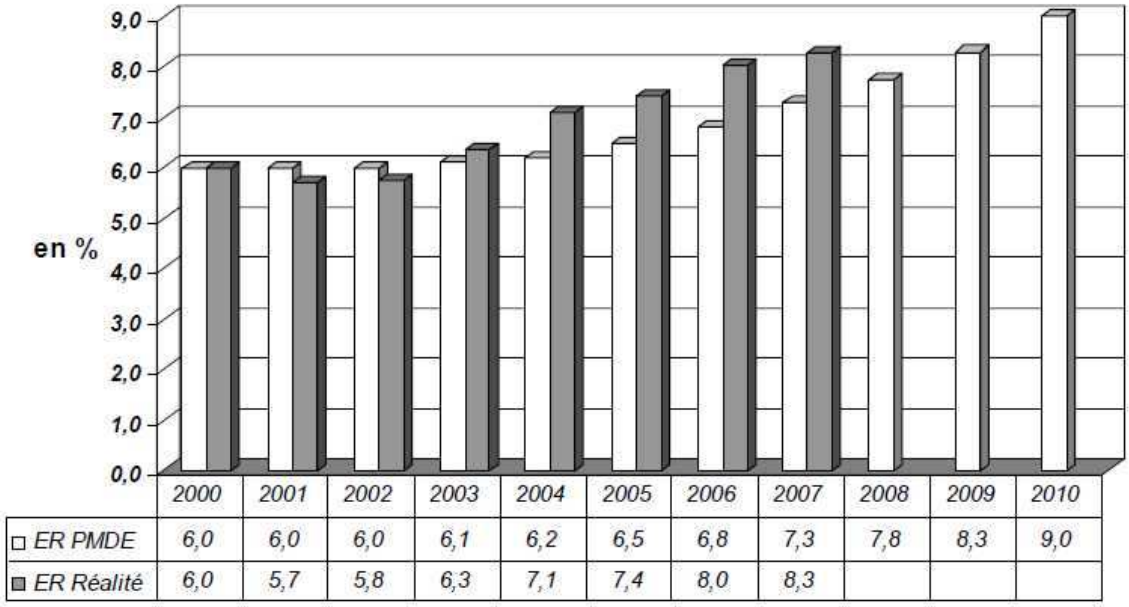


Figure 24: Green heat production from RES in Wallonia : substitution fuel (Combustible substitution), fire wood (Bois de chauffage), animal and vegetatable by-products (Sous-produits végétaux et animaux), biogas + liquid biofuels (Biogaz + biocarburants), total except biomass (Total hors biomasse) from 1990 to 2007 (source : ICEDD, 2008)

As defined in PMDE , the target for the year 2010 is 9% heat consumption from renewables.

Following the present trend, this target should be reached, and even largely exceeded.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ER PMDE	6,0	6,0	6,0	6,1	6,2	6,5	6,8	7,3	7,8	8,3	9,0
ER Réalité	6,0	5,7	5,8	6,3	7,1	7,4	8,0	8,3			

Figure 25: Heat from renewables : noted evolution (ER réalité) and envisaged evolution (ER PMDE) from 2000 to 2010 (source : ICEDD, 2008)

→ ***Liquid biofuels***

Since February 2007, the Néochim plant (Feluy) has started to produce liquid biofuel. Its annual production capacity is 240 000 tons, and the production for the year 2007 was evaluated at 87 000 tons (source : ICEDD, 2008).

The Biowanze plant (Wanze) produces bioethanol from sugar beet and cereals. Its annual production capacity is 300 millions liters, but there was no production for the year 2007. Biowanze plant has started to produce by the end of the year 2008. Bran (by-product from cereals crushing) is used to feed a boiler which produces electricity and steam needed for the production of bioethanol. CO_2 balance is therefore very interesting.

8% rape are produced in the country (equivalent to 72.5 GWh) and 92% are imported (829.4 GWh).

There are also in Wallonia a few farmers producing rape seed oil with small agricultural press. Rape seed oil can be used as agricultural fuel and for CHP (cogeneration). Rules have to be implemented to determine how to sell this oil to the private individuals as a tax-free fuel.

→ ***The pellet sector***

The pellets market in Wallonia is rather new. A few years ago, there were just a few pellets retailers which were distributing imported pellets.

The oldest pellets manufacturer in Wallonia began its activity by the end of the year 2005. Up to now (July 2009), there are 6 factories producing pellets in Wallonia. Their global annual production capacity is about 420 000 tons pellets. Two of them (ERDA and IBV) are producing pellets mainly for industrial market, the others producing for domestic use.

Production for the year 2008 was about 218 000 tons pellets, of which 72 500 tons for domestic use (33%).

There are also other projects for several new pellets factories.

Table 7: Main pellets factories in Wallonia (situation July 2009) (source: ValBiom)

Name	Town	Start activity	Annual production capacity (kton/year)
Granubois	5555 Bièvre	End 2005	15
Badger pellets	6760 Virton	End 2006	50
ERDA	6880 Bertrix	June 2007	130
Pellets Mandi	6220 Fleurus	August 2007	30
Delhez Bois	4770 Amel	April 2008	55
IBV	6690 Vielsalm	May 2008	150
Total			**430**

Also taking into account smaller producers lead to an estimated total pellet production capacity in **Belgium** of 500 kton/year.

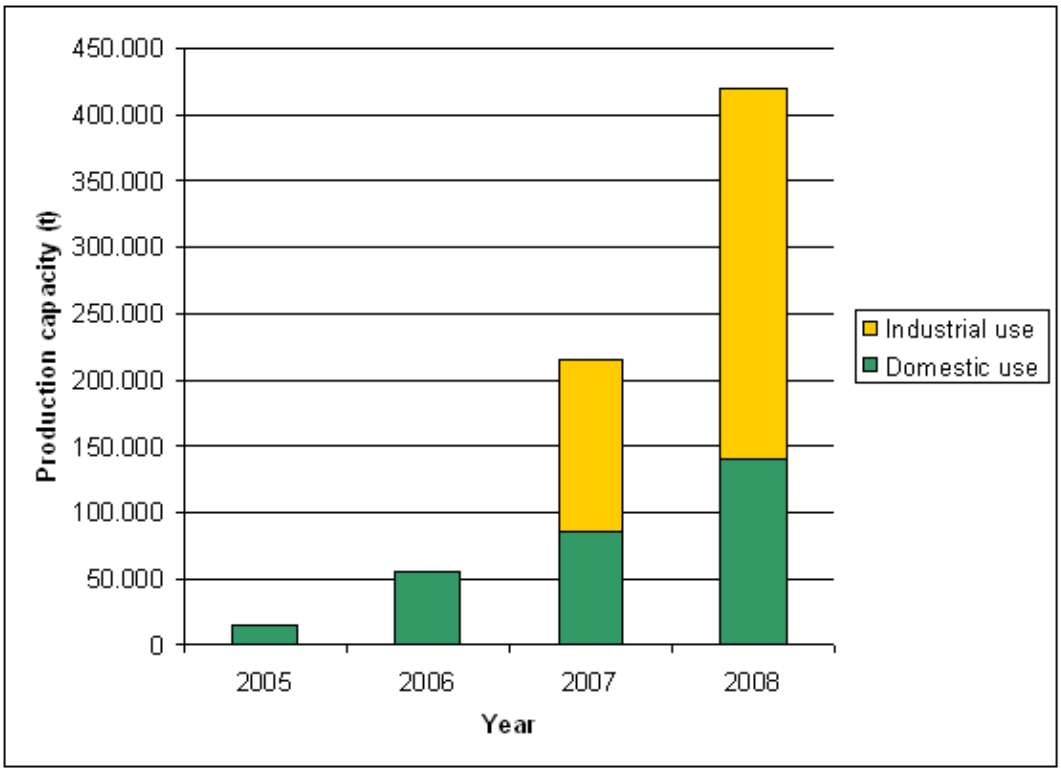


Figure 26: Pellet production capacity in Wallonia (2005 – 2008) (source : ValBiom)

Pellets market in Wallonia is not well balanced between small scale and large scale use. There is indeed one power plant (80 Mwe) using 350 000 tons pellets each year to produce electricity. The greatest part of pellets is imported, but it is planned that about 15% of pellets used to produce electricity should come from Wallonia in a near future.

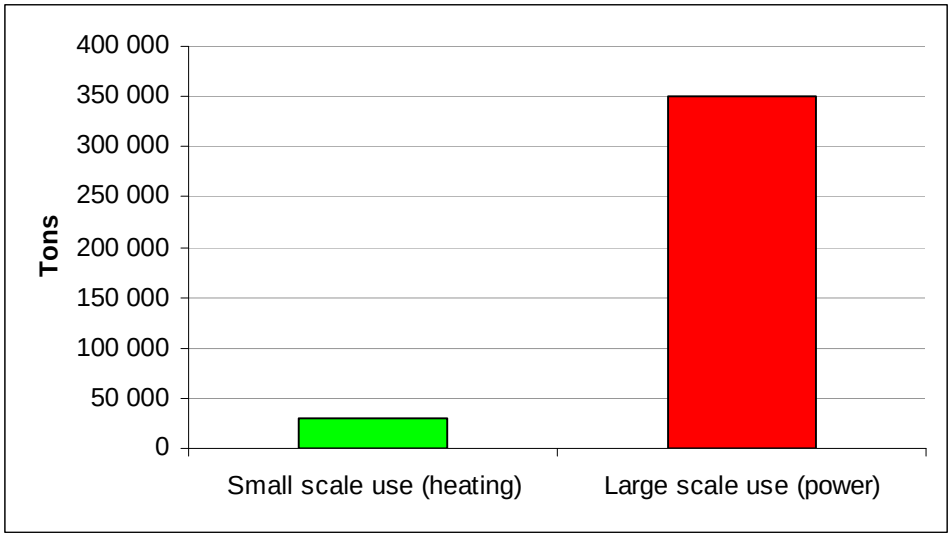


Figure 27: Types of pellet market in Wallonia (2007) (source : ValBiom)

Per capita use of pellets as fuel for residential heating is increasing from 2005 (about 2 kg pellets per capita) to 2007 (about 8 kg pellets per capita)

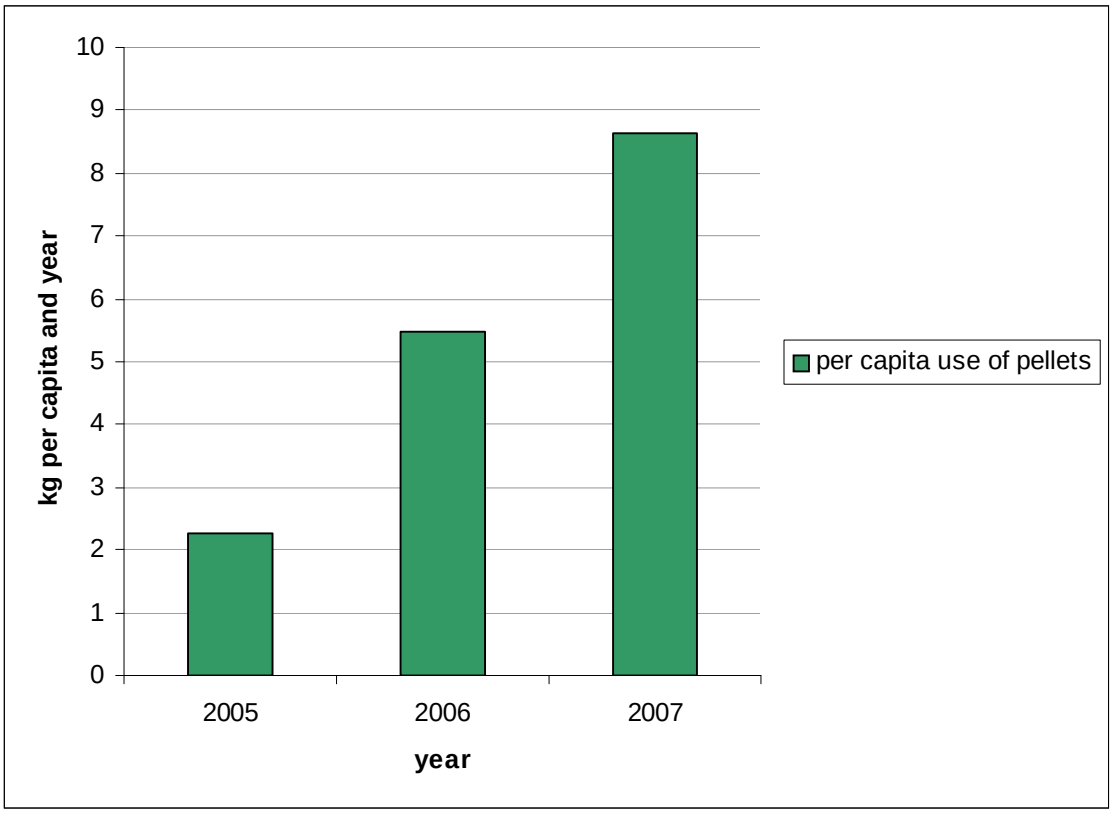


Figure 28: Per capita use of pellets as fuel for residential heating (2005 – 2007) (source : ValBiom and Walloon Energy service)

ValBiom (Belgian Biomass association) has examined pellets market in Wallonia since the year 2004, following its own methodology :

- surveys were performed in 2004 and 2005 ;
- as there were regional grants for almost all kind of wood heating devices in 2006 and 2007, analyses were performed on the data collected by the Walloon Energy Service administration ;
- a lot of contacts with pellets sector (e.g. producers, pellets retailers, stoves and boilers retailers).

These actions have lead to make an evaluation of the number of pellets devices in use in private households.

Following these evaluations, 1 327 pellets stoves were installed during the year 2005 (Figure 29). In 2007, three times more devices were installed (4 193) !

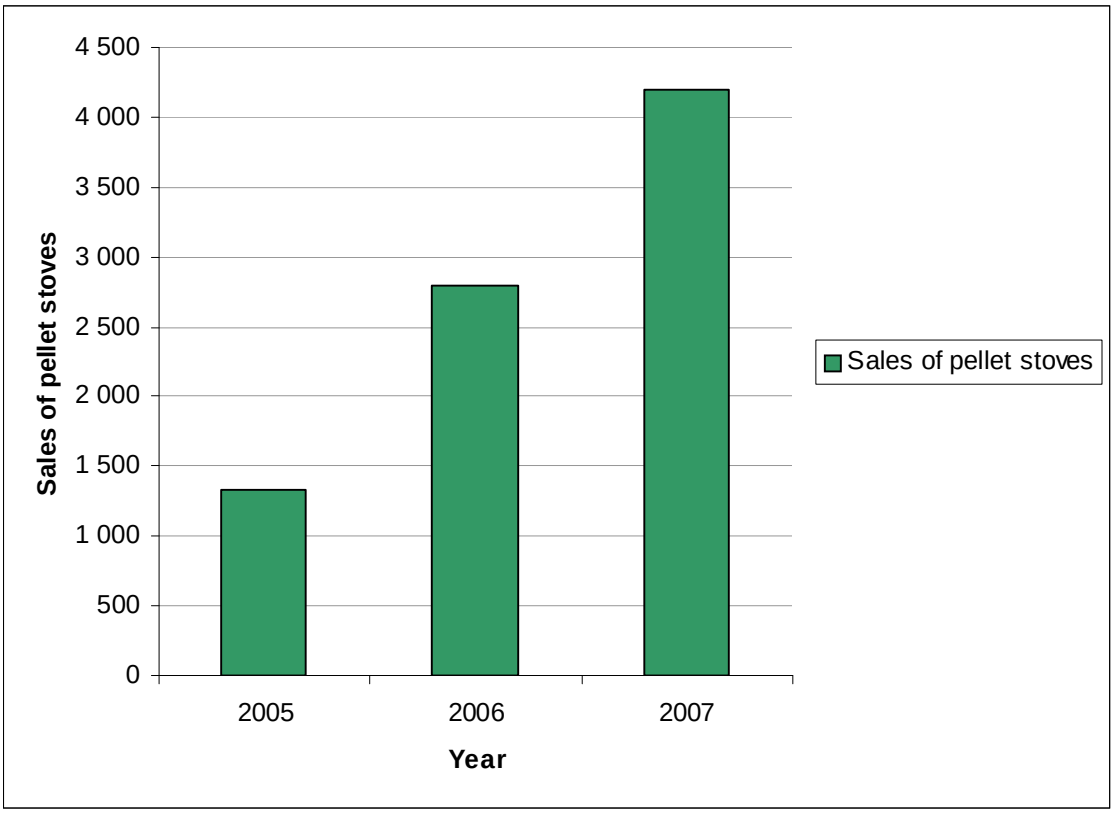


Figure 29: Sales of pellet stoves in Wallonia (estimation, 2005 – 2007) (source: ValBiom and Walloon Energy service)

If we consider the number of pellets devices in use in Wallonia by the end of the year 2007 (Figure 30), we can evaluate :

- 1 099 boilers ;
- 8 634 stoves ;
- 393 stove-boilers.

For the period 2004 to 2007, there was a strong increase : total number of pellets devices was evaluated at 413 by the end of the year 2004. It was 24 times more by the end of 2007 !

If we assume the same trends for the year 2008, we can evaluate the present situation contributing to save 60 000 tons fossil CO_2. This evaluation corresponds to the use of about 15 000 devices but it has to be confirmed by a survey at a regional level.

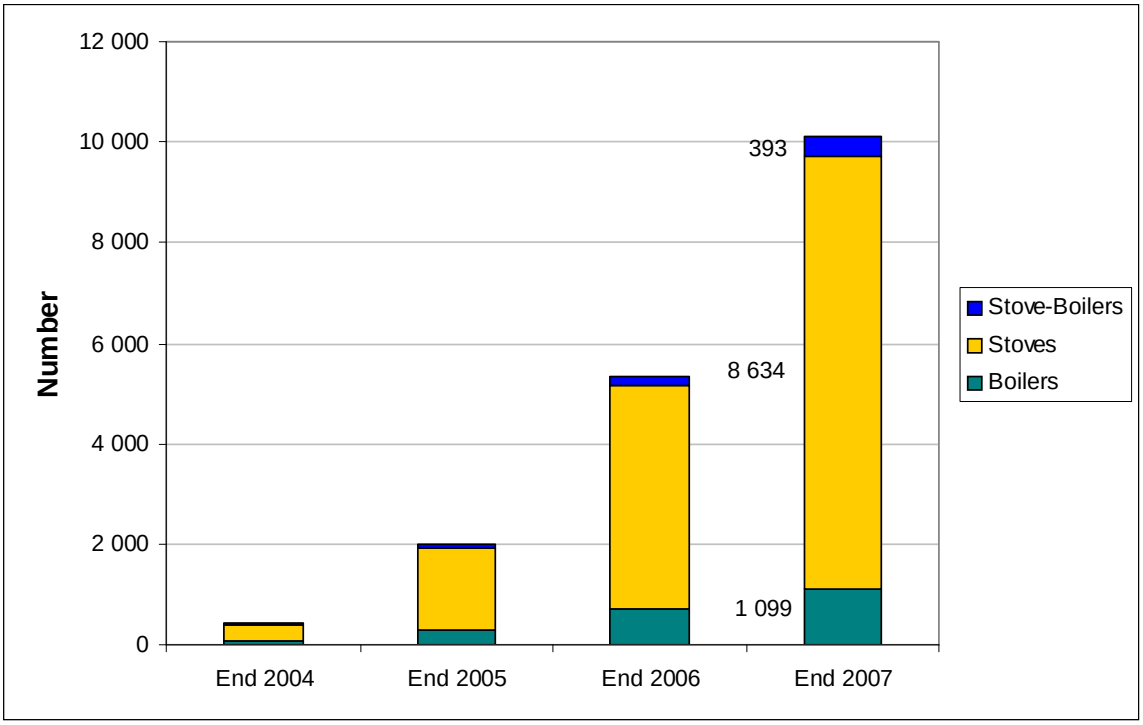


Figure 30: Pellet devices in use in Wallonia (2004 – 2007) (source: ValBiom and Walloon Energy service)

Installed power (domestic use) was evaluated at about 96.9 MWth for the year 2007. It corresponded to the use of about 35 000 tons pellets, which contributed to save about 44 000 tons fossil CO_2.

ValBiom has monitored pellets price (for domestic use) since October 2007. Pellet price is the result of contacts with several pellets producers and retailers. Price is given for bulk delivery. In comparison, fuel oil price is given for a minimum amount of 2 000 litres. Data are converted in cent € per kWh.

In comparison with the fluctuation of fuel oil price, it's interesting to notice that pellet price is remained quite stable (Figure 31).

The present situation (June 2009) is quite different than one year ago, where pellet price advantage compared to fuel oil was 51%. Now there is a more little difference (10%) (Figure 32).

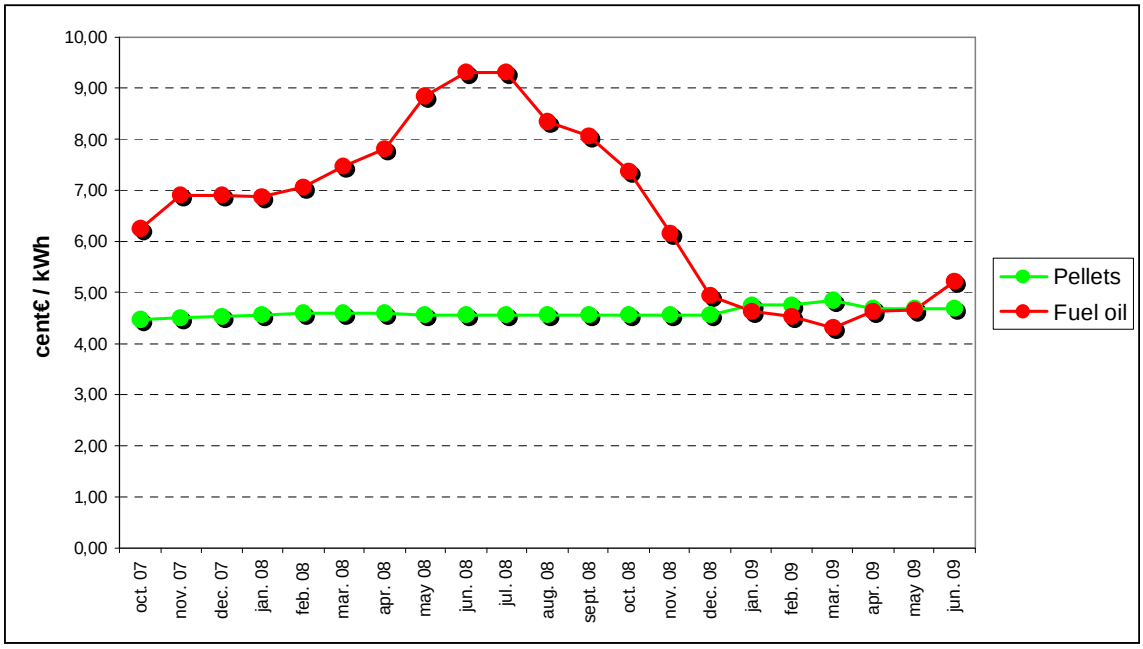


Figure 31: Pellet and heating oil prices in Wallonia (October 2007 – June 2009) (pellets : bulk delivery, fuel oil : min 2000 l) (source : ValBiom and http://mineco.fgov.be)

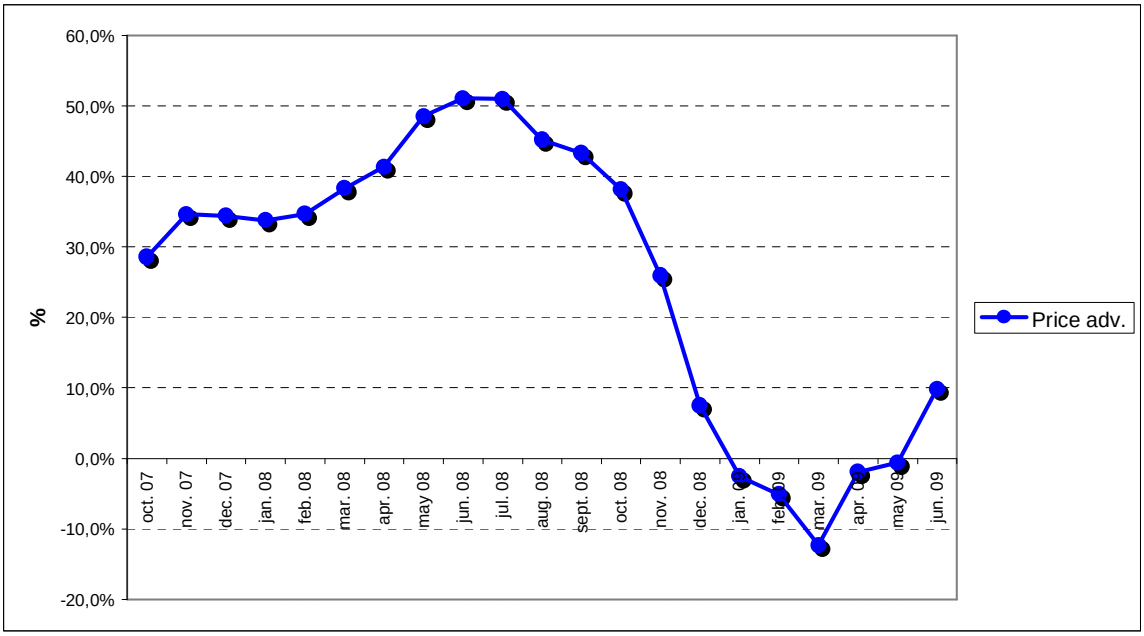


Figure 32: Price advantage pellets versus fuel oil in Wallonia (October 2007 – June 2009) (source : ValBiom)

1.3.4 Green electricity summary table (Flanders + Wallonia)

Table 8: Green electricity summary table for the Flemish & Walloon region (source: Flanders: VREG & Wallonia: CWAPE)

	Green power in Flanders in certificates equivalent to 1000 kWh (2002-2007)				
	Total	**Biogas**	**Solid+Liquid biomass**	**Total Biomass**	**%**
2003	291 568	133 948	96 729	230 677	79.1%
2004	543 891	212 095	234 433	446 528	82.1%
2005	967 035	196 718	612 309	809 027	83.7%
2006	1 431 059	127 116	1 061 250	1 188 366	83.0%
2007	1 640 377	183 315	1 167 386	1 350 701	82.3%

	Green power in Wallonia in certificates equivalent to 1000 kWh (2003-2008)				
	Total	**Electricity with biomass**	**Cogeneration with biomass**	**Total Biomass**	**%**
2003	1 432 720	65 373	183 203	248 576	17.4%
2004	1 488 907	81 893	221 582	303 475	20.4%
2005	1 731 445	263 903	233 845	497 748	28.7%
2006	2 139 073	501 821	275 964	777 785	36.4%
2007	2 471 356	576 441	434 025	1 010 466	40.9%
2008	2 896 171	702 682	632 348	1 335 030	46.1%

CHAPTER 2 POLICY

2.1 General overview

Belgium has committed itself to reduce the greenhouse gas emissions with 7,5% by 2012. The level of CO2eq emissions (CO_2, CH_4, N2O) for the country was 145.7 Mton CO2eq in the 1990 base year. The level increased to 150,6 CO2eq Mton in 1999, but decreased in 2006 to 137 Mton CO2eq. The target for the 2008 – 2012 period is 134,8 Mton CO2eq (Table 9).

Table 9: Progress towards the Kyoto targets

Current and projected progress towards 2008-2012 Kyoto targets[4]	Absolute (Mt CO_2 eq.)	Relative to BY emissions	EU-15 average
Base-year (BY) emissions	145.7	0.0%	0%
GHG target under the Kyoto Protocol	134.8	-7.5%	-8.0%
2006 emissions	137.0	-6.0%	-2.7%
Average GHG during the last 5-year period (2002-2006)	143.0	-1.8%	-2.0%
Projected 2010 emissions (existing measures in place)	140.3	-3.7%	-3.6%
Projected effect of the (planned) additional measures	*0.0*	*0.0%*	*-3.3%*
Projected effect of carbon sink activities	*0.0*	*0.00%*	*1.3%*
Projected use of Kyoto mechanisms	*-7.0*	*-4.8%*	*3.0%*
Projected 2010 emissions, taking into account existing and additional measures, carbon sinks and Kyoto mechanisms	133.3	-8.5%	-11.3%
In 2006, Belgium's emissions were 6% lower than the base-year level, slightly above its burden-sharing target of -7.5% for the period 2008-2012. According to Belgium's projections, with the existing policies and measures, emissions will increase to reach by 2010 a level 4% below base-year emissions. Belgium expects to achieve its target by making use of Kyoto mechanisms (financing emission reduction projects in other countries), reaching a level 9% below base-year emissions.			

Belgium, like all European countries, was given objectives in terms of the renewable energy content in its overall energy balance.
At a European level, there is a strong objective to produce 20% of energy from renewables in 2020[2]. The Belgian overall target for the share of energy from renewable sources in final consumption of energy in 2020 was fixed at 13%. The share between the three Regions is still under negotiation.
For liquid biofuels (for transport) Belgium took over the 5.75% of the European Commission.

[2] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009, on the promotion of the use of energy from renewable sources (amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC).

2.2 Responsibilities within the Belgian energy sector

Belgium is a Federal State consisting of 3 regions: the Flemish Region, the Walloon Region and the Brussels-Capital Region. The evolution of the Belgian energy policy has been shaped by the country's general political evolution, and has led to the transfer of wide competences from the State to the Regions.

In the beginning of the nineties (1991) an important part of energy related matters were transferred from the federal authorities to the regional authorities of Brussels, Flanders and Wallonia. The federal government stayed responsible for issues that need to be dealt with at the national Level. The regions gained responsibility for a lot of energy related legislation (Table 10). Each region started to develop his own energy policy tailor made for his region. This tailor-made policy could be stimulated by subsidies but not by fiscal reductions because fiscal matters are federal issues.

Within the scope of this study of particular interest are the responsibilities:

- On regional level which are:
  - New and renewable sources of energy
  - Rational use of energy

- On Federal level which are:
  - Fiscal benefits renewable investments
  - Tax exemptions bio-fuels

Table 10: Division of energy policies responsibilities

Division of Responsibilities for Energy Policy between Federal and Regional Governments	
Federal Government	**Regional Governments**
Indicative programme for the electricity Sector	**Distribution and transport of electricity through networks with a maximum voltage of 70 kV**
Nuclear fuel cycle and related R&D programmes as well as research in the Field of nuclear fusion	**Public distribution of gas**
Large infrastructures for storage Transport and production of energy	**Use of methane and blast furnace gas District-heating equipment and networks**
Setting tariffs	**Use of waste product reclaims from coal tips**
Central production planning Tax exemptions biofuels	**New and renewable sources of energy Recovery of waste energy from industry or other uses**
Fiscal benefits renewable investments Grid > 70 kV Off-shore	**Rational use of energy**

2.3 Responsibilities within the Belgian electricity sector

Table 11: Electricity market roles and responsibilities of the Federal and Regional regulators (IEA, 2006)

Federal *CREG*	**Flanders** *VREG*	**Wallonia** *CWaPE*	**Brussels-Capital** *IBGE/BIM*
- Advise federal government - Regulate transmission above 70 kV - Monitor the wholesale electricity market - Monitor the federal green certificate market - Give advice on the appointment of the transmission grid operator - Work with the competition authority - Verify the absence of cross-subsidies between categories of clients - Approve tariffs for using the transmission and distribution network - Arbitrate disputes	- Advise Flemish government - Regulate transmission and distribution up to 70 kV - Issue retail supply licenses - Monitor the regional electricity market - Monitor the Flemish green certificate and CHP market - Appoint distribution system grid operators - Provide dispute mediation	- Advise Walloon government - Regulate transmission and distribution up to 70 kV - Issue retail supply licenses - Monitor the regional electricity market - Monitor the Walloon green certificate market - Appoint distribution system grid operators - Arbitrate grid access disputes	- Regulate transmission and distribution up to 70 kV - Issue retail supply licenses - Monitor the regional electricity market - Monitor the Brussels-Capital green certificate market - Appoint distribution system grid operators - Arbitrate grid access disputes

2.3.1 VREG – the Flemish electricity & gas regulator

VREG is responsible for the efficient organisation and working of the deregulated Flemish electricity and gas market. It appoints the distribution network operators, grants delivery licences to suppliers and issues certificates/guarantees of origin to producers of electricity from renewable energy sources and combined heat and power systems.

In addition to this, VREG draws up technical regulations for access to the electricity and natural gas network and for the management and expansion thereof. It mediates and deals with disputes relating to access to the distribution network, and the application of the code of good practice and the technical regulations.

VREG also has a control function. It carries out careful monitoring to ensure that the distribution network operators and suppliers comply with legal and statutory obligations. Examples of these are the public service obligations to which the various parties in the market are tied.

Along with this, VREG acts as an advisor to the Flemish authorities to optimise the organisation and working of the energy market. It follows the trends in the Flemish energy market, considered in a European context, via studies. The VREG has been operational since 1st December 2001.

2.3.2 CWaPE – the Walloon electricity & gas regulator

Within the framework of European Directive 96/92/EC concerning the common rules for the internal market in electricity (subsequently revoked by new European Directive 2003/54/EC concerning the internal electricity market), the Walloon Region, within its area of competence concerning electricity distribution (networks with a voltage less than or equal to 70 kV), issued a Decree on 12 April 2001 concerning the organisation of the regional electricity market. This Decree addresses the following issues, among others:

- the progressive opening of the market for consumers and the introduction of a principle of competition between producers / suppliers;
- the determination of the rules of operation of the market controlled by a regulatory body, the Walloon Commission on Energy (Commission wallonne pour l'Energie, CWaPE);
- the determination of public service obligations on the part of market operators, including a system of green certificates promoting any efficient technology for the production of energy from renewable sources or cogeneration.

2.4 Non-governmental-organisations and research institutes

Among Non-Governmental-Organisations and research institutes involved in the bio-energy sector the next ones must be mentioned.

- VITO (www.vito.be) - the Flemish Institute for Technological Research carries out studies on the potential of energy production from landfill gas in Flanders, inventory of Flemish actors on the biomass for energy market, studies on potential and barriers of biomass for energy production and setting up a regional biomass network;
- CRA-W Gembloux - the Agricultural Engineering Department of the Agricultural Research Centre is involved in the research and experimentation of biomass use and on thermal and chemical transformations of ligneous matter.
- VALBIOM (www.valbiom.be) - the Belgian Biomass Association is a non-profit association that gathers people involved in the biomass issues. Its aim is to promote the production and use of biomass in Belgium. VALBIOM has 115 members, including companies universities, research centres and professional organisations, co-ordinates national activities on biomass. VALBIOM is member of AEBIOM , European biomass association (www.ecop.ucl.ac.be/aebiom)
- EDORA – is a professional independent organisation with the goal to study all possible measures to assure the general interest in the energy sector of the renewable energy sector. (http://www.edora.org/index_ok.php?id_menu=10)
- ODE (http://www.ode.be/) - ODE-Vlaanderen, the Organisation for sustainable energy in the Flemish region.

2.5 Financial support schemes

2.5.1 For the production of energy crops

A premium is granted of maximal 45 €/ha for energy crops. This premium can be combined with the activation of regular payment entitlements.

In Belgium until 2007 a compulsory set-aside policy was in place. Late 2007 Belgium followed the European Commission, which decided to set the compulsory set-aside to 0% for fall 2007 – spring 2008. The obligation to set-aside parcels to activate set-aside payment entitlements was dropped. The value of the entitlement was preserved and could be activated with a subsidised crop.

2.5.2 For the production of biofuels

The European directive 2003/30 offers the opportunity to member states to grant a tax advantage for biofuel production. Biofuels tax advantages/exemptions are a reasonability of the Federal government (Table 10). The directive 2003/30 has been implemented into the Belgian legislation in 2005. A tax exemption was given for a quotum of biodiesel as well as bio-ethanol This quotum was divided over interested parties by a call for tenders The tax exemption was however neutral for the state budget since the tax on the fossil fuel part was increased.

One of the allocation criteria was the aspect of GHG balance of the feedstock for bio-fuel production. This balance will be periodically evaluated.

The tax advantage for the production was granted in different phases to different producers for biodiesel and bio-ethanol. Pure plant oil has been completely exempted from excise duty.

The following parties were granted a quotum for biodiesel production for the 1st phase from 1 November 2006 until 30 September 2007:

- Néochim (Feluy)
- Oleon (Ertvelde)
- Proviron (Oostende)
- Flanders Bio Fuel (Gistel)

In total 286 million litres.

The following parties were granted a quotum for biodiesel production for the 2nd phase from 1 October 2007 until 30 September 2013:

- Bioro (Gent)
- Néochim (Feluy
- Oleon (Ertvelde)
- Proviron (Oostende)

In total 2280 million litres.

The following parties were granted a quotum for bio-ethanol production for the phase (1 oct 2007 – 30 sept 2013): 1500 million liters

- Bio-Wanze (Wanze)
- Alco Bio Fuel (Gent)
- Tate & Lyle (Aalst)

In total 1500 million litres.

The tax reduction is only eligible for a minimal blend of 3,37% biodiesel in 2006, 4,29% in 2007 and 5% afterwards. The possibility of tax reduction for higher blends is only possible for regional public transport companies.

The success of the tax exemption for biofuels on the effective blending of biofuels was however limited since a blending obligation for fuel suppliers in the transport sector was not imposed.

2.5.3 For the production of green electricity (green certificate systems)

Today, electricity suppliers have to buy a minimum % of "green" electricity (i.e. made from renewable energy sources: wind, hydro, solar, biomass, cogeneration[3]). To ensure this, a new market mechanism has been set up. It consists of a system of green certificates.

The financial support of green electricity is a Regional responsibility . As such each region has worked out a green certificate system for electricity (Table 12). Each system is explained in detail in the following paragraphs.

[3] In the Walloon region no distinction is made between CHP en electricity, in the Flemish region there are certificates for green electricity as well as CHP.

Table 12: The 3 Belgian green certificates systems resp. for Flanders, Brussels and Wallonia (source: CogenSud)

The Green Certificates mechanism

Evolution of the green electricity production (expected…)

Years	Quota/Penalty Green Cert.		Quota/Penalty Cogen Cert.		Quota/Penalty		Quota/Penalty	
2002	0.8%	75 €	-	-	-	-	-	-
2003	1.2%	100 €	-	-	-	-	3%	75 €
2004	2%	125 €	-	-	2%	75 €	4%	100 €
2005	2.5%	125 €	1.19%	40 €	2.25%	75 €	5%	100 €
2006	3%	125 €	2.16%	45 €	2.5%	75 €	6%	100 €
2007	3.75%	125 €	2.96%	45 €	?	100 €	7%	100 €
2008	4.5%	125 €	3.73%	45 €	?	100 €	?	?
2009	5.25%	125 €	4.39%	45 €	?	100 €	?	?
2010	6%	125 €	4.9%	45 €	?	?	?	?
2011	?	125 €	5.2%	45 €	?	?	?	?

→ ***Flemish region***

<u>Certificate system for Green electricity</u>

On 17th of July in 2000 the Flemish Government voted the following Decree: 'Decreet houdende de organisatie van de elektriciteitsmarkt'. With this new legislation the first step was taken for a new organisation of the electricity market in the Flemish Region. A part of this Decree described the organization of a system of 'green certificates', which was important for the market development of green electricity out of biomass.

The producer of renewable electricity receives, from the regulator (VREG) one (1) green electricity certificate for the production of one (1) MWh renewable electricity. This certificate can be sold to the energy suppliers who have the obligation of reaching a certain percentage of renewable electricity out of there total amount of delivered electricity (Figure 33). Yearly obligations were set to reach a certain percentage of green electricity for each electricity supplier were recently fixed till 2020 (Figure 34). By 2020 13% of the electricity has to be produced based on green production in the Flemish region.

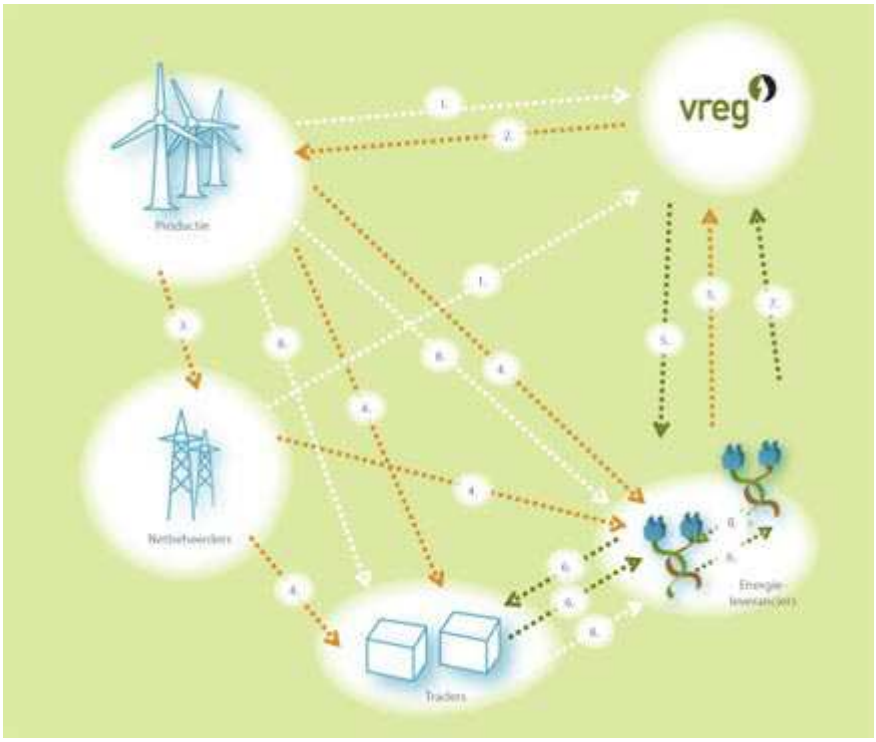


Figure 33: Green electricity certificate system Flemish region (source: http://www.vreg.be/nl/06_sector/04_groenestroomproducenten/01_systeem.asp)

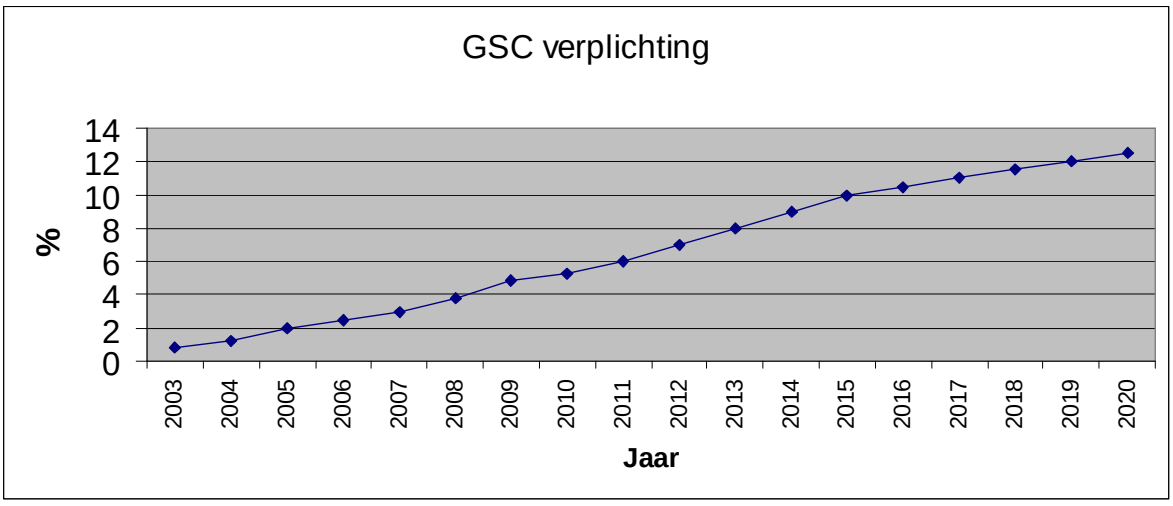


Figure 34: Yearly obligation of green electricity percentage for suppliers (GSC verplichting; green electricity obligation)

If they do not reach their quota they are obligated to pay a penalty to the regulator for each missing certificate. The penalty is set on 125 €/MWh until March 2015. From April 2015 onwards the penalty is set on 100 €/MWh. The market price of a certificate since 2006 is given in the graph below and is approximately 110 €/certificate (Figure 35).

To give the green electricity producers a financial security minimum levels of certificates were fixed. This means that, if the price of the certificates on the market

drop below a certain value, green electricity producers can sell their certificates to the distribution companies who are obligated to buy them at a minimal fixed price. The minimal fixed price was set in function of the renewable technology used.

Situation until the end of 2009:

- For hydropower, tidal energy and geo-energy this is 95 €/MWh
- For wind and biomass energy this is 80 €/MWh
- For solar electricity this is 450 €/MWh

  This minimal fixed price and the purchase obligation of the distribution companies is secured for 10 years for all technologies with exception of solar electricity where the timeframe is 20 years.

Situation starting from 2010:

- For hydropower, tidal energy, geo-energy, on-shore wind and bio-energy (from solid or liquid biomass, bio-waste & bios-gas) this is 90 €/MWh
- For solar electricity this is 350 €/MWh in 2010, yearly decreased with 20 €/MWh up to and including 2013 and with 40 €/MWh from 2014 onwards.
- For bio-gas from sludge & waste dumps and combustion of the organic fraction of waste this is 60 €/MWh
- For biomass co-combustion up to 60% in coal-fired power plants (>50 MWe), only 1 out of 2 certificates are eligible for the green electricity obligation.

  This minimal fixed price and the purchase obligation of the distribution companies is secured for 10 years for all technologies with exception of solar electricity. For solar installations built between 2006-2012 the timeframe is 20 years. For installations built after 2012 the timeframe is 15 years.

Important remark is that the certificate system is only valid for installations under 70 kV grid because the regions are only responsible for this part of the grid.

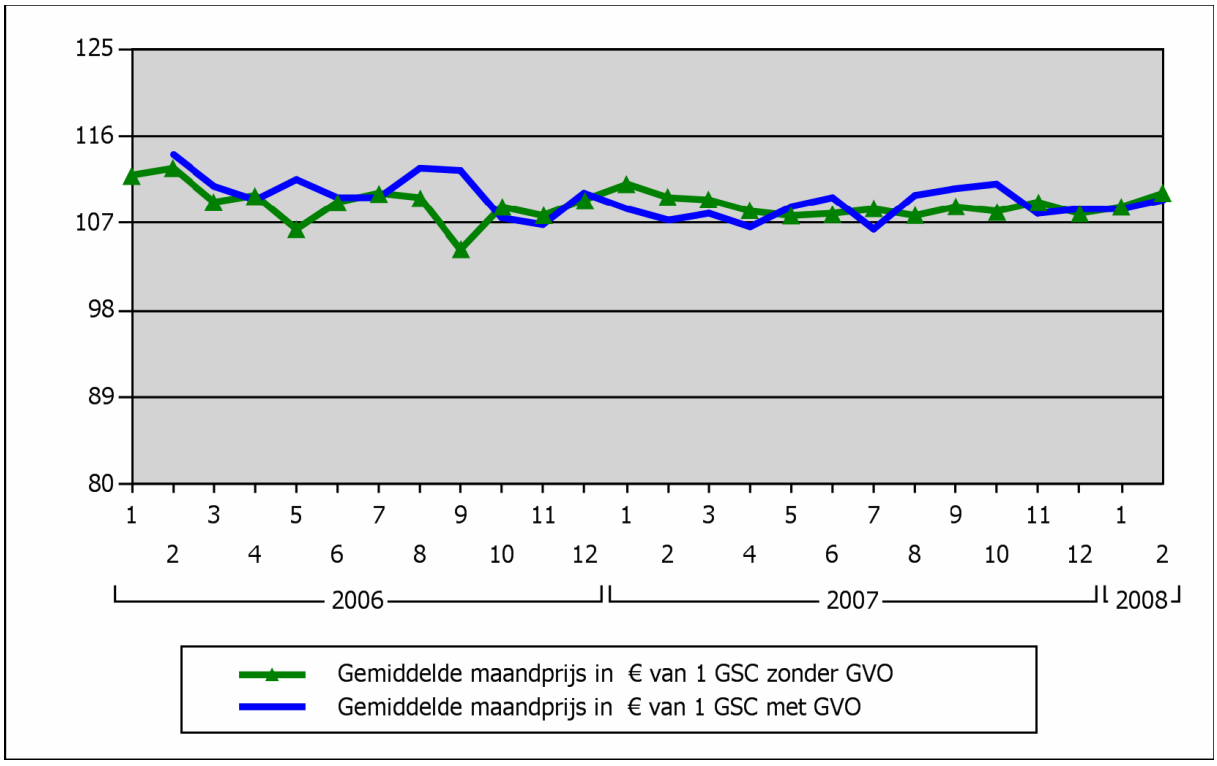


Figure 35: Average price of a green electricity certificate (green: average certificate price without guaranty of origin, blue: average certificate price with guaranty of origin) (source: www.vreg.be)

It is also important to acknowledge that the system in Flanders is based upon the energy balance and the use of fossil energy along the supply chain that is then subtracted from the number of granted certificates. An example of calculation is given hereunder for wood pellets originating from Canada. The electricity used by the pellet plant and for the drying is directly subtracted as well as the primary energy used for the local and overseas transportation. The reader shall note that this means that electricity is considered like it was a primary energy source.

Contributions for energy consumption in pellet production:

1) Electricity consumption pelleting:	106	kW_e/ton
2) Primary energy for drying is biomass:	0	kW_p/ton
3) Train transport : 700 km per train	108	kWh_p/ton
4) Sea transport: 750 ton diesel/40000 ton	232	kWh_p/ton
TOTAL	446	kWh/ton

Primary energy in 1 ton wood pellets is	4700	kWh_p
Gross electricity generation per ton (38%)	1786	kWh_e
Subtraction	- 446	kWh_e
Net result	1340	kWh_e

The number of certificates is then reduced with a factor:

- k = 1786/1340 = 0,75 (loss of 25% green certificates).

One sees that energy needed for drying is not considered if it is made from renewable sources, while electricity is always taken into consideration, even if from renewable origin.

Certificate system for combined heat and power

If a bio-energy production installation is a CHP, the installation can also make use of the system CHP-certificates. This system is similar to that of the renewable electricity certificates. Important difference is that a certificate can be produced for each MWh primary energy that is saved with the CHP installation in comparison with separated electricity and heat production. The quotum obligation for the coming years are given in the table below.

Year	Quota
2006	1.19%
200/	2.16%
2008	2.96%
2009	3.73%
2010	4.39%
2011	4.9%
2012	5.2%
2013	5.23%

Figure 36: CHP quotum obligation

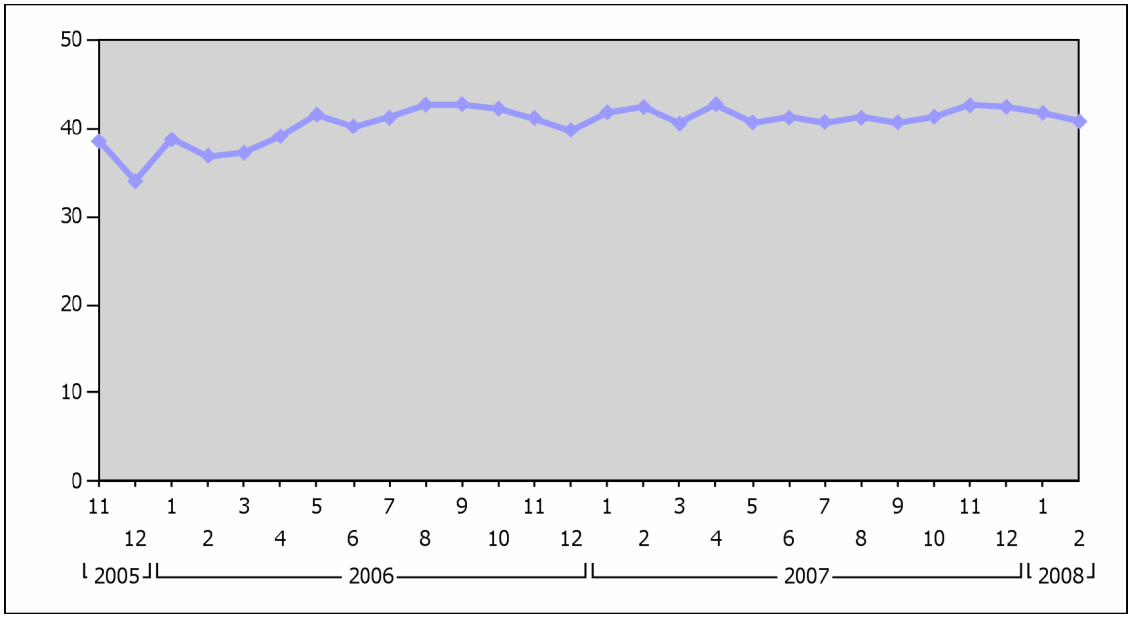


Figure 37: Average price of a CHP certificate (source: www.vreg.be)

The penalty price is 45 €/MWh primary energy saving. The evolution of the market price per certificate since 2005 is given in the figure above. Also a minimum value of the certificate is foreseen on 27 €/MWh primary energy saving. An important difference with renewable electricity is the digressive support of the system; The first 4 years 100% of the certificates are given to new installations, after 4 years the amount of certificates decreases following their primary energy saving ratio.

→ ***Walloon and Brussels region***

The second system in Wallonia is compatible with the one in Brussels region and resembles the Flemish system but is based on CO_2-avoidance. In the present section, we describe the Walloon system. In short the CWaPE grants the certificates to the green producer, who can sell the certificates to electricity suppliers who have the obligation to provide a certain percentage of green electricity on the total amount of electricity delivered (Figure 38) (Table 13).

On 30 November 2006, the Walloon Government issued an order concerning the promotion of green electricity and revoking the order of 4 July 2002 and all subsequent orders amending it. This new order sets out the system of green certificates applicable in Wallonia.

The mechanism for supporting the production of green electricity established in the Walloon Region also falls within the framework of the following European Directive:

- Directive 2001/77/EC of 27 September 2001 (promotion of electricity produced from renewable energy sources in the internal electricity market);
- Directive 2004/8/EC of 11 February 2004 (promotion of cogeneration based on a useful heat demand in the internal energy market).

These directives make the promotion of green electricity a European Community priority due to its contribution to:

- the security and diversification of energy supplies;

- environmental protection (particularly the reduction of greenhouse gas emissions) and sustainable development;
- increasing the competition in the internal energy market;
- economic cohesion (regional and local development) and social cohesion (creation of local jobs).

For these reasons, and in order to achieve the objectives set nationally, these directives make explicit provisions for Member States to establish support mechanisms, which include quota systems (green certificates).

On 16 July 2002, the federal Government also passed the Royal Decree concerning the establishment of mechanisms aiming at promoting electricity produced from renewable energy sources. This sets up a system of minimum prices for the purchase of green certificates by transmission system operators (TSOs).

On 16 March 2006, the Walloon Government decided on a set of measures intended to ensure equilibrium on the Walloon market for green certificates and which will require amendment of the legislation currently in force. It was translated in 2007 into modifications of the Decree on 12 April 2001.

These modifications came in force from 1st January 2008. The following measures are concerned:

- granting period of green certificates went from 10 years to 15 years, respecting the application of a reduction rate for the last 5 years. This rate is calculated for each chain producing green electricity;
- granting rates of green certificates have been modified for some chains: biomass, CHP biomass, photovoltaic;
- the number of green certificates granted to plants put into service before 1st May 2001 are reduced following a "q" coefficient, determined for each chain producing green electricity.

Other useful information related to green certificate system are available at the following website: http://www.cwape.be.

The 2 following figures show the green certificate support mechanism in Wallonia.

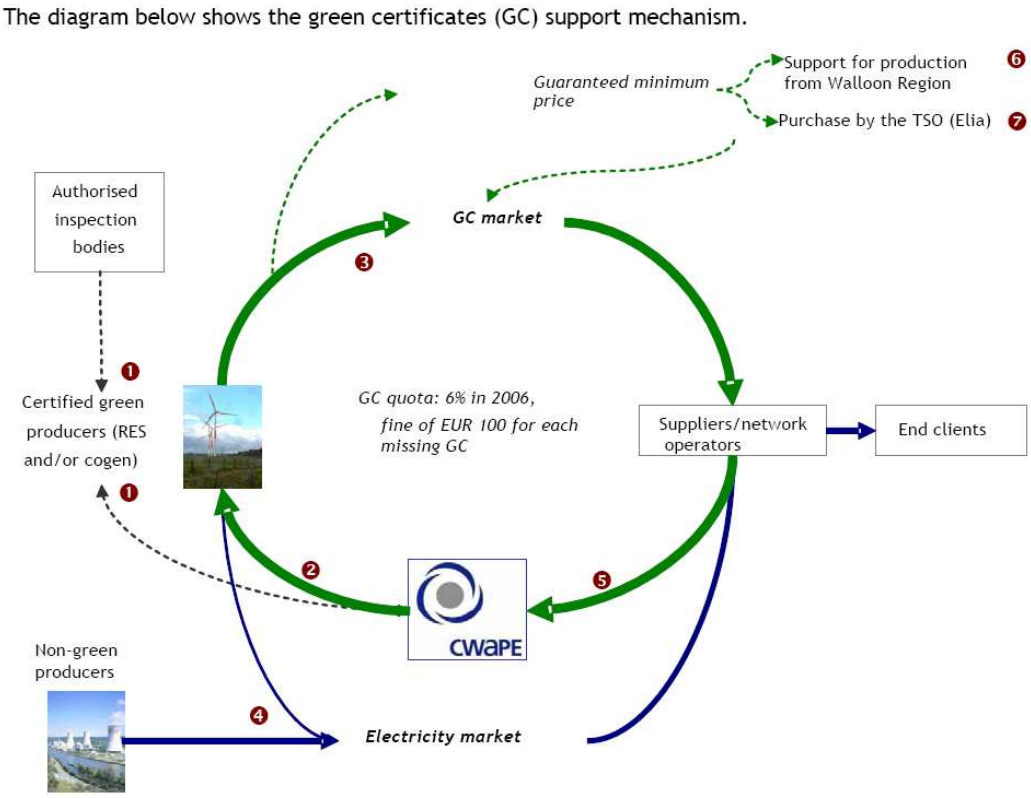


Figure 38: Green electricity certificate system Walloon region (source: CWaPE)

Table 13: Green electricity obligation for Walloon electricity suppliers:

- *5% between 1 January 2005 and 31 December 2005;*
- *6% between 1 January 2006 and 31 December 2006;*
- *7% between 1 January 2007 and 31 December 2007;*
- *8% between 1 January 2008 and 31 December 2008;*
- *9% between 1 January 2009 and 31 December 2009;*
- *10% between 1 January 2010 and 31 December 2010;*
- *11% between 1 January 2011 and 31 December 2011;*
- *12% between 1 January 2012 and 31 December 2012.*

The market value for a green certificate is above 90 €, during 2006 the average price was 91.58 euro. Compared to the physical electricity price of 30 €, this is a 300 % bonus for the clean producer.

The Walloon certificate system is based upon avoided fossil CO_2 emissions with respect to a reference being the combined cycle power plant firing natural gas with an efficiency of η_E=55%. The regulatory body (Commission Wallonne pour l'Energie, CWaPE) has published a list of reference specific fossil CO_2 emissions of the whole supply chain for all fossil fuels as well as the major biomass resources. Some elementary operations have even been quantified for woody products as well (Table 14).

Table 14: Reference specific CO_2 emission factors in Wallonia (kg CO_2/MWhp of primary energy)

	kgCO2/MWhp
❖ NON FOSSILE	
• wind/solar/hydraulics	0
• organic biodegradable matters	0
❖ milling	4
❖ transport < 200 km	5
❖ transport > 200 km	25
❖ drying	10
• corn crops	22
• wood	23
• wood pellets with residues from the forestry	30
• cultivated wood (short rotation coppices)	45
• rapeseed oil	65
• bio-diesel	80
❖ FOSSILE	
• natural gas	251
• gas-oil	306
• light fuel oil	310
• heavy fuel oil	320
• coal	385

Let us considered 'C' factors as CO_2 emission rates with respect to primary energy[4]. Then for natural gas one has:

C_{NG} = 251 kgCO_2/MWhp.

Let us considered 'G' factors as CO_2 emission rates with respect to electricity generation. For the reference technology, a STAG power plant firing natural gas, one has:

G_{NG} = 251/55% = 456 kgCO_2/MWh$_e$.

The number of granted certificates is reduced with a 'k' factor corresponding to the relative avoidance of fossil CO_2 emissions with respect to the reference. This means that one green certificate is granted every time 456 kg of fossil CO_2 emissions are saved with respect to the reference power plant.
If G_{PP} is the specific CO_2 emission rate of the considered power plant with respect to its fuel mix according to the official published emission factors, then, the 'k' factor is calculated according to the following formula (α_E, net electric efficiency of the power plant) :

$$k = \frac{G_{NG} - G_{PP}}{G_{NG}} = 1 - \frac{G_{PP}}{G_{NG}} = 1 - \frac{C_{PP}/\alpha_e}{C_{NG}/\eta_e}$$

Let us take the example of a thermal power plant firing wood pellets with a net efficiency of α_E=34%. For Belgian wood pellets, one has in Table 14 the contribution for wood pellets (30) and the one for the transportation on less than 200 km (5). With η_E=55%, α_E=34%, on has:

C_{PP}= 30 + 5 =35 kgCO2/MWhp,
k = 0,77 (loss of 23% green certificates).

[4] The present section is based on Ryckmans & André (2007).

For Canadian wood pellets, one has a higher contribution for transportation (25) such that:

C_{PP}= 30 + 25 = 55 kgCO2/MWhp,
k = 0,65 (i.e. loss of 35% of green certificates).

Within both systems, one sees that the final result is similar and that the development potential of wood pellets, as a new type of fuel for generating renewable electricity, appears to be attractive for Belgium. This is mainly due to the high penalty level related to the green obligation (12,5 c€/kWh in Flanders and 10 c€/kWh in Wallonia), and it remains true even if the Belgian systems reduce significantly the number of granted green certificates according to a rather detailed LCA analysis.

2.5.4 For environmental friendly investments

→ ***Flemish region***

Three times a year a call-system is opened by the Flemish Government where companies can apply for investment support for ecological investments. Investments in renewable energy are part of the list of these ecological investments. SME's receive 20% of the extra cost in comparison to standard technology, large enterprises receive 10 % of the extra cost with a maximum of 1.5 million €; The extra cost is predefined and is set on 50% for biomass electricity or cogeneration and on 80% for biomass heat production. In the near future the subsidy will be increased to 40% instead of 20% for SME's and 20% instead of 10% for large enterprises.

2.5.5 Demonstration support for new innovative energy technologies

→ ***Flemish region***

Each year the Flemish Energy Agency makes up a list with new innovative technologies, among which renewable energy related technologies such as heating on pellets. Companies who are willing to invest in these technologies can receive up to 50% of their costs with a maximum of 250.000 € per project. In return the authorities ask the permission for a detailed monitoring and follow-up of the project so that 'lessons-can-be-learned' from this project as the first of his kind.

2.5.6 Tax measures for energy saving investments in a residential dwelling

Different types of tax measures are existing: tax allowance, income tax credit and income tax reduction (or tax deduction). In Belgium the income tax reduction is being applied since 2003.

- **Income tax credit**: a percentage of the equipment costs and possibly the labour costs may be reimbursed to the taxpayer against payable income tax for

the fiscal year in which the investment was made. If the total payable tax is less than the deductible allowance, then the difference is paid to the taxpayer.
- **Tax allowance**: a certain percentage of the equipment costs and possibly the labour costs may be deduced from the net taxable income.
- **Income tax reduction (or tax deduction)**: using the same principle as the previous measure, but when the deductible allowance is higher than the payable tax, the taxpayer does not receive the difference.

The income tax reduction for energy saving measures is a Federal measure and consists of 8 measures which are eligible for tax allowance.

1. Replacement of an old central heating system by a new condensing boiler, wood boiler or heat pump.
2. Energy audit
3. Solar thermal appliances
4. Photo Voltaic appliances
5. Higher isolating windows
6. Isolation of roofs
7. Regulation of central heating system by programmable thermostats, thermostatique valves or exterior temperature sensors

Forty percent of the investment is eligible for tax allowance with a CAP of 2650 (2007) euro for wood boiler systems. For replacing an old boiler by a new wood boiler, the wood boiler has to fulfil the norm EN 12809, it has to be a boiler with automatic filling of the non-treated wood or pressurised wood dust. The nominal useable efficiency has to be minimum 60% following the norms 303-5.

The IEE Refund+ project investigated the success of different tax measures throughout Europe. The specific results for Belgium are given below:

Country	Incentive rate	Tax ceiling	Eligibility contingent on the equipment	Eligibility contingent on the installation	Eligibility contingent on the building
Belgium	*40%*	*€1,280*	*Yes for wood boilers, solar thermal and GHP (e.g. efficiency and solar orientation)*	*Registered building constructor*	*Before 2005, owners only. Since 2005, owners and tenants*

Note: The reduction ceiling of 1.280 € is the 2006 level. This level has been yearly increased to 2600 (2007), 2650 (2008) and 2.770 € (2009).

Despite a higher level of financial support in 2006, the Belgian tax reduction measure has had little direct impact on the growth of the renewable sectors. Both consumers and the trade tend to view the tax measure as a mechanism that backs up consumers' choices but has barely initiated new investments. The national and regional subsidies are the real drivers behind the growth of the renewable sectors. The tax measure has been primarily used for investments geared to improving roof insulation or installing double glazing. These two items account for 95% of the tax measure budget in 2005 as against 4.4% for expenditure on renewables. This phenomenon, known as Trias Energeticas, describes the fact that household energy-saving investments are organised along three successive and distinct stages, namely: reducing energy consumption, then the development of renewables and finally optimizing energy production from fossil energy. Belgium is still currently at stage one.

Best practices identified from Belgian experience

- Eligibility constraints regarding quality of equipments (performance) and installation (only registered installers)

- A good complementarity with regional support actions (incentive financial support once combined)

Main recommendations for Belgium

- Improve the information on the measure towards installers and consumers
- Introduce separate ceiling for each measure
- Spread investment made in 1 year over several taxable years
- Extend the measure to new buildings for wood boilers
- and increase the technical requirements about their efficiency

Note: These recommendations were made for the existing system of 2006. In the Belgian *economical recovery plan*, which was initiated to cope with the financial crisis, some adaptations were carried out which tackled some of the recommendations mentioned above.

Concerning 'Spread investment made in 1 year over several taxable years' As from 2009, if the amount of the income tax reduction exceeds the reduction ceiling the remainder can be transferred to the 3 following tax years. This exception is however only made for dwelling of 5 years and older.

2.5.7 Fiscal deduction

This is a Federal incentive which allows enterprises investing in renewable energy or CHP to deduct 13.5% of their investment from their taxable profits. Taxes on these profits are about 33%. This generates a net result of 4.5% of avoided taxes.

2.6 Acceptance criteria for biomass in the certification systems

2.6.1 Flemish region

The Flemish regulator VREG which grants the green electricity certificates recently (July 2008) communicated 'acceptance criteria for wood resources for the production of green electricity which is eligible for green certificates'. In general wood resources which can be used as industrial base material/feedstock are not eligible for green certificates. This is in line with the policy from OVAM (the Flemish waste agency) which adopted the 'ladder of Lansink' as a policy. This 'ladder of Lansink' states that the 'recycling of resource' is to be (environmentally) higher valued than the 'energetic valorisation'.

The following wood streams are eligible for green certificates i.e. are not used as resource in the industry (mainly wood processing industries).

- bark
- wood dust (<2 mm)
- wood cuttings & twigs (< 4 cm/diam.)
- stumps (up to 30 cm above ground level)
- wood from SRC (short rotation coppice)

The compliance with one of the streams listed above must be demonstrated with an audit report performed by an accredited body. This report must be redone each two years.

Electricity out of waste wood is only eligible for green certificates if the incineration of the waste wood stream was permitted by a sectoral execution plan. It is the OVAM which decides whether or not a stream is to be catalogued as 'waste'. Following wood streams are not seen as waste streams (waste wood) according to OVAM:

- wood pellets (as far as they comply with DIN-norm, Önorm or the Belgian product norm NBN (in progress)
- energy crops (wood production with the goal of energy production)
- rest wood generated by forest exploitation or forest sanitary maintenance)

2.6.2 Walloon region

Walloon authority imposes that each supplier undergoes an audit within 6 months. The audit must examine the sustainability of the wood sourcing as well as detail the energy balance of the whole supply chain. This includes the energy that is used for pelleting the wood and for transporting the final product up to the site of the power plant. If the product would appear in contradiction with the sustainability principle, the CWaPE (Energy Regulator in Wallonia) would then have the right to cancel the granted green certificates.

For each producer, the global supply chain is analyzed by SGS international, accepted as independent body by all Belgian Authorities for the grant of green certificates. SGS happens to be represented in all parts of the world as well since one of their core businesses consists in certified inspections of vessels lading in harbours. This means that local branches of SGS can perform audits and analyses everywhere in the world that are then accepted by Belgian authorities.

SGS checks first of all the sourcing of the wood (hardwood, softwood, saw dust, shavings, coppices) and the transportation between the sources and the pellet plant. If the biomass is not a secondary product but a primary one, then the whole energy consumption needed for planting, fertilizing, harvesting etc. must be taken into consideration and energy used subtracted from the number of granted green certificates. SGS evaluates all energy consumptions for making the pellets (electricity for the densification and auxiliaries, fossil fuels or biomass for drying). Finally, SGS looks to the final transportation to the sea harbour (train, truck) and checks the global traceability.

2.7 Sustainability criteria

2.7.1 Flemish region

In the regulation of certificates for renewable Electricity there is an in-build procedure that VREG (the regulator of the certificates) request advices to the Flemish Waste Agency about the dedication of scarce national biomass waste streams that will be used for energy production. The Flemish Energy Agency judges the use of this biomass waste streams following the philosophy of the 'Ladder of Lansink' (see A3.1). With this advice only an answer is given to the question if a certain stream can be used for bio-energy. There is no advice for which bio-energy vector it should be used (electricity, heat, cooling, transport).

In the certificate system for renewable electricity production no direct criteria for GHG emissions are taken into account. Indirect it is taken into account by the calculation of the net electricity production for the certificates. The energy used for preparing the biomass and for transporting it to the Flemish border has to be deducted from the gross renewable electricity production except if the energy used for production and transport of the biomass is from a renewable source.

Other aspects of sustainability were discussed with the bio-energy platform during two well-attended meeting in 2007. Different actors had the chance to give their point of view on this theme and a lot of information was exchanged. During those meetings it became clear that a European system or even a world wide system on sustainability criteria is the best way to go forward. Therefore the Flemish authorities follow the developments on different European level with care e.g. European directive, Commission Cramer of the Netherlands, system of UK, etc.
In the mean time some private partners like GDF-SUEZ / Electrabel already took action and introduced a label/specification sheet for their biomass streams used in their energy plants.

2.7.2 Walloon region

For a forest point of view, it's important to mention that the PEFC Council is an independent, non-profit, non-governmental organisation, founded in 1999 which promotes sustainability managed forests through independent third party certification. The PEFC provides an assurance mechanism to purchasers of wood and paper products that they are promoting the sustainable management of forests. The Belgian forest certification scheme is based on the criteria defined by PEFC Council. The forest management standards applied in Belgium, which are established at regional level, use the Pan-European Criteria and Indicators for Sustainable Forest Management (Lisbon 1998) and the Pan-European Operational Level Guidelines for Sustainable Forest Management (Lisbon 1998) as well as the improved pan-European criteria and indicators for sustainable forest management (Vienna 2002) as common framework. The revised Belgian Forest Certification Scheme was endorsed by the PEFC Council as meeting the PEFC Council requirements on 4th March 2008 and is valid for a five years period. The management standards are reflected in practice by the drafting of an individual Charter for sustainable PEFC forest management and regional targets for the improvement of sustainable forest management (http://www.pefc.org, May 2009). Forests owners (private or public) undertake to respect this Charter.

Regarding forest implemented certification schemes, about 50% of Walloon forests are certified under the PEFC frame (281 000 ha, status July 2009). It represents a total amount of 518 forest owners (private and public). Furthermore, there are 212 Belgian companies complying with PEFC rules (chain of custody of forest based products). About 12% of them have a "wood-energy" activity: they sell wood logs for heating. Some companies (11%) have also an indirect link with wood-energy, as they sell sawdust to factories producing pellets or wood chips to companies generating heat or power (http://www.pefc.be, July 2009).

Since the first set of Pan-European Indicators for Sustainable Forest Management (SFM), developed in the early 90s, experience has shown that criteria and indicators are very important tools for European forest policy (http://www.mcpfe.org, May 2009). Initiated through the Lisbon Conference in 1998, the Ministerial Conference on the Protection of Forests in Europe (MCPFE) decided to improve the existing set of Pan-European Indicators for SFM (Vienna 2002).

The development of sustainability criteria for solid wood fuels should be based on the existing PEFC model. This one should be encouraged in order to be adopted by a large

majority of forest owners and wood industries. From there, the certification system will be easily extended to the energy use of forest and industry wood, produced locally or imported, helping this market to extend in a sustainable way.

In addition to the energetic audit of the supply chain including greenhouse gas emissions, Walloon authorities impose that the sustainable character of the forestry resources for imported biomass be proven as well. Evidence of sustainability can be delivered according to:

- a traceable chain management system at the supplier's end,
- forest certificates pertaining sustainability of sources, of the type "Forest Stewardship Council" or equivalent,
- or in the absence of such forest certification, all public documents originating from independent bodies like FAO, or NGO's like WWF, Greenpeace, … making a review of the forest management and control in the considered country.

It is the first time in our knowledge that such an extensive check is performed by an independent body for analyzing the sustainability of the wood pellets supply chain in many different regions of the world with a accent put on the fossil energy use, CO_2 equivalent greenhouse gas emissions and the management of the forestry resources.

2.7.3 Biofuels

Biofuel production plants that received a quota from the federal government had to make a GHG-balance. This was one of the selection criteria for the quota. Projects with their energy supply made of own waste-streams, could present better GHG-balances and had an advantage in the final quotation of their projects.

2.7.4 The supplier declaration of GDF-SUEZ / Electrabel

To protect the environment a certification program with a quality mark is necessary in order to replace in a sustainable way fossil fuels by biomass and generating traceable green power.
The quality system for being granted green certificates corresponding to the generated renewable electricity firing wood pellets is focused on a tracing system for biomass from (by) products (and its energy produced) back to the sustainable source.

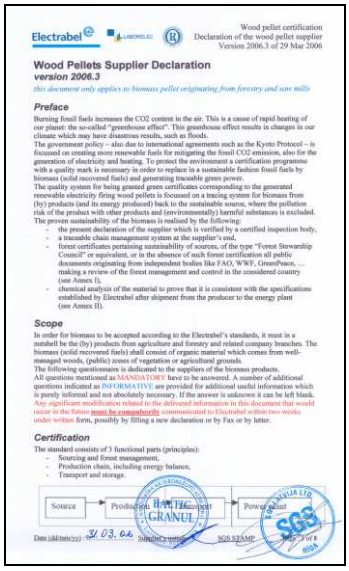
In Flanders an energetic audit for calculating the net green electricity production is necessary (see: acceptance criteria). Till now, Flanders authorities have however not requested audits or a certification procedure for sustainability of imported biomass by law.

Since Wallonia does and since the products might be used in two different power plants located in different regions, GDF-SUEZ / Electrabel has decided to apply the same certification procedure gathering the requirements of both regions.

It is also necessary to inform a potential supplier of all requirements made by GDF-SUEZ / Electrabel concerning:

- the technical specifications of the product for firing it in a thermal power plant (chemical composition, physical properties),
- the sustainability criteria for being accepted within the Belgian green certificate systems.

All this is concentrated in one single document called "Supplier Declaration" (8 pages). This document is signed by a representative of the producer and is verified and stamped by a certified inspection body before being delivered to the Belgian authority (Figure 39).



Electrabel

Wood pellet certification
Declaration of the wood pellet supplier
Version 2006.3 of 29 Mar 2006

Wood Pellets Supplier Declaration
version 2006.3
this document only applies to biomass pellet originating from forestry and saw mills

Preface

Burning fossil fuels increases the CO2 content in the air. This is a cause of rapid heating of our planet: the so-called "greenhouse effect". This greenhouse effect results in changes in our climate which may have disastrous results, such as floods.
The government policy – also due to international agreements such as the Kyoto Protocol – is focussed on creating more renewable fuels for mitigating the fossil CO2 emission, also for the generation of electricity and heating. To protect the environment a certification programme with a quality mark is necessary in order to replace in a sustainable fashion fossil fuels by biomass (solid recovered fuels) and generating traceable green power.
The quality system for being granted green certificates corresponding to the generated renewable electricity firing wood pellets is focussed on a tracing system for biomass from (by) products (and its energy produced) back to the sustainable source, where the pollution risk of the product with other products and (environmentally) harmful substances is excluded.
The proven sustainability of the biomass is realised by the following:

- the present declaration of the supplier which is verified by a certified inspection body,
- a traceable chain management system at the supplier's end,
- forest certificates pertaining sustainability of sources, of the type "Forest Stewardship Council" or equivalent, or in the absence of such forest certification all public documents originating from independent bodies like FAO, WWF, GreenPeace, ... making a review of the forest management and control in the considered country (see Annex I),
- chemical analysis of the material to prove that it is consistent with the specifications established by Electrabel after shipment from the producer to the energy plant (see Annex II).

Scope

In order for biomass to be accepted according to the Electrabel's standards, it must in a nutshell be the (by) products from agriculture and forestry and related company branches. The biomass (solid recovered fuels) shall consist of organic material which comes from well-managed woods, (public) zones of vegetation or agricultural grounds.
The following questionnaire is dedicated to the suppliers of the biomass products.
All questions mentioned as MANDATORY have to be answered. A number of additional questions indicated as INFORMATIVE are provided for additional useful information which is purely informal and not absolutely necessary. If the answer is unknown it can be left blank.
Any significant modification related to the delivered information in this document that would occur in the future must be compulsorily communicated to Electrabel within two weeks under written form, possibly by filling a new declaration or by Fax or by letter.

Certification

The standard consists of 3 functional parts (principles):

- Sourcing and forest management,
- Production chain, including energy balance,
- Transport and storage.

Source | Production | Transport | Power plant

GRANUL

SGS

31.03.06

Figure 39: GDF-SUEZ / Electrabel certificate for imported biomass (source: Laborelec)

Swiss inspection company SGS is in charge of checking the document and carrying out a full audit of the pellet plant and of the supply chain within the 6 months following the first time the pellets are fired (Figure 40).

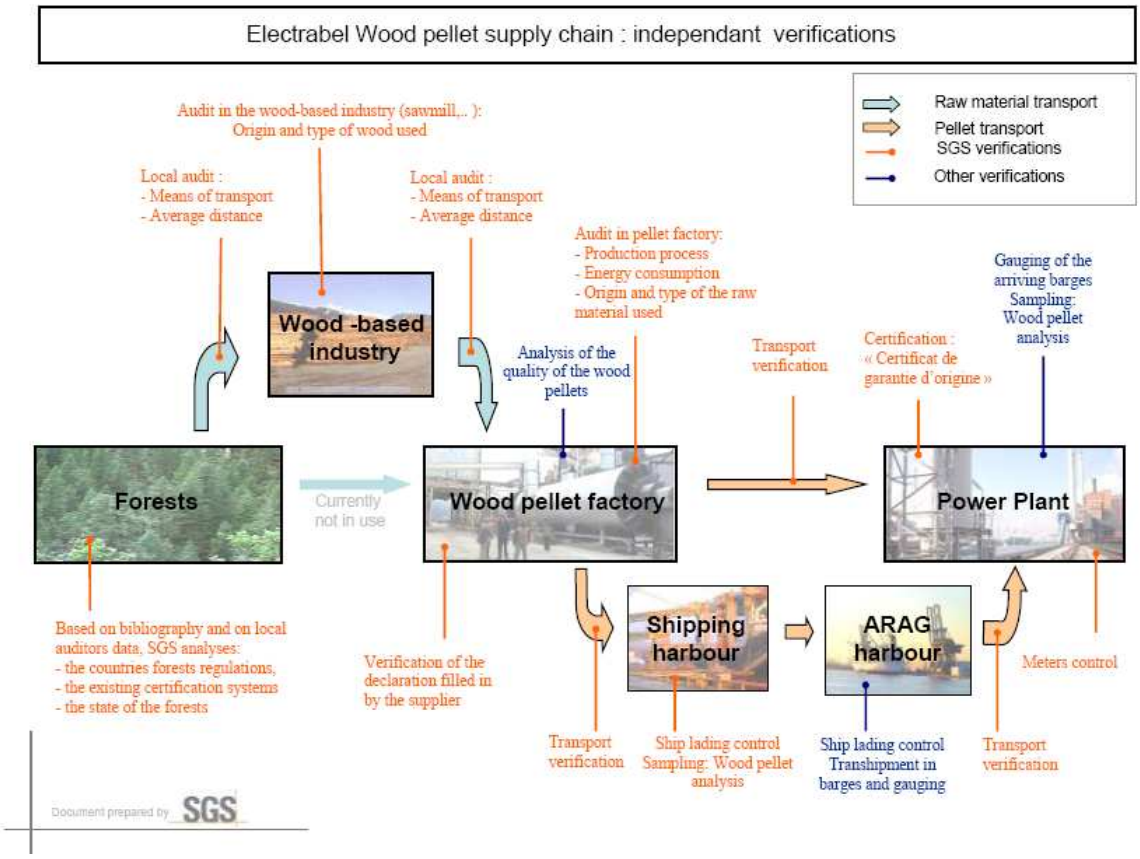


Figure 40: Independent inspections of the wood pellets supply chain operated by SGS (source: Laborelec)

In order for biomass to be accepted according to the GDF-SUEZ/Electrabel's standards, it must in a nutshell be a by- product (preferably not a primary one such that additional certificates are not lost) from agriculture and forestry. The biomass (solid recovered fuels) shall consist of organic material that comes from well-managed woods, (public) zones of vegetation or agricultural grounds. Energy consumption must be reasonable with respect to other references and heat for drying must be generated from renewable sources (biomass).
For calculating the number of granted certificates Flemish authorities require the knowledge of a list of parameters related to the pellet plant. Therefore, the supplier must fill in an informative questionnaire that consists of three functional parts (Figure 41):

- sourcing and forest management: wood origin;
- production chain, including energy consumptions;
- transport and storage, including rail and sea transport.

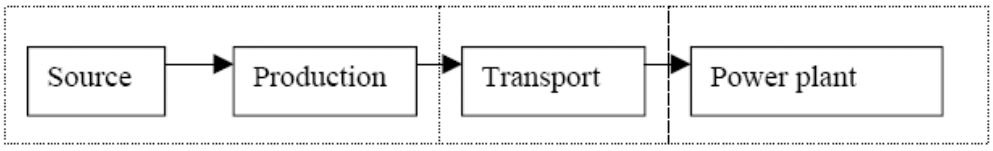


Figure 41: Functional parts of supply chain (source: Laborelec)

Other useful information are available at the following website: http://www.laborelec.com.

CHAPTER 3 BIOMASS RESOURCES

3.1 Overview land use

Table 15: Absolute data of total area and areas of interest for biomass production (source: http://www.statbel.fgov.be/)

Absolute figures (km²)	1980	1990	2000	2003	2004	2005	2006	2007	Evolution 2006-2007
Total surface	**30.519**	**30.528**	**30.528**	**30.528**	**30.528**	**30.528**	**30.528**	**30.528**	=
Ground surface	30.269	30.278	30.278	30.278	30.278	30.278	30.278	30.278	=
Agriculture	**19.092**	**18.302**	**17.653**	**17.511**	**17.471**	**17.434**	**17.393**	**17.352**	**-41**
Arable land	7.346	7.594	8.631	8.342	8.391	8.420	8.407	8.387	-20
Permanent cultivation land	156	177	233	232	233	230	223	235	+12
Permanente grass	6.664	5.786	5.069	5.356	5.300	5.191	5.173	5.073	-100
Agriculture other	4.927	4.745	3.730	3.581	3.548	3.593	3.590	3.658	+68
Forests & woodlands	**6.096**	**6.097**	**6.072**	**6.068**	**6.065**	**6.064**	**6.062**	**6.059**	**-3**

Table 16: Relative data of total area and areas of interest for biomass production (source: http://www.statbel.fgov.be/)

Relative figures (%)	1980	1990	2000	2003	2004	2005	2006	2007	Evolution 2006-2007
Ground surface	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**0%**
Agriculture	63%	60%	58%	58%	58%	58%	57%	57%	0%
Arable land	24%	25%	29%	28%	28%	28%	28%	28%	0%
Permanent cultivation land	1%	1%	1%	1%	1%	1%	1%	1%	5%
Permanente grass	22%	19%	17%	18%	18%	17%	17%	17%	-2%
Agriculture other	16%	16%	12%	12%	12%	12%	12%	12%	2%
Forests & woodlands	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**0%**

The estimated annual biomass resources in Belgium are presented in Table 17. The most important resources are forest residues (located in Wallonia, for the greatest part) and industrial by-products (solid by-products and black liquor).

Table 17: Estimated annual available biomass resources in Belgium (source: IEA report 2006)

Source	Flanders (ktoe)	Wallonia [5] (ktoe)	Belgium (ktoe)
Solid agricultural residues	/	9	9
Manure	100	0 – 58	100 – 158
Forest residues	0	137	137
Wood industry by-products	283	44	327
Industrial organic residues	18	/	18
Green wastes	66	18	84
TOTAL	**467**	**209 – 267**	**675 – 733**

3.2 Agriculture

3.2.1 Belgium

Table 18: Agricultural land-use per region (http://www.statbel.fgov.be/)

Land-use per region		1980	1985	1990	1995	2000	2005	2006	2007
Flemish region	Ground surface (km²)	13.511	13.512	13.522	13.522	13.522	13.522	13.522	13.522
	Agriculture (km²)	9.336	9.117	8.866	8.646	8.474	8.347	8.322	8.298
	Agriculture (%)	69%	67%	66%	64%	63%	62%	62%	61%
Walloon region	Ground surface (km²)	16.845	16.844	16.844	16.844	16.844	16.844	16.844	16.844
	Agriculture (km²)	9.732	9.567	9.420	9.287	9.165	9.074	9.058	9.041
	Agriculture (%)	58%	57%	56%	55%	54%	54%	54%	54%

The Belgian experience with energy crops is recent and small. The total rapeseed production is small amounted 9.872 in 2007 of which 89% in the Walloon region and 11% in the Flemish region.

Since the European directive 2003/30 has been implemented into the Belgian legislation in 2005. A call for tenders was launched for biodiesel and bioethanol that will be produced and marketed starting in November 2006 and October 2007 respectively. A tax advantage has been given for blends, while keeping it neutral for the state budget (increased tax on fossil part).
Pure plant oil has been completely exempted from excise duty. There are no commercial or large-scale uses of energy crops neither are there important demonstration units.

3.2.2 Flemish region

The amount of ha that was set-aside in 2004 was 7.400 ha (can be used for energy crops. Within the European Project VIEWLS an estimation of 10% to 40% of European agricultural land could be used for energy crops. In the forecast study of VITO of 2005, it was estimated that between 5% and maximum of 10% is realistic for this region to become available for energy crops. Reasons for this are the low available

[5] Marchal *et al.* (2003)

space per capita and the focus on animal production, this means the available space for energy crops will be between 20.000ha and 50.000 ha.

Recent evolutions in market prices of food crops do not encourage farmers to start growing energy crops like rapeseed. The careful but slowly increase in rapeseed production in the Flemish region dropped last year and experts judge that this will drop further this year.
Import of biomass resources will therefore be necessary especially for the production of biofuels for transport.

In 2006 about 950 ha were listed for energy crop production on non-food set-aside land and food land with energy premium. Most important was the rapeseed crop. About 95% of the rapeseed production went to the bio-diesel industry, the rest part was used to produce PPO (pure plant oil).

	Energiegewassen	Non-Food
Koolzaad	430 ha	442 ha
Maïs	-	6 ha
Granen (tarwe & triticale)	5 ha	68 ha

Figure 42: Overview of energy crops 2006 (Source; Agricultural administration)

Note: translation Dutch➔ English
- Energiegewassen energy crops
- Koolzaad rape seed
- Granen cereals

3.3 Forestry

3.3.1 Belgium

In Belgium, about 600,000 ha of the land are covered by forest. The total exploitable production should be around 4.8m^3 per year, but only 4m^3 are effectively exploited (Table 15). This overproduction however is not entirely usable for biomass.

With an afforestation index of 21,3% Belgium is on the sixth place in the EU-15 (Figure 43

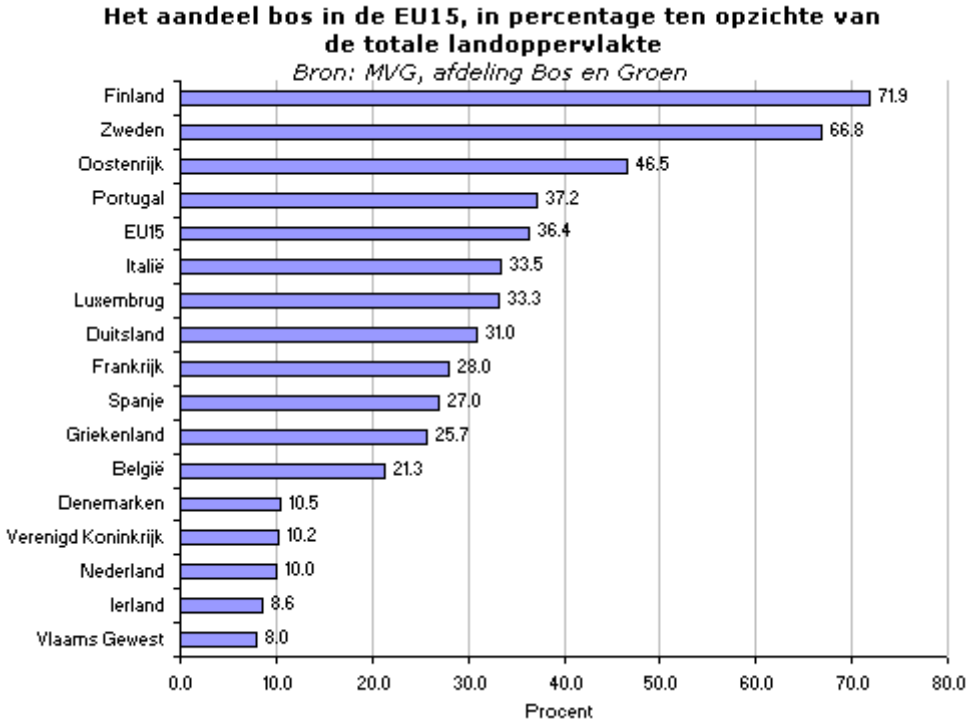


Figure 43: Share of forest in percentage of the total land surface (source: http://aps.vlaanderen.be/statistiek/nieuws/milieu/2004-05_bos.htm)

3.3.2 Flemish region

Only a limited part of the area in the Flemish region is forest. The woods are fragmented in a densely populated region and need to fulfil various functions at the same time namely an ecological function, a social and educational function, an economical and scientific function. More than half of the surface of woods (54%) is smaller than 100 ha.

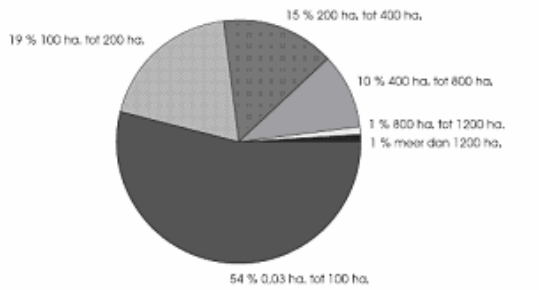


Figure 44: Forest division by surface

The total afforested area in the Flemish region amounts to 146.381 ha. In a European context the Flemish region has the lowest percentage of forested area. Calculated on the total land surface the share of forests in the region is as low as 8%. No other member state in the EU 15 has a lower afforestation index.

In the Flemish region 70% of the afforested area is in private ownership, while 17% is owned by the Flemish region and 17% is owned by public entities (provinces, municipalities,…).

The Flemish forests consist of 50% deciduous forests, 36% coniferous forests and 11% mixed forests. Based on wood-volume the most important deciduous species are poplar (30%), oak (20%) and beech (14%). Most important coniferous species are scotch pine (60%) and Corsican pine (27%).

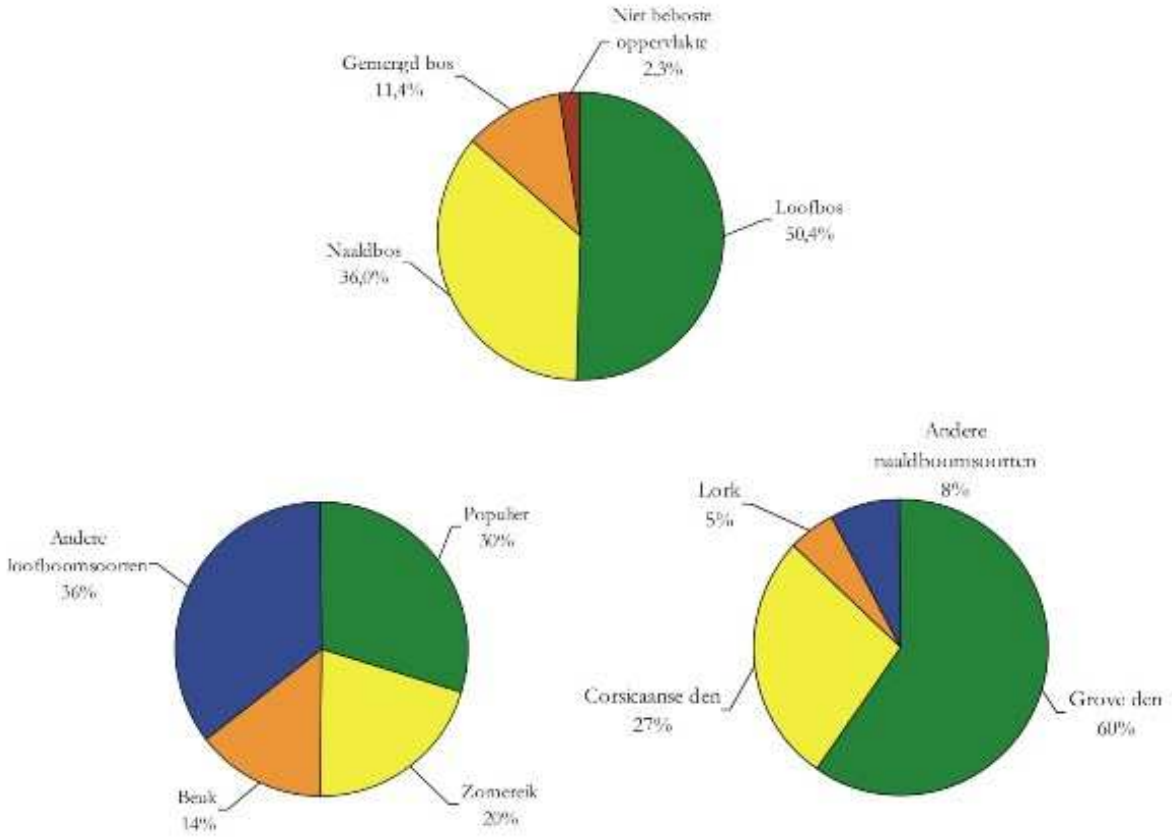


Figure 45: Forestry statistics (top: division by type (deciduous, coniferous, mixed), bottom-left (deciduous), bottom-right (coniferous)

Forestry will be adopted in the OVAM biomass inventory shortly and data will be available in the next version of this document but were not available at the time of this report.

3.3.3 Walloon region

Walloon forest covers an area of 553 000 ha, which represents an afforested rate of 33%. This rate varies from one natural region to another one, the highest rate being in the Southern part of Wallonia. Concerning tree species, there are about 50% coniferous and 50% deciduous. Forested area is also divided between private owners (50%) and public ones (50%).

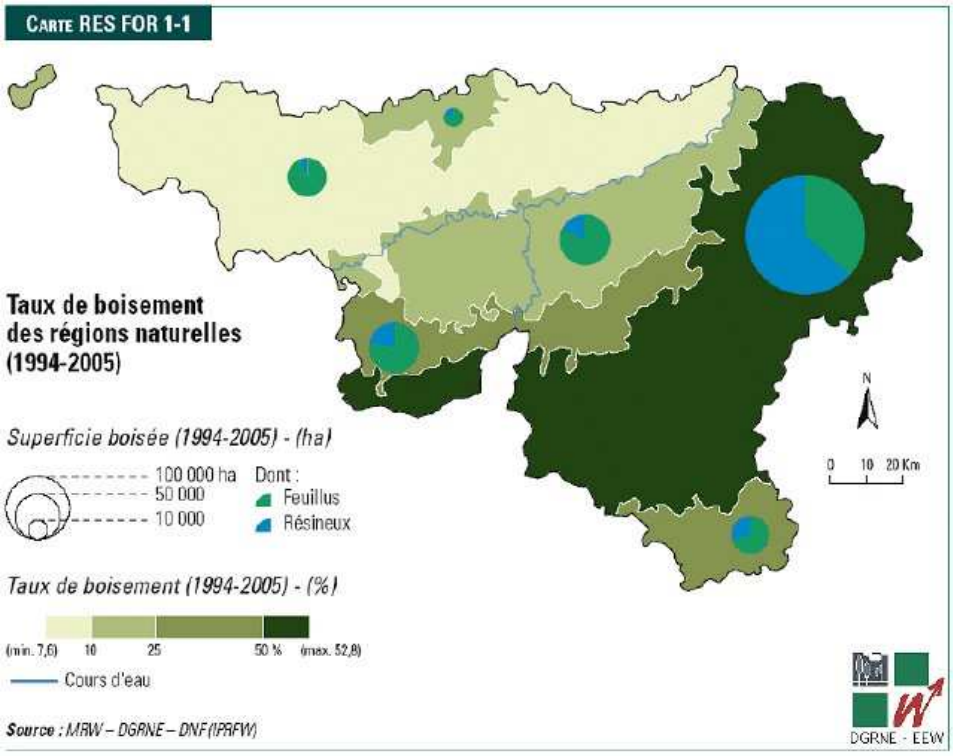


Figure 46: Afforested rate for natural regions (source: MRW-DGRNE-DNF)

There is a global balance between annual volume increment (3.7 million m^3) and annual fellings (3.6 million m^3), but there are some differences following the species (coniferous versus deciduous).

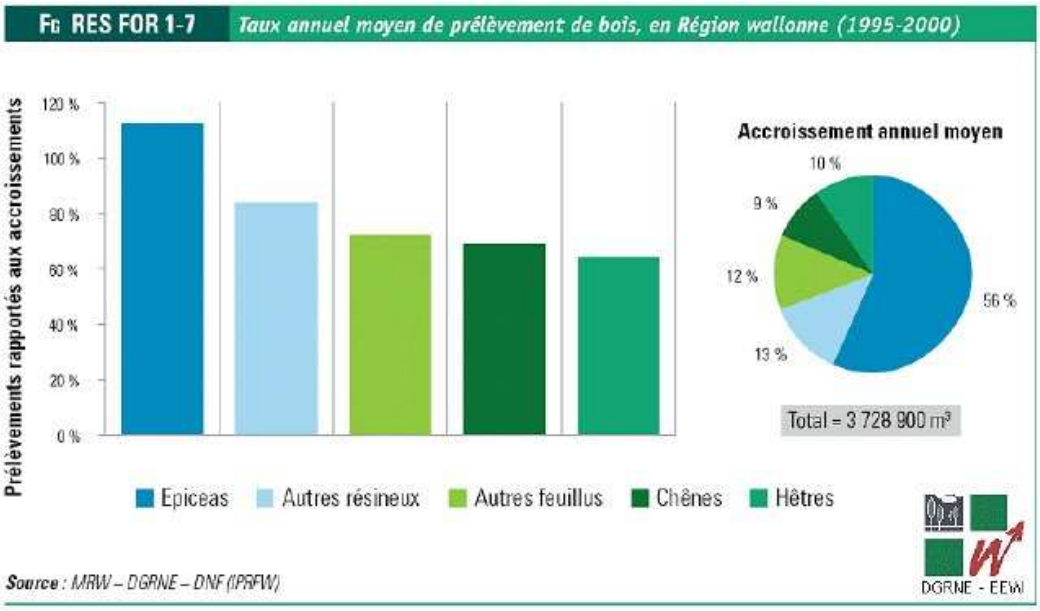


Figure 47: Annual volume increment and annual volume fellings (MRW-DGRNE-DNF)

Note: translation French➔	English
• Epiceas	spruce
• Autres résineux	other coniferous
• Autres feuillus	other deciduous
• Chênes	oak
• Hêtre	beech

It's estimated that the share of wood consumption covered by inland production represents less than 50%. Only recycled papers and fibre boards have production surplus, production of fire wood seems to be sufficient for current consumption. Self-supply potential for wood production is rather low in Belgium, due to high population density for a small territory.

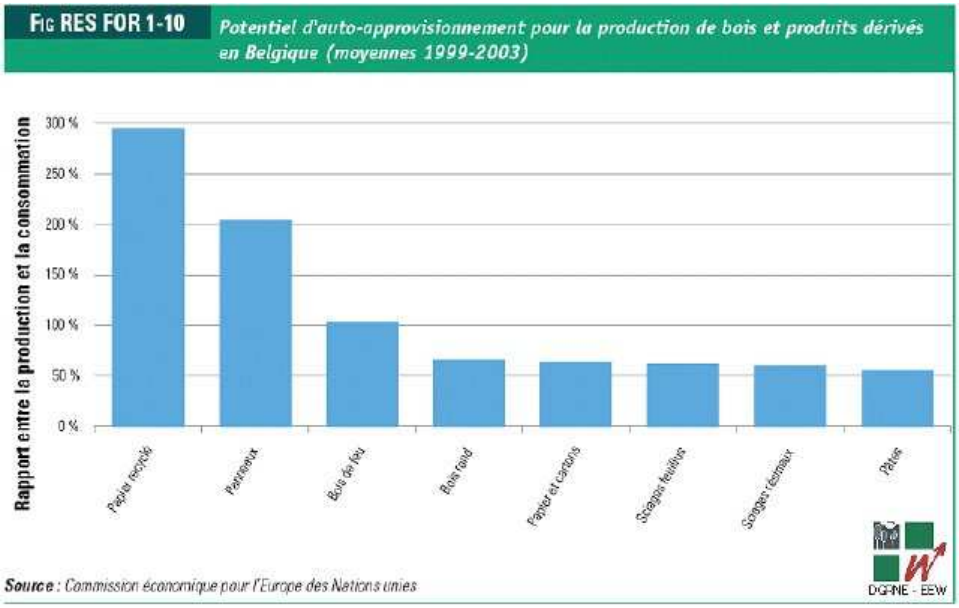


Figure 48: Self-supply potential for wood production and by-products in Belgium (source: United Nations Economic Commission for Europe)

Note: translation French➔	English
• Papier recyclé	recycled paper
• Panneaux	particle board
• Bois de feu	fire wood
• Bois rond	round wood
• Papier et cartons	paper and card board
• Sciages feuillus	deciduous sawing
• Sciages résineux	coniferous sawing
• Pâtes	pulp

Total carbon stock of Walloon forests was estimated at 101.5 million tons for the year 2005, which corresponds to about 7 years greenhouse gases emission in Wallonia. This carbon is stocked in woody biomass for one half, the other part being in deadwood and soil.

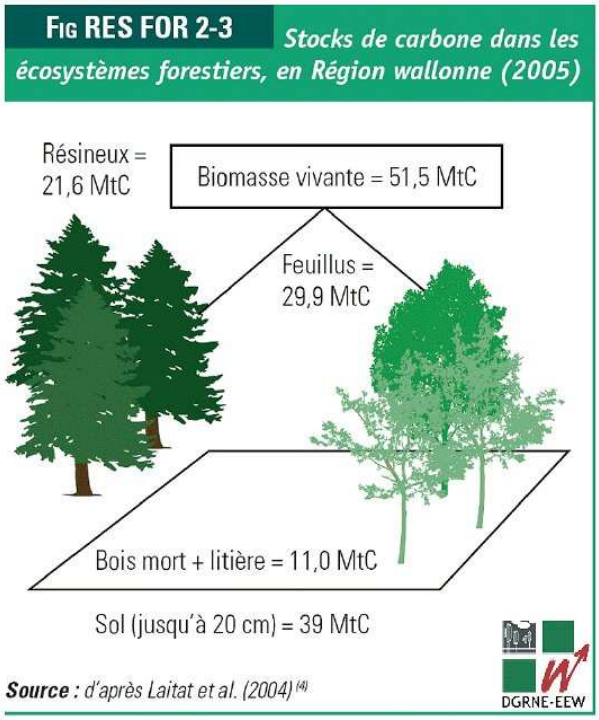


Figure 49: Total carbon stock in forest ecosystems (source: Laitat et al., 2004)

Figure 50 illustrates the estimated annual biomass resources in Wallonia.

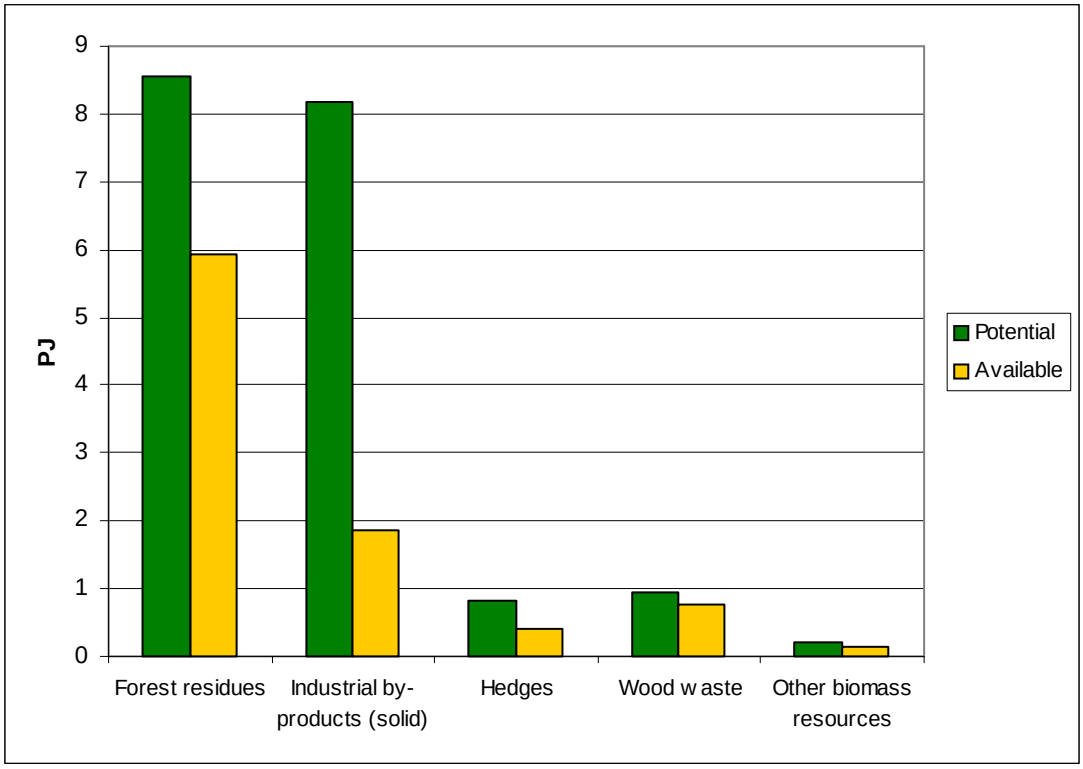


Figure 50: Estimated annual biomass resources in Wallonia 2000 (total potential 18.7 PJ, total available 9.1 PJ) [Source : Marchal et al. 2003]

3.4 Waste

3.4.1 Flemish region

The OVAM (Flemish waste agency) recently started a yearly inventory of biomass waste streams. In this study are not only indicate the total quantities of the waste steams but also the possible allocation in the energy production sector. This is done with respect and regard to existing policies.

The **selective collected green waste from the management of gardens of private individuals** amounted to 514.500 ton in 2006. For this waste stream only material recycling is allowed, incineration is prohibited. This stream is mainly used as mulching and compost. The report mentions that from environmental point of view it is not an option to incinerate this waste stream, however the option to do this is left open in function of the needs (Figure 51).

Jaartal	Selectief ingezameld groenafval (ton)
2000	472.262
2001	465.572
2002	526.537
2003	474.668
2004	541.687
2005	500.048
2006	514.500

Figure 51: Selective collected green waste (ton) (source: Biomass inventory 2006-2007 OVAM)

Residential organic biologic waste (vegetable, fruit and garden waste) which is collected selectively amounted to 310.000 ton in 2006. This waste stream consist of 80% garden waste and 20% fruit and vegetable waste. This stream is eligible for digestion following the 'Ladder of Lansink'. However since in the previous decade large investments have been made in composting installations these installations need a secure feedstock potential. That is why, although this waste stream is perfectly suitable for digestion, the larger part of it is reserved for composting. A energy potential is calculated based on a pre-digestion before coming to the real composting process, as such the energy which is lost due to water vaporisation during the composting process, could be usefully used. The total energy potential amounts (theoretically) to 852 TJ/year.

Used frying fats & oils selectively collected from households. In 2006 about 4.915 ton was collected. This stream is not allowed, by European law, to be used in food or feed only technical use is allowed (bio-diesel, oleo-chemistry,…). 68% of this stream is used for biodiesel production mainly abroad, 20% goes to products (industrial soaps, cosmetics,…), 12% is used for incineration for the purpose of green electricity production. In principle there is an incineration ban on this waste stream, however an exemption has been made for one electricity installation. The production

of bio-diesel is allowed (mostly exported to the Netherlands, limited production capacity in Belgium) but this will depend on potential and price, since there are other sectors where this stream is used.

Organic-biological fraction of rest waste (residential waste, non-hazardous company waste,..). This is processed in incineration installations for waste or by biogas production in dumping sites. Based on sorting analyses about 41% of this waste is acknowledged to be green. The yearly incinerated rest stream amounts to 1.142.186 ton. Of this amount 353.515 is accepted to be organic-biological residential waste with a energetic capacity of 3.536 TJ/y. Eight of twelve installations produce green electricity certificates by means of energy recuperation of incineration. The installed capacities are listed below (Table 19).

Table 19: Installed electric power for waste stream incineration (source: Biomass inventory 2006-2007, OVAM)

	Producent	Productie-installatie	Technologie	Vermogen (kWe)
Biomassa	Electrabel nv	Indaver restafval	Biomassa (restafval)	8.600
	Electrabel nv	ISVAG restafval	Biomassa (restafval)	11.500
	IVOO	IVOO restafval	Biomassa (restafval)	2.300
	IVM ov	IVM restafval	Biomassa (restafval)	3.500
	IMOG	IMOG restafval	Biomassa (restafval)	2.500
	Bionerga	Bionerga	Biomassa	2.700
	IVBO	IVBO restafval	Biomassa (restafval)	1.700
	IVAGO	IVAGO	Biomassa (restafval)	6.640

Note: translation Dutch➔ English

- Producent Producer
- Productie-installations Installation
- Technologie Technology
- Vermogen Power
- Biomassa Biomass
- Restafval Waste

Installed production capacities for dumping site bio-gas electricity are listed in the table below (Table 20).

Table 20: Installed electric power for waste stream incineration (source: Biomass inventory 2006-2007, OVAM)

	Stortplaats	Vermogen (kWe)
Stortgas	Stort Pellenberg	181
	Depovan (1-2)	1.140
	Remo	9.539
	DDS	288
	IGEAN	310
	IOK Meerhout	312
	IOK Olen	230
	Ilva Vlierzele	1.180
	IOK Merksplas-Beerse	476
	IVAREM	590
	De Kock-Watco	1.081
	Stevan stort	181
	Hooge Maey	1.888
	Voorde	486

Note: translation Dutch➔ English
- Stortgas landfill gas
- Stortplaats landfill site
- Vermogen power

Road side cuttings can be used as feed but in most cases have to be composted, however not all cuttings are composted. As such these cuttings are an excellent resource for digestion without conflicting with the installed composting capacities.

Wood waste excludes wood from forestry for wood production, sanitary forestry management and includes all sorts of wood waste streams in the different sectors (households, companies, final processing,…). On the supply side the potential amounts to 1.311-1.571 kton with a subdivision of 57% (wood processing industry), 15% (general industry), 11% (building-demolition), 17% (residential) (Table 21). On the demand side 850 kton is used by the fibreboard industry, 400 kton by the wood sector, 200 kton by the energy sector and 150 kton is exported. For 2008 the demand from the energy sector for wood waste was assessed to be 490 kton.

Table 21: Wood waste resources (source: Biomass inventory 2006-2007, OVAM)

Sector	Hoeveelheid (Ton)	Percentage (%)
Houtverwerkende sector	740.000 – 900.000	57
Algemene bedrijfssectoren*	200.000	15
Bouw- en sloopsector *	150.000 – 250.000	11
Huishoudens*	221.560	17
TOTAAL	1.311.560 – 1.571.560	

** Deze drie categorieën worden verder in de tekst als 'postconsumer houtafval' vermeld.*

Note: translation Dutch➔ English
- Hoeveelheid Quantity
- Houtverwerkende nijverheid Wood processing industry
- Algmene bedrijfssectoren General industry
- Bouw- en sloopsector Building & demolition sector

- Huishoudens Residential sector

The energy potential from **animal waste** amounted 3.431 TJ/j based on incineration with energy recuperation for 2010 an amount of 1.187 TJ/j is foreseen. The allocation of animal waste depends on the category which is linked to the processing possibilities of the waste stream going form obligated material recuperation to energetic valorisation.

Used fats and frying oils can not be incinerated, however an acceptation has been granted to one installation which uses about 9.500 ton/y with a energy valorisation of 370 TJ/y. The bigger part is exported of biodiesel production.

Sludge can be digested or incinerated. In a 'sludge master plan' is foreseen that by 2010 95% of all local sludge can be processed in Flanders. The table below shows the potential of energy from sludge for digestion (248 TJ/y) and incineration (1.682 TJ/y) in 2006. The energy potential of sludge is strongly depended on the moist content. the table below gives figures for 2005 (moist, 2/3 GJ/ton) and 2006 (dried, 9/10 GJ/ton) (Table 22).

Table 22: energetic valorisation of sludge (source: Biomass inventory 2006-2007, OVAM)

Biomassa-afvalstromen	Hoeveelheden Vergisting en verbranding met energierecuperatie	
	2005[1]	2006[2]
Slib vergisting	49 TJ/j 19.500 ton/j	248 TJ/j 26.200 tds/j
Slibverbranding	232 TJ/j 93.000 ton/j	1.682 TJ/j 177.122 tds/j

Note: translation Dutch➔ English

- Biomassa afvalstromen biomass waste streams
- Hoeveelheden quantities
- Vergisting digestion
- Verbranding combustion
- Energierecuperatie recuperation of energy
- Slib sludge
-

CHAPTER 4 CURRENT AND EXPECTED FUTURE ENERGY USE OF BIOMASS

Information related to this chapter are detailed in chapters 1 and 3.

CHAPTER 5 CURRENT BIOMASS USERS

5.1 Overview

Information on current biomass user are also given in chapter 3. Main users of biomass resources are briefly summarized within this section.

Since 2002, in order to cope with the green obligation, the Belgian main utility GDF-SUEZ / Electrabel started carrying out co-firing of different biomass resources in its pulverized coal power plant. In 2005, GDF-SUEZ / Electrabel has retrofitted two existing pulverized coal power plants of the year 1960's for firing wood pellets instead of coal. Rodenhuize power plant, located near Gent, generates electricity with hard coal (70%), wood-pellets (25%) and olive cake (5%). Les Awirs power plan, located near Liège, has been converted for firing exclusively wood pellets (100%) with co-firing limited quantity of natural gas. Today the Belgian capacity of GDF-SUEZ / Electrabel for generating green electricity with biomass reaches 260 MW (Table 23).

Table 23: Use of biomass in Belgian thermal power plants

Power plant	Biomass and technique	Shared power level
Ruien	separate injection of wood dust of Belgian origin	10 MW
Ruien	co-gasification of clean wood chips (Belgium, France)	22 MW
Langerlo	co-milling of sewage sludge of Belgian origin	4 MW
Langerlo	separate injection of wood dust of Belgian origin	28 MW
Langerlo, Rodenhuize, Ruien	co-milling of imported olive cake	34 MW
Mol	co-milling of imported coffee ground	2 MW
Rodenhuize	separate milling and injection of wood pellets	80 MW
Les Awirs	firing imported wood pellets	80 MW
Total	**biomass**	**260 MW**

Both retrofitted plants Rodenhuize (Unit 4) and Les Awirs (Unit 4) operate at nominal load since September 2005. The capacity of both plants together is about 2500 tons of wood pellets per day or 700 000 tons a year. The suppliers are spread all over the world. Globally about 15% of the feedstock is expected to originate from Belgium, about 40% from Scandinavia and Eastern EU as well as bordering countries (Russia,

Ukraine) and 45% from overseas (Northern and Southern America, Asia, South-Africa).
Flat boats up to the sites of the power plants ship to the harbor of Antwerp and from there the imported feedstock on. For being granted green certificates for the green power that is generated, GDF-SUEZ / Electrabel is submitted by the Belgian authorities to an extensive analysis of the supply chain. The present paper delivers the key results of this analysis.

The company Electrawinds NV has built two bio-liquid power plants in Belgium The first plant is located in Oostende (Belgium) with a capacity of 13 MW net power (2005). The plant is a technical innovation for Europe, as it will be fed by used frying oil, vegetable oils and animal fats, most of them being imported from the Netherlands (Biox). A second power plant is built in Mouscron in Wallonia (2006). Electrawinds NV has selected Desmet Ballestra as technical partner for elaborating the technologies for converting these various raw materials into a valuable fuel, feeding the motors of the power plant.

- Input: 25 000 ton oil, fry-oil and animal fat.
- Technology: combustion in diesel engines.
- Investment: € 17 million, with € 2,25 million subsidies.
- Net power 17,6 MW.
- Electricity generation: 93 000 MWh/y.

The second utility in Belgium, SPE, is operating a former peak power plant in Harelbeke equipped with 8 diesel engines, each having a net installed power of 9 MWe .
Since end of 2005 4 engines fire only palm oil making 36 MWe of green power. The heated generated though the flue gases of the engines is recuperated for making steam that feeds a steam turbine of 3,6 MWe. Palm oil is imported from Malaysia.

5.2 Biomass use in new industries[6]

5.2.1 General overview

The main objective of the EUBIONET III project is to increase the use of biomass based fuels in Europe by finding ways to overcome the market barriers. One of the goals of this project is to investigate the use of biomass in a number of different industry sectors. Industries are indeed important energy consumers. This sector will play an important role in reducing CO_2 emissions to reach the European objectives (Directive 2009/28/EC).

In Belgium, the shaper industry sectors (NACE 2 C code) are very well developed. A short description of the main Belgian activities for the industries concerned by EUBIONET III is presented in Table 24.

[6] This section is based on Belgian EUBIONET III report (Pieret, 2009).

Table 24:NACE codes and description of selected Belgian industries

NACE code	Description
C10. Manufacture of food products	This sector is well represented in Belgium. It is the third most important industrial sector in terms of business. Production units are set up long the main industrial Belgian axes. Meat production, bakeries, beverages, chocolate factories and breweries account for the most important part of this sector activity.
C11. Manufacture of beverages	Included in C10
C19. Manufacture of coke and refined petroleum products	In Belgium, oil refineries are concentrated near Antwerpen. Several storages are spread over the country, the biggest one is located in Feluy. Main companies are Total and Esso.
C20. Manufacture of chemicals and chemical products	Second important industrial sector in Belgium, The chemical production units are concentrated near Antwerp (Flemish region), pharmaceutical production units are located in Wallonia with UCB, GSK and Solvay.
C21. Manufacture of basic pharmaceutical products and pharmaceutical preparations	Included in C20
C23. Manufacture of other non-metallic mineral products	Four groups are present in Belgium for cement production, they belong to the five most important groups in the world: Holcim, Heidelberg, Ciment Français, Lafarge. Their PIB contribution is equal to 0.2 %. Rock is also extracted in Belgium to produce lime and cement. Major part of extraction activities and transformation are located in Wallonia rich in quarries.
C23.3 Manufacture of clay building materials	
C23.5.1 + C23.5.2 Manufacture of cement, lime and plaster	
C23.6 Manufactrure of articles of concrete, cement and plaster	
C24 Manufacture of basic metals	In Belgium, the steel production depends on international groups like Arcelor Mittal (70%) and Duferco (20%). Productions units are present in Flanders and in Wallonia. Belgium is an important steel producer with 1 T/capita.

(Sources: ESSENSCIA, FEBIAC, FBP, FEB, FEBIEX, FEBELCEM)

The primary energy use (PJ) and the part of the renewable energy in 2006 for each categories listed above are detailed in Table 25. The bioenergy contribution is difficult to estimate because a lack of data. Following some information, we consider that the most important users of renewable energies are the main users of biomass. Table 25shows that biomass is used in manufactures of food products, chemical products and non-metallic mineral products.

Table 25: Primary energy use and renewable energy contribution in selected industrial sectors in 2006

NACE code	Primary energy use (PJ)	Renewable energy contribution (PJ)
C10 Manufacture of food products	45.55	0.5
C11 Manufacture of beverages	Included in C10	Included in C10
C19 Manufacture of coke and refined petroleum products	146.45[a]	dna
C20 Manufacture of chemicals and chemical products	142.98	0.21
C21 Manufacture of basic pharmaceutical products and pharmaceutical preparations	Included in C19	Included in C19
C23 Manufacture of other non-metallic mineral products	59.12	10.34
C23.3 Manufacture of clay building materials	8.33	Included in C23
C23.5.1 + C23.5.2 Manufacture of cement, lime and plaster	Included in C23	Included in C23
C23.6 Manufacture of articles of concrete, cement and plaster	Included in C23	Included in C23
C24 Manufacture of basic metals	140.05	dna

[a]: gaz included
"dna": data not available

(Sources: SPF, Eurostat)

5.2.2 Development potential of bioenergy for main industrial sectors

Biomass can be used to produce heat and/or steam and/or power. Belgian industries having biomass resources (by-products) have in general already built a bioenergy project (e.g. in wood industry) when it was profitable or are waiting better economic context to invest. In general, bioenergy plans are considered interesting by industries to reduce GHG emissions, to receive green certificates, to use by-products and to improve their brand image. In the current economic crises atmosphere, beginning in 1999, industry sectors have sought to reduce production costs without endanger the production quality. Reduce energy costs is one solution. In food-industry e.g., energy is essential to produce motive force, heat, cold and power. Production process and products storage are the more energy consumer activities in the food-industry, buildings and offices are minor. Energy audits have been led in Belgian industries to help them to build energy plans. Audits show that biomass could be used to produce heat (biogas, wood), heat and electricity by CHP (biogas, fats, oils, wood gasification). CHP projects lead to the biggest energy consumption reductions while biomass heat production leads to the biggest CO_2 emissions reductions.

However, some barriers exist to the implementation of a bioenergy project. Bioenergy projects consist in big investments. The economic crisis context discourages investments (energy management is not major of concern, it does not consist in urgent investments). The pay-back time is too long for the industry level and the profitability isn't guaranteed.

Bioenergy technologies are also more complex and it's difficult to find qualified people or it needs time to train some. Production process accommodations are really expensive. Solid biofuels storage needs more space than fossil fuel.

Bioenergy has not been already widely considered as a solution to produce energy as usual as fossil fuels. Consequently, some industries are not yet convinced and the industrial bioenergy projects currently in service are quite new, hindsight is consequently not long enough (difficulties to estimate the projects relevance).

Regarding legislation, several kinds of biomass are considered as waste and use them lead to a more restrictive legislation (e.g. emissions standards more strict with biodiesel in comparison with light fuel oil). Administrative and legislative barriers always exist.

It seems that CHP could be well developed especially in Flanders and in general in the food-industry and breweries with biogas production. These industrial sectors insure their own supply with their process by-products. Unfortunately, installation costs are huge and technologies quite complicated.

Biomass is also already used in co-combustion to produce cement and lime and these sectors plan to increase biomass use. But in their case, an outside biomass supply is needed, implying additional cost to buy biomass, to transport and to store it (depending of the type of biomass). These sectors consider less biomass availability as a potential barrier and in this context competition with other sectors using biomass as raw material is present. Several biomass types and qualities also co-exist in the same time but supply traders are rare. Quality could be a problem based on the final user: lime production for example need only good quality biofuels unlike cement.

For CHP based on wood, there is also a technological gap for mean power size installations using wood: no available technology for power between 3 kW and 300 kW.

Regarding barriers and taking into account the current fossil fuels low costs, it is the research of the environmental respectful image that often encourages industries to build bioenergy projects and be brave to cross barriers.

CHAPTER 6 BIOMASS PRICES

6.1 Electricity prices

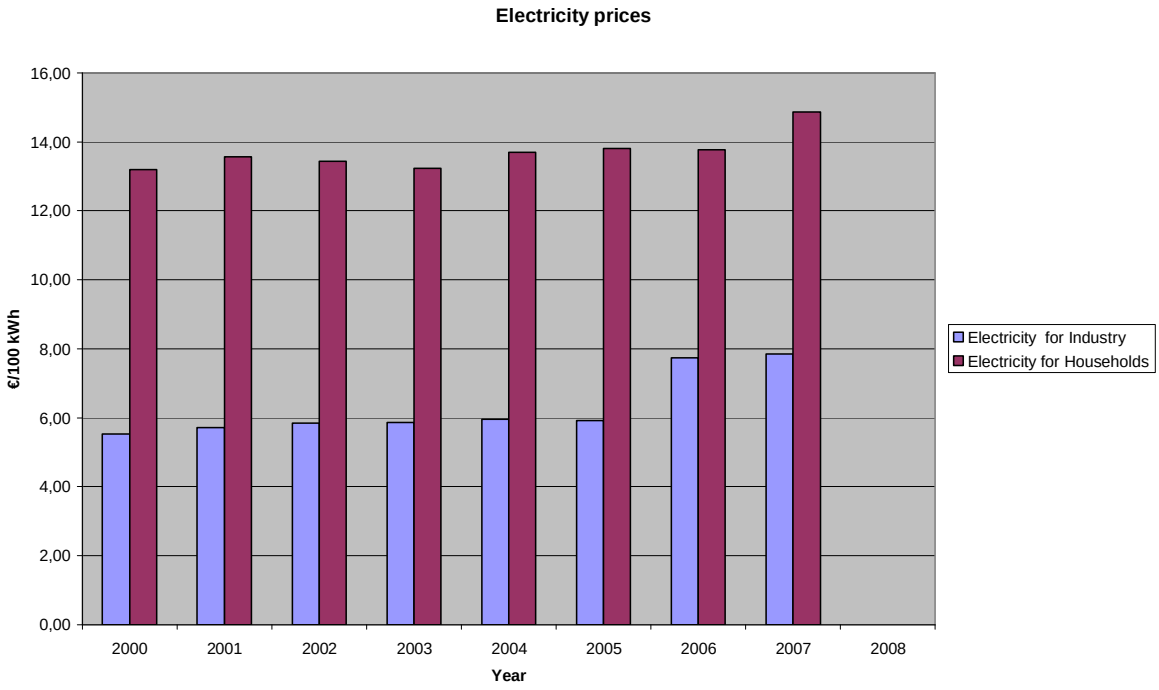


Figure 52: Electricity prices (taxes included) (source: Statistical pocketbook, EU energy & transport figures, DGTREN)

6.2 Fuel prices

Fuel prices represented in the figure below are indicative. Various factors make it impossible to provide one fixed price for a fuel type . Among these factors are:

- The type of consumer:
  - large, medium, small
- Fluctuations in commodity prices in one year:
  - Brent oil price mid 2008 above 140 $/barrel
  - Brent oil price mid 2008 below 65 $/barrel
- Regional differences:
  - Especially for woody biomass resources for small consumers (wood logs for dwellings)

Retail prices of biomass in the Belgian industry are quite confidential. The data in Figure 53 were obtained from the EU DGTREN statistical pocketbook 2007. Remarking is the very high price for natural gas for households (60 €/MWh) in comparison with heating gasoil for households (30 €/MWh) and this in particular for the time frame 2000-2004. Based on data provide by the National Institute for Statistics Figure 54 different results are obtained. Based on these data before 2000 natural gas was more expensive then gasoil but both were in the same range of 20 €/MWh. After 2000 gasoil became more expensive then natural gas and prices rose to 30 €/MWh in the 2000-2004 period. Since prices rose spectacular with the natural gas price lagging behind on the gasoil price.

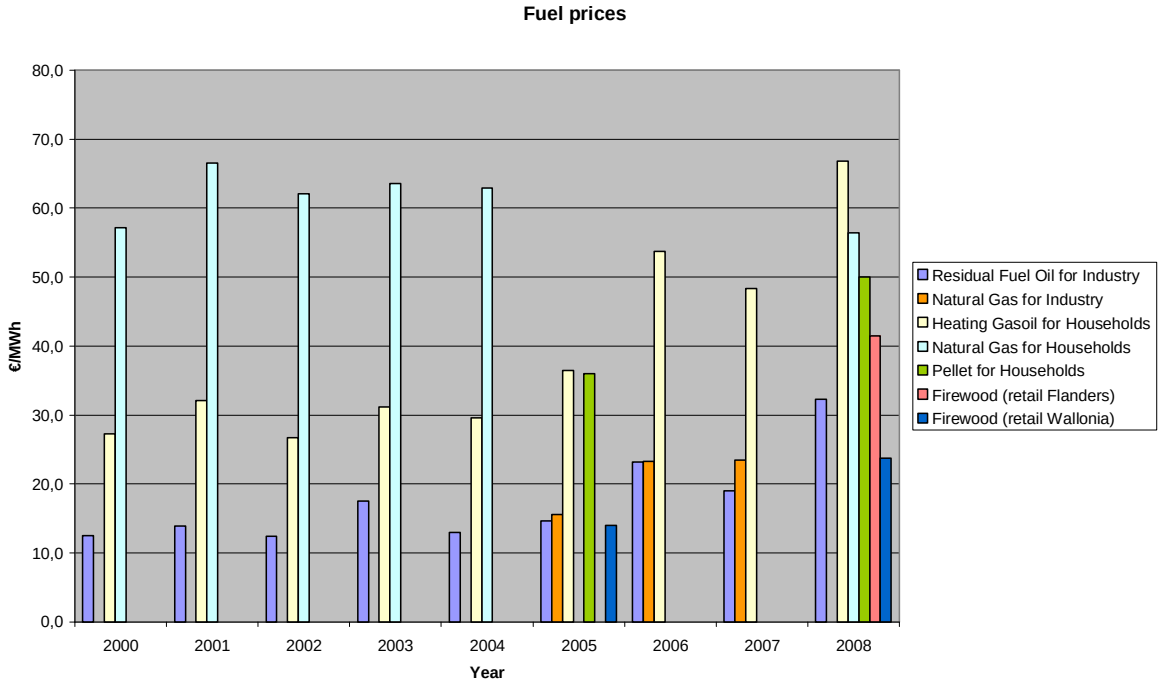


Figure 53: Fuel prices (taxes included) (sources: : Statistical pocketbook, EU energy & transport figures, DGTREN, IEA country report Belgium 2006, various internet sources (specific for firewood))

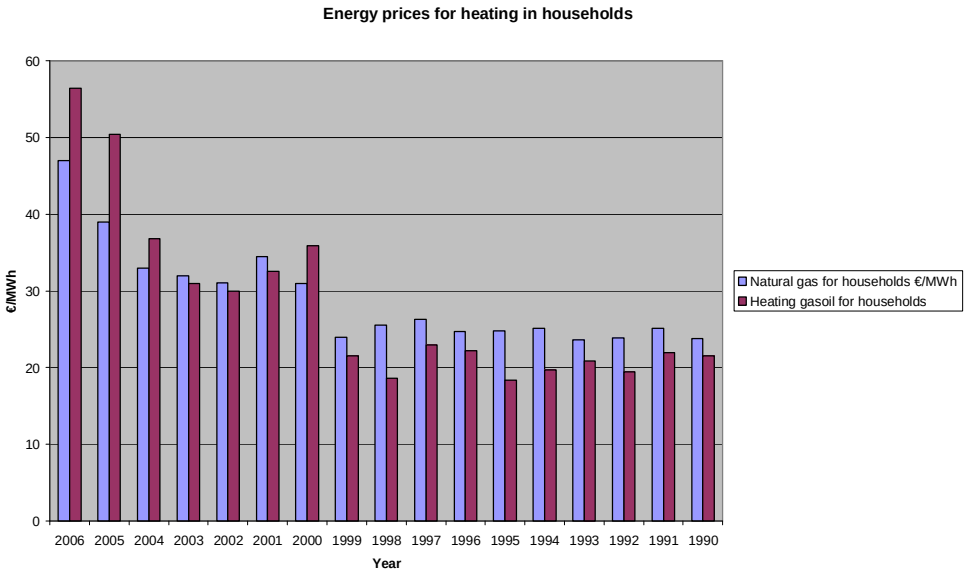


Figure 54: Energy prices for heating in households (source: http://www.statbel.fgov.be/figures/d64_nl.asp#1bis)

Indicative prices per ton for wood and wood waste are given in the table below (Table 26). First four lines indicated wood waste resources in the price range of 15-35 €/ton depending on contamination, sorting and processing (cut/un-cut). The four bottom lines indicate prices for primary wood, respectively wood logs (55 €), round wood, chips, saw dust (85 €).

Table 26: Indicative prices for wood and wood waste (source; Biomass inventory 2006-2007 OVAM)

Soort houtafval	Prijs
Opgeschoond onbehandeld houtafval	35 EUR/ton
Gebroken niet verontreinigd behandeld houtafval	15 EUR/ton
Opgeschoond niet verontreinigd behandeld houtafval	20 EUR/ton
niet verontreinigd behandeld houtafval meubelindustrie	30-35 EUR/ton
Soort primair hout	
blokken, afkortstukken, kaphout en dossen (vochtgehalte 35 à 40%)	55€ EUR/atro ton*
rond hout (vochtgehalte 45%)	85 EUR/atro ton*
chips (vochtgehalte 50%)	85 EUR/atro ton*
zaagmeel (vochtgehalte 50%)	85 EUR/atro ton*

Note: translation Dutch➔ English

- houtafval — wood waste
- opgeschoond onbehandeld — untreated wood
- niet-verontreinigd behandeld — non-polluted treated
- blokken, afkortstukken, kaphout — cutting residues & wood logs
- rond hout — round wood

- zaagmeel sawdust

6.3 Fuel and energy taxation

Table 27: Taxation of energy products

Excises in € per 1000 litres			VAT rates		
Euro Super 95	**Automotive gas oil**	**Heating gas oil ****	**Standard rate**	**Electricity**	**Natural gas**
623	**333**	**18**	**21%**	**21%**	**21%**

CHAPTER 7 BIOMASS IMPORT & EXPORT

7.1 Flemish region

Because of the scarce available area and a low forest-index, the Flemish region has a rather low potential for growing biomass resources from agriculture and forest activities. The focus of this region is therefore the valorisation of the available biomass-waste streams in the region.

The following figure gives an overview of the yearly biomass resources needed for a pro-active scenario in 2020 for bio-electricity (1st bar), bio-heat (2nd bar) and biofuels (3rd) for transport. The estimated amount of biomass resources available in the Flemish Region is presented in the 4th bar. The available resources for bio-energy exist out of rapeseed (yellow), wheat (light blue), the organic fraction of waste streams (dark blue), biomass waste streams (beige), used oils and fats (dark green) and lingo-cellulose biomass, pellets and wood waste (light green) in 2020. As becomes clear the resources needed by the first three bars strongly exceed the biomass resource potential. The import of biomass resources will play a major role in the Flemish Region to reach the amounts that are forecasted Figure 55).

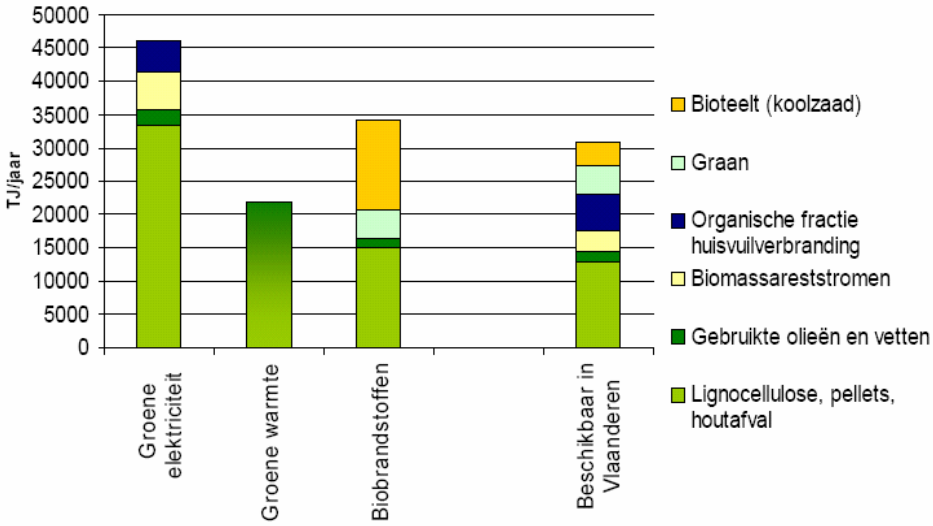


Figure 55: Resources needed and resources available for the production of bio-energy in the 3 energy vectors (VITO study)

Note: translation Dutch➔English

- Koolzaad rape seed
- Graan wheat
- Organisch fractie huisvuilverbranding organic fraction of MSW
- Biomassa reststromen biomass waste streams

- Gebruikte olieën en vetten — used oils and fats
- Groene elektriciteit — green electricity
- Groene warmte — green heat
- Biobrandstoffen — bio-fuels
- Beschikbaar in Vlaanderen — availability in the Flemish region

Since 2005 a yearly biomass-inventory is made by OVAM (Public Waste Agency of Flanders), this inventory tries to map the different flows and the pathways of the biomass-waste streams: how the biomass-waste is treated and further utilised (recycling or energy or disposed or exported). The OVAM has only a clear sight on the import and export of waste streams which resort under the 'Orange list procedure following EG N°259/93'. The majority of the biomass waste streams can be imported exported following the 'Green list procedure' which does not require any notification and are as such unknown.

7.1.1 Biomass export

Used frying fats & oils were mainly exported in 2006 towards Germany and the Netherlands with a total amount of 24.838 ton. These fats originate from **households and catering** and are mainly (80%) used to produce biodiesel. The interest to use these fats in Belgium is rather low since fuel suppliers to not have a blending obligation contrary to Germany & the Netherlands where a 2% blending obligation is set.

Organic-biological waste streams from businesses/services with a recycling destination; this stream is also a 'green list' stream a can be traded freely. No figures are available.

Residential organic biologic waste (vegetable, fruit and garden waste). The export of this stream was limited to 6.000 ton which were exported to the Netherlands for composting.

In 2206, 70.061 ton of **wood waste** was exported to mainly Germany, the Netherlands and France.

Sludge is exported to various countries, to Germany for example where the sludge is used in digestion- and composting installations, brown coal installations or dumping sites. Aquafin exported 7.010 ton to RWE Power kraftwerk Wachtberg (Germany) and 5.8000 to Intermoselle (Luxembourg), where it was used in the cement industry. Sludge is also exported to the Walloon region to be used in co-incineration or the cement industry.

Table 28: Export of sludge for biogas production (amounts in kg) (source: OVAM biomass inventory 2006-2007) (jaartal: year, hoeveelheid: quantity)

Jaartal	Hoeveelheid (kg)
1990	3.010.001
2000	21.802.500
2001	15.475.000
2002	9.977.500
2003	10.578.000
2004	15.252.500
2005	11.800.000

Animal wastes are exported for the production (Table 29) of green electricity and bio-fuels (Table 30). 1st column (year), 2nd column (total amount), 3rd column (meal part), 4th column (fat part)

Table 29: Export of animal waste for green electricity production (source: OVAM biomass inventory 2006-2007) (jaartal: year, hoeveelheid: quantity, meel: powder, vet: fat)

Jaartal	Hoeveelheid (kg)	Meel (kg)	Vet (kg)
2001	15.691.939	15.690.939	0
2002	5.827.284	5.827.284	0
2003	30.472.280	30.472.280	0
2004	0	0	0
2005	3.626.205	3.625.600	605

Table 30: Export of animal waste for biofuel production (source: OVAM biomass inventory 2006-2007) (jaartal: year, hoeveelheid: quantity, meel: powder, vet: fat)

Jaartal	Hoeveelheid (kg)	Meel (kg)	Vet (kg)
2002	7.539.000	7.539.000	0
2003	14.213.840	14.213.840	0
2004	13.208.000	11.033.000	2.175.000
2005	10.752.800	10.752.800	0

The OVAM-inventory of biomass streams in Flanders gives estimations of wood streams in the Flemish Region. The supply of wood in the Flemish region lays between 1,3 million ton and 1,5 million ton/year of inland supply. 0,190 ton is imported from abroad, this is the wood waste that is not on the green import list, the amount of wood imported from the green import list is not known. Also the part of wood imported from the other regions no amounts are available. In total the Flemish Waste Agency estimates the wood supply in the Flemish region between 1,5 and 1,7 million tons/year. The demand of wood is estimated on 1,649 million tons a year, so depending on the estimations there is a surplus or shortage of wood. Forecasts with planned energy-installations in 2008, points out that a shortage will be more likely

(estimations of OVAM: 120.000 ton in 2008). Since 2007 this waste stream became a 'green list' stream, this makes a future view on these streams difficult.

7.1.2 Biomass import

In 2006 **olive pulp** was imported to be used for co-incineration in two GDF-SUEZ / Electrabel electricity production installations in Langerlo (26.000 ton) and Ruien (30.056 ton). The coal installation of Rodenhuize processed 3.059 ton).

Yearly about 90.000 ton of **coffee grounds** are imported from Spain and Switzerland, also for incineration with energy recuperation.

For **untreated wood** there are no figures available since this is a 'green list' stream.

In 2006 173.000 ton of **wood waste** was imported mainly for recycling purposes.

The amount of wood waste available for bio-energy in the Flemish region is given below, together with an outlook till 2020.

Table 31: Quantities of wood waste availability in the Flemish region in TJ/y (stookwaarde: calorific value)

Tabel 36: Hoeveelheden houtafval, beschikbaar in Vlaanderen, [extrapol. HWV 04]

Biomassareststromen	Stookwaarde GJ/ton	Hoeveelheden beschikbaar in Vlaanderen voor energetische valorisatie (TJ/j)				
		2002	2005	2010	2015	2020
houtafval	15	11820	12338	12855	12855	12855

Yearly, OVAM, the Flemish Waste Agency market study enquires incineration plants concerning their feedstock. Co-combustion of biomass and bio-waste by licensed incineration plants is also adopted in this enquiry. The results are given below and amount a total of circa 1 million tonnes a year in the Flemish region.

Table 32: Amount of biomass feedstock used in incineration plants for 2008 (ton/y)

Year	2008	Electrabel (power station)						Stora Enso (paper industry)		Linopan (chipboard)		Norbord (chipboard)		
Unit	ton	Ruien		Rodenhuize		Langerlo								
		Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import	
wood	not defined					67.967						26.261	18.463	112.691
	chips	65.927	3.649											69.576
	pellet				399.112									399.112
	dust	74.962	3.937											78.899
	waste							66.917	4.657	18.470				90.044
olive	pith		22.781		1.533									24.314
	pulp						251.445							251.445
Total		140.889	30.367	-	400.645	67.967	251.445	66.917	4.657	18.470	-	26.261	18.463	**1.026.081**

7.2 Walloon region

There are no accurate data for Wallonia at the present time, but the following figures were estimated for the year 2008 :

- pellets import : 300 000 tons
- pellets export : 1 000 tons.

7.3 Belgium

In addition, it could be useful to mention some data related to international biomass trade in Belgium. In the Eurostat statistics[7], traded products are grouped based on EU's combined customs nomenclature, which gives 8 digits CN (Combined Nomenclature) codes for different products[8]. The statistics record the amounts and the values of the traded products.
The foreign trade quantities (in tons) and values (in €) of the product groups selected for the study are presented in the tables below. The forest industry's wooden raw material streams have been included in the study, but forestry products have been excluded. Straw was included in the study (Table 33) (Table 34).

Table 33: Imported biomass streams in 2004 (Eurostat, 2006)

	CN code(s)	Quantities (t)	€/ton
Round wood	See footnote[9]	1.752.234	49,3
Chips	44012100, 44012200	96.022	40,8
Sawdust of wood	44013010	173.434	48,0
Wood waste and scrap	44013090	897.118	31,1
Fuel wood	44011000	16.543	77,4
Tall oil	38030010, 38030090, 38070090	1.500	410,9
Peat	27030000	620.745	41,5
Ethanol	29051100, 29094911, 29094919	434.364	353,9
MTBE, ETBE, …	29091900	82.374	442,6
Straw	12130000, 84334010, 84334090	68.995	775,7

Table 34: Exported biomass streams in 2004 (Eurostat, 2006)

	CN code(s)	Quantities (t)	€/t
Round wood	See footnote	754.588	87,9
Chips	44012100, 44012200	305.570	46,8
Sawdust of wood	44013010	130.912	20,5
Wood waste and scrap	44013090	450.200	62,0
Fuel wood	44011000	20.719	44,7

[7] http://epp.eurostat.cec.eu.int (July 2006)

[8] See Annex A

[9] 44032031, 44032039, 44032011, 44032019, 44032091, 44032099, 44039110, 44039190, 44039200, 44039210, 44039951, 44039959, 44034100, 44039910, 44039995

Tall oil	38030010, 38030090, 38070090	2.356	530,1
Peat	27030000	255.563	59,5
Ethanol	29051100, 29094911, 29094919	77.676	957,9
MTBE, ETBE, …	29091900	248.058	412,1
Straw	12130000, 84334010, 84334090	37.210	2.028,0

Customs statistics can give rough figures on international biomass trade. Statistics do not differentiate the end-use purposes of the material into energy use and raw material use, and various products can be included in the CN codes.

CHAPTER 8 BARRIERS & OPPORTUNITIES FOR INTERNATIONAL BIO-ENERGY TRADE

Belgian data on biomass energy trade volume are generally not available. To overcome this situation, it will be useful to implement a "biomass monitoring system" at a federal level or, at least, at a regional level but sharing the same methodology. The main responsibilities of such a system (the exact structure is to be implemented) should be: to evaluate annually biomass energy trade volume (import / export) classified by origin of wood, to survey annually the market of domestic biomass heating systems (e.g. wood stoves, wood boilers) classified by type of solid biomass.

Since Belgium has a **limited bio-resource potential** a lot of biomass resource **imports** will be needed in order to reach to European targets set. Since import will play an important role sustainability criteria will set barriers as well as create opportunities for certain biomass resources. At the moment the topic of sustainability already plays a certain role but is generally not well defined. Traces of sustainability can be found in the 'Ladder of Lansink' in an environmental view, the deduction of pre-treatment for green certificate allocation in an energetic way of view, the certification scheme of GDF-SUEZ / Electrabel, for bio-fuels the GHG-balance was a main criterion; for all these topics the reader is referred to previous chapters. Sustainability criteria must be set but this will be a European/international exercise with a lot of attention for a market level playing field.

However, nevertheless the limited resource potential of Belgium, some bio-energy resources are still **exported**, this is due to the lack of capacities or technical installations to valorise these resources or a stringent waste and/or environmental policy. This generates barriers to valorise domestic resource in Belgium and/or to attract investors to invest in renewable energy installations. A good balance between policy, the environmental target and practical feasibility needs to be pursued.

CHAPTER 9 DISCUSSION & CONCLUSION OF CURRENT DEVELOPMENTS

The Belgian energy production system is based on a variety of energy sources: oil, natural gas, nuclear (>50% of power generation), coal, wind, hydro and biomass. Natural gas and biomass are the most growing resources. Key strengths & weaknesses are listed below to conclude this report.

Key strengths:

- The system of certificates for renewable electricity helped the market an important step forward. Investments in renewable electricity are growing fast. New projects and ideas are rising up.
- The system of certificates is been quiet stable in comparison to other member states. Stability of the legal framework is one of the most important demands of the investors.
- Exploitation support is the most important trigger, but also the investment support and fiscal deduction gives an important impulse to the sector.

Key weaknesses

- No sufficient support system for renewable heating and cooling is set up yet, therefore this part of the sector is lacking behind in growth.
- The implementation of a support system for renewable heating and cooling next to the existing systems of certificates for renewable electricity and CHP must be done with care to keep the equilibrium between the 3 sectors. The dedication of biomass to the different energy vectors (electricity, heat or cooling, transportfuel, bio-CHP) will depend on this equilibrium.
- The import of biomass is necessary to reach the European goals, an important challenge for the future is to take care of the sustainable character of this imported biomass streams without restricting and burden the sector too much (level playing field).
- Belgium is intensely populated and therefore the general public has reservations about several types of bio-energy projects in there neighbourhood. The NIMBY-syndrome is a problem where a lot of new installations have to deal with. In some cases they even have to stop their project because of the actions taken by local action committees. Awareness rising and better communication with the local public is an important action point to the future on different levels.
- A lot of permits and licenses are necessary before a project can start up. Different authorities from different levels (municipal, district, regional, federal) and different legislative fields (energy, environment, waste, land-use,…) have there role to play in this process. A further streamlining and transparency of this process is important for the renewable energy sector. Especially two issues are not completely clear at the moment: how to follow the philosophy of the Ladder of Lansink for biomass waste streams (also in relation with the imported biomass streams and energy crops) and how to streamline the different emission levels for bio-energy installations.

- The phase out of nuclear energy is vague. Political statements are made and withdrawn. This creates an uncertain climate for investments in bio-energy.

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→ ***WEBSITES***

→ **INTERNATIONAL**

- International energy agency (http://www.iea.org/)
- European Commission – Energy (http://ec.europa.eu/energy/index_en.htm)
- Eurostat (http://epp.eurostat.ec.europa.eu/)
- Eubionet (http://www.eubionet.net)
- European Environment Agency (http://www.eea.europa.eu)
- Refund+ IEE (http://www.energies-renouvelables.org/refund/default_quest.asp)

→ **NATIONAL**

- Federal Public Service - DG Economy, SMEs, Self-employed and Energy. (http://mineco.fgov.be)
- Federal Public Service Economy – DG Statistics Belgium (http://www.statbel.fgov.be/home_en.asp)
- Federal Public Service of Finance. (http://www.fisconet.fgov.be)
- Federal planning bureau – economic analyses & forecast (http://www.plan.be)
- CREG - Commission for electricity and gas regulation. (http://www.creg.be)

- Laborelec (http://www.laborelec.com)

→ **REGIONAL**

- Study bureau of the Flemish Government (http://www4.vlaanderen.be/dar/svr/Cijfers/Pages/Excel.aspx)
- ValBiom (Belgian Biomass Association, http://www.valbiom.be)
- CHP-promotion & development (http://www.cogensud.be)
- CWaPE - Commission wallonne pour l'Energie. (http://www.cwape.be)
- VREG - Flemish Regulation Entity for the Electricity and Gas market http://www.vreg.be
- OVAM – Flemish Waste Agency (http://www.ovam.be)
- VITO – Flemish Institute for Technological Research (http://www.vito.be)
- ICEDD – Institut de Conseil et d'Etudes en Developpement Durable (http://www.icedd.be)
- Energy in Wallonia (http://energie.wallonie.be)
- Environment in Wallonia (http://environnement.wallonie.be)
- CRA-W – Agricultural Research Centre (http://cra.wallonie.be)
- ILVO – Institute for Agricultural en Fisheries Research (http://www.ilvo.vlaanderen.be/)
- VMM - The Flemish Environment Agency (http://www.vmm.be/english)
- INBO – Research Insitute for Nature & Forest (http://www.inbo.be/)

ANNEXES

→ *ANNEX A CN codes*

CN code	Product
12130000	CEREAL STRAW AND HUSKS UNPREPARED WHETHER OR NOT CHOPPED GROUND PRESSED OR IN THE FORM OF PELLETS
27030000	PEAT INCL. PEAT LITTER WHETHER OR NOT AGGLOMERATED
29051100	METHANOL "METHYL ALCOHOL"
29091900	ACYCLIC ETHERS AND THEIR HALOGENATED SULPHONATED NITRATED OR NITROSATED DERIVATIVES (EXCL. DIETHYL ETHER)
29094911	2-"2-CHLOROETHOXY"ETHANOL
29094919	ACYCLIC ETHER-ALCOHOLS AND THEIR HALOGENATED SULPHONATED NITRATED OR NITROSATED DERIVATIVES (EXCL. 22''-OXYDIETHANOL "DIETHYLENE GLYCOL DIGOL" MONOALKYLETHERS OF ETHYLENE GLYCOL OR OF DIETHYLENE GLYCOL AND 2-"2-CHLOROETHOXY"ETHANOL)
38030010	CRUDE TALL OIL
38030090	TALL OIL WHETHER OR NOT REFINED (EXCL. CRUDE TALL OIL)
38070090	BREWER''S PITCH AND SIMILAR PREPARATIONS BASED ON ROSIN RESIN ACIDS OR VEGETABLE PITCH; WOOD TAR OILS WOOD CREOSOTE WOOD NAPHTHA AND VEGETABLE PITCH (EXCL. WOOD TAR BURGUNDY PITCH YELLOW PITCH STEARIN PITCH FATTY ACID PITCH FATTY TAR AND GLYCERIN PITCH)
44011000	FUEL WOOD IN LOGS BILLETS TWIGS FAGGOTS OR SIMILAR FORMS
44012100	CONIFEROUS WOOD IN CHIPS OR PARTICLES (EXCL. THOSE OF A KIND USED PRINCIPALLY FOR DYING OR TANNING PURPOSES)
44012200	WOOD IN CHIPS OR PARTICLES (EXCL. THOSE OF A KIND USED PRINCIPALLY FOR DYING OR TANNING PURPOSES AND CONIFEROUS WOOD)
44013010	SAWDUST OF WOOD WHETHER OR NOT AGGLOMERATED IN LOGS BRIQUETTES PELLETS OR SIMILAR FORMS
44013090	WOOD WASTE AND SCRAP WHETHER OR NOT AGGLOMERATED IN LOGS BRIQUETTES PELLETS OR SIMILAR FORMS (EXCL. SAWDUST)
44032011	SAWLOGS OF SPRUCE OF THE SPECIES "PICEA ABIES KARST." OR SILVER FIR "ABIES ALBA MILL." WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED
44032019	SPRUCE OF THE SPECIES "PICEA ABIES KARST." OR SILVER FIR "ABIES ALBA MILL." IN THE ROUGH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED (EXCL. SAWLOGS; ROUGH-CUT WOOD FOR WALKING STICKS UMBRELLAS TOOL SHAFTS AND THE LIKE; WOOD IN THE FORM OF RAILWAY SLEEPERS; WOOD CUT INTO BOARDS OR BEAMS ETC.; WOOD TREATED WITH PAINT STAINS CREOSOTE OR OTHER PRESERVATIVES)
44032031	SAWLOGS OF PINE OF THE SPECIES "PINUS SYLVESTRIS L." WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED
44032039	PINE OF THE SPECIES "PINUS SYLVESTRIS L." IN THE ROUGH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED (EXCL. SAWLOGS; ROUGH-CUT WOOD FOR WALKING STICKS UMBRELLAS TOOL SHAFTS AND THE LIKE; WOOD IN THE FORM OF RAILWAY SLEEPERS; WOOD CUT INTO BOARDS OR BEAMS ETC.; WOOD TREATED WITH PAINT STAINS CREOSOTE OR OTHER PRESERVATIVES)
44032091	SAWLOGS OF CONIFEROUS WOOD WHETHER OR NOT STRIPPED OF BARK OR

	SAPWOOD OR ROUGHLY SQUARED (EXCL. SPRUCE OF THE SPECIES "PICEA ABIES KARST." SILVER FIR "ABIES ALBA MILL." AND PINE OF THE SPECIES "PINUS SYLVESTRIS L.")
44032099	CONIFEROUS WOOD IN THE ROUGH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED (EXCL. SAWLOGS; ROUGH-CUT WOOD FOR WALKING STICKS UMBRELLAS TOOL SHAFTS AND THE LIKE; WOOD IN THE FORM OF RAILWAY SLEEPERS; WOOD CUT INTO BOARDS OR BEAMS ETC.; WOOD TREATED WITH PAINT STAINS CREOSOTE OR OTHER PRESERVATIVES; AND SPRUCE OF THE SPECIES "PICEA ABIES KARST." SILVER FIR "ABIES ALBA MILL." AND PINE OF THE SPECIES "PINUS SYLVESTRIS L.")
44034100	DARK RED MERANTI LIGHT RED MERANTI AND MERANTI BAKAU WOOD IN THE ROUGH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED (EXCL. ROUGH-CUT WOOD FOR WALKING STICKS UMBRELLAS TOOL SHAFTS AND THE LIKE; WOOD CUT INTO BOARDS OR BEAMS ETC.; WOOD TREATED WITH PAINT STAINS CREOSOTE OR OTHER PRESERVATIVES)
44039110	SAWLOGS OF OAK "QUERCUS SPP." WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED
44039190	OAK "QUERCUS SPP." IN THE ROUGH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED (EXCL. SAWLOGS; ROUGH-CUT WOOD FOR WALKING STICKS UMBRELLAS TOOL SHAFTS AND THE LIKE; WOOD IN THE FORM OF RAILWAY SLEEPERS; WOOD CUT INTO BOARDS OR BEAMS ETC.; WOOD TREATED WITH PAINT STAINS CREOSOTE OR OTHER PRESERVATIVES)
44039200	BEECH 'FAGUS SPP.' IN THE ROUGH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED (EXCL. ROUGH-CUT WOOD FOR WALKING STICKS UMBRELLAS TOOL SHAFTS AND THE LIKE; WOOD IN THE FORM OF RAILWAY SLEEPERS; WOOD CUT INTO BOARDS OR BEAMS ETC.; WOOD TREATED WITH PAINT STAINS CREOSOTE OR OTHER PRESERVATIVES)
44039210	SAWLOGS OF BEECH "FAGUS SPP." WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED
44039910	POPLAR IN THE ROUGH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED (EXCL. ROUGH-CUT WOOD FOR WALKING STICKS UMBRELLAS TOOL SHAFTS AND THE LIKE; WOOD CUT INTO BOARDS OR BEAMS ETC.; WOOD TREATED WITH PAINT STAINS CREOSOTE OR OTHER PRESERVATIVES)
44039951	SAWLOGS OF BIRCH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED
44039959	BIRCH IN THE ROUGH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED (EXCL. SAWLOGS; ROUGH-CUT WOOD FOR WALKING STICKS UMBRELLAS TOOL SHAFTS AND THE LIKE; WOOD CUT INTO BOARDS OR BEAMS ETC.; WOOD TREATED WITH PAINT STAINS CREOSOTE OR OTHER PRESERVATIVES)
44039995	WOOD IN THE ROUGH WHETHER OR NOT STRIPPED OF BARK OR SAPWOOD OR ROUGHLY SQUARED (EXCL. ROUGH-CUT WOOD FOR WALKING STICKS UMBRELLAS TOOL SHAFTS AND THE LIKE; WOOD CUT INTO BOARDS OR BEAMS ETC.; WOOD TREATED WITH PAINT STAINS CREOSOTE OR OTHER PRESERVATIVES TROPICAL WOOD OF SUBHEADING NOTE 1 TO THIS CHAPTER AND CONIFEROUS WOOD OAK BEECH POPLAR EUCALYPTUS AND BIRCH WOOD)
84334010	PICK-UP BALERS FOR STRAW OR FODDER
84334090	STRAW OR FODDER BALERS (EXCL. PICK-UP BALERS)