OUTLOOK AND RECOMMENDATIONS

27 OUTLOOK FOR FUTURE MARKET DEVELOPMENTS FOR BIO-ENERGY

27.1 Introduction

In this section a series of hypothetical scenarios is presented, describing the possible situation of the EU market till 2020 in the perspective of complete fulfilment of the RES target.

For each sector of energy use (electricity, heat and transport) a forecast is made:

1) of the **overall energy demand**[403].
2) of the **portion of the overall energy demand coming from RES** (necessary to comply with the targets set at the EU level) and of the consequent derived demand of bio-energy sources (bio-fuels, bio-gas and biomass).

Three different scenarios – differing for the level of the EU self sufficiency for energy crops - are presented to picture the situation of **demand of energy crops** resulting from the expected demand evolution by sector of energy use.

The forecasts are made following the assumptions represented in Box 27.1[404].

Box 27.1 – Assumptions and main limitations of the model

Demand	Supply of biomass for energy purposes
- The foreseen evolution of final energy consumption by sector of energy use (electricity, heat and transport) is exogenous to the model (the source is represented by official forecasts[405]); - The market share of each bio-energy source calculated on the final energy consumption (for each sector of energy use) is assumed to be constant in the considered period and equal to the shares registered in 2004;	- The production technology is assumed to be a constant parameter, as the forecasts concern a medium-term period (from 2005 to 2020). Nevertheless, Box 2.2 also drafts a perspective scenario in the hypothesis of agricultural yields growing of 1% per year. - Solid biomass for the production of electricity and heat destined to self consumption are not taken into account.

27.2 The foreseen demand by sector of energy use

This section presents the expected demand evolution of electricity, heat and fuels coming from RES, given the foreseen demand by sector of energy use (electricity, heat and transport) and the EU targets. The demand of bio-energy sources resulting from the expected demand evolution by sector of energy use is then estimated.

27.2.1 Electricity

The final electricity consumption is expected to increase significantly[406] (see Table 27.1). In particular, it is expected to increase by 33%% from 2004 to 2020, with an average increasing annual rate of 7,4%.

[403] Source: Eurostat data and "European energy and transport", trends to 2030 – update 2005, Directorate general for energy and transport, European Commission.
[404] See the following sections for the specific assumptions concerning each bio-energy source.
[405] See footnote 403.
[406] See footnote 403.

Table 27.1 - Final electricity consumption

	2004	2005	Forecast		
			2010	2015	2020
Final electricity consumption	2.651.682	2.718.710	3.015.775	3.283.661	3.522.936

Gwh
Source: Eurostat for 2004 and "European energy and transport", trends to 2030 – update 2005, Directorate general for energy and transport, European Commission, for forecasts 2005-2020.

Table 27.2 – UE targets: electricity

	from 2010
Share of electricity consumption produced from RES	21%

Source: Directive 2001/77/EC
NB: Directive 2001/77/EC requires MS to set national indicative targets for the consumption of electricity produced from renewable energy sources (RES-E) by 2010, based on reference values identified in the Annex to the Directive. These objectives should lead to an overall target of 21% of gross electricity consumption for EU-25 Countries. In addition, Directive 2001/77/EC allows for direct and indirect mechanisms for the support of RES-E.

In order to comply with the EU targets in terms of share of electricity consumption produced from renewable energy sources, RES-E (see Table 27.2) and given the final electricity consumption (see Table 27.1), the demand of the electricity produced from RES is expected to have the following evolution (Table 27.3).

According to Table 27.3, the compliance with the EU targets implies a significant increase of the electricity produced from solid biomass and from biogas (87% between 2004 and 2020)[407].

Table 27.3 – Demand of electricity to comply with the EU targets

	2004	2005	Forecast		
			2010	2015	2020
Electricity to be produced by RES-E	450.000	500.000	731.469	790.547	841.213
among which:					
solid biomass	35.000	39.000	57.055	61.663	65.615
variation rate towards 2004		*11,43%*	*63,01%*	*76,18%*	*87,47%*
- among which energy crops	140	156	228	247	262
variation rate towards 2004		*11,43%*	*63,01%*	*76,18%*	*87,47%*
biogas	13.050	14.500	21.213	22.926	24.395
variation rate towards 2004		*11,11%*	*62,55%*	*75,68%*	*86,94%*
- among which energy crops and agricultural residues	1.958	2.175	3.182	3.439	3.659
variation rate towards 2004		*11,11%*	*62,55%*	*75,68%*	*86,94%*
Solid biomass/RES-E	***7,8%***	***7,8%***	***7,8%***	***7,8%***	***7,8%***
Biogas/RES-E	***2,9%***	***2,9%***	***2,9%***	***2,9%***	***2,9%***
Energy crops/solid biomass	*0,4%*	*0,4%*	*0,4%*	*0,4%*	*0,4%*
Energy crops and agricultural residues/biogas	*15,0%*	*15,0%*	*15,0%*	*15,0%*	*15,0%*

Gwh
Source: DEIAGRA elaborations

[407] It should be remembered (see box 2.1) that:

- Actually, the RES produced from solid biomass and bio-gas accounts for 7,8% and 2,9% of the total electricity produced by RES in 2004. Energy crops represent about 21% of the energy coming from solid biomass, whereas agricultural residues represent about 18% of the energy coming from bio-gas.
- We assume that the share of the electricity coming from solid biomass and bio-gas on the total electricity produced by RES remains constant in the considered period. Furthermore, we assume that the share of electricity coming from energy crops on the total electricity produced by solid biomass, as well as the share of electricity coming from agricultural residues on the total electricity produced by bio-gas, remain constant in the considered period.
- Given the evolution of electricity demand, the EU targets and given the above-mentioned assumptions, we point out that the electricity produced from solid biomass (among which the electricity coming from energy crops) and bio-gas (among which the electricity coming from agricultural residues) should increase about 87% from 2004 to 2020.

27.2.2 Heat

The final heat demand is expected to increase in the next years (see Table 27.3), in particular it is expected to increase about 22% from 2004 to 2020.

Table 27.4 – Final heat demand (from CHP and district heating)

	2004	2005	Forecast		
			2010	2015	2020
Final heat demand (from chp and district heating)	72.000	74.217	80.177	83.571	87.691

Ktoe
Source: "European energy and transport", trends to 2030 – update 2005, Directorate general for energy and transport, European Commission, for forecasts 2005-2020.

Table 27.5 – UE targets: heat

	2010
Share of final heat demand produced from RES	20%

Source: European Parliament final A6-0020/2006.
NB: As far as the heating sector is concerned no EU framework legislation has been set out to date for the promotion of RES. The European Parliament has recently adopted a motion for a resolution requesting the Commission to submit a legislative proposal on increasing the share of renewable energy for heating and cooling, following a series of recommendations provided by the Parliament itself (European Parliament final A6-0020/2006). The Commission's proposal should set a target for the share of RES in heating and cooling of at least 20% by 2020 as compared to the current share of approximately 10%.

In order to comply with the EU targets in terms of share of heating demand produced from renewable energy sources, RES-H (see Table 27.5) and given the final heat demand (see Table 27.4), the demand of heat produced from RES should have the following evolution (Table 27.6).

Table 27.6 – Demand of heat to comply with the EU targets

	2004	Forecast		
		2010	2015	2020
Heat to be produced by RES-H	2.024	16.035	16.714	17.538
among which:				
solid biomass	1.600	12.684	13.221	13.873
variation rate towards 2004		*692,75%*	*726,31%*	*767,04%*
- among which energy crops	6,40	50,74	52,88	55,49
variation rate towards 2004		*692,75%*	*726,31%*	*767,04%*
biogas	423	3.351	3.493	3.665
variation rate towards 2004		*692,26%*	*725,80%*	*766,51%*
- among which energy crops and agricultural residues	63	503	524	550
variation rate towards 2004		*692,26%*	*725,80%*	*766,51%*
Solid biomass/RES-H	***79,1%***	***79,1%***	***79,1%***	***79,1%***
biogas /RES-H	***20,9%***	***20,9%***	***20,9%***	***20,9%***
Energy crops/solid biomass	*0,4%*	*0,4%*	*0,4%*	*0,4%*
Agricultural residues/biogas	*15,0%*	*15,0%*	*15,0%*	*15,0%*

Ktoe
Source: DEIAGRA elaborations
NB: data do not take into account the heat produced by domestic apparatus[408]
According to Table 27.6, the compliance with the EU objectives implies an increase of the heat produced from RES from 427 Ktoe in 2004 to 17,5 Mtoe in 2020.

[408] See Box 27.1.

According to table 27.6 the compliance with the EU targets implies a significant increase of the heat produced from solid biomass and from biogas (770% between 2004 and 2020).

27.2.3 Transport

The total demand of fuels for transport[409] is expected to increase about 19% from 2004 to 2020.

Table 27.7 – Petrol and diesel demand evolution

	2004	2005	Forecast		
			2010	2015	2020
Total	350,24	360,61	377,20	400,00	416,30
among which:					
- gasoline	117,34	115,00	142,10	144,00	145,40
- diesel	172,60	175,00	182,10	194,00	207,60

Mtoe
Source: Eurostat for 2004 and "European energy and transport", trends to 2030 – update 2005, Directorate general for energy and transport, European Commission, for forecasts 2005-2020.

Table 27.8 – EU targets: transport

	2005	2010	2015	2020
Percentage of contribution of biofuels and other renewable fuels on the total quantity of fuels placed in the market (EU 25)	**1,40**	**5,75**	**5,75**	**5,75**

Source: Directive 2003/30/EC
NB: Following the White Paper "European Transport Policy for 2010: Time to Decide" (COM(2001) 370 final), Directive 2003/30/EC on the promotion of bio-fuels for transport requires MS to set national indicative targets to ensure that a minimum share of bio-fuels and other renewable fuels is placed into their markets for subsequent use in the transport sector. To this end, the Directive provides reference values for the share of bio-fuels of 2% and 5.75%, in 2005 and 2010 respectively, measured on the basis of energy content, and calculated as a percentage of all petrol and diesel placed in the market.

In order to comply with the EU targets in terms of percentage of contribution of bio-fuels and other renewable fuels on the total quantity of fuels placed in the market (EU-25) and given the total fuels demand, the demand of bio-ethanol and bio-diesel should have the following evolution.

Table 27.9 – Demand of bio-fuels to comply with the EU targets

	2004	2005	Forecast		
			2010	2015	2020
Bioethanol	0,21	1,61	8,17	8,28	8,36
Biodiesel	1,74	2,45	10,47	11,16	11,94
Total	1,95	5,05	21,69	23,00	23,94
Bioethanol/Total demand	***0,1%***	***0,4%***	***2,2%***	***2,1%***	***2,0%***
Biodiesel/Total demand	***0,5%***	***0,7%***	***2,8%***	***2,8%***	***2,9%***

Mtoe
Source: DEIAGRA elaborations

The compliance with the EU objectives implies an increase of bio-ethanol demand from 0,21 Mtoe in 2004 to 8,36 Mtoe in 2020 (+ 3804%) and an increase of bio-diesel demand from 1,74 Mtoe in 2004 to 11,94 Mtoe in 2020 (+ 586%).

[409] See footnote 406.

27.3 The foreseen demand of bio-energy sources

In this section, we estimate the demand of bio-energy sources resulting from the expected demand evolution by sector of energy use. We estimate, in particular, the demand of bio-fuels and bio-gas.

27.3.1 The demand of bio-fuels

The total demand of petrol and diesel for transport is expected to increase about 19% from 2004 to 2020.

In order to comply with the EU targets in terms of percentage of contribution of bio-fuels and other renewable fuels on the total quantity of fuels placed in the market (EU-25) and given the total fuels demand, the demand evolution of bio-ethanol and bio-diesel should have the trend highlighted in table 27.9.

27.3.2 The demand of bio-gas

The bio-gas demand is expected to increase[410] from 3.724 Ktoe in 2004 to 10.587 Ktoe in 2020.

Table 27.10 – Bio-gas demand evolution

		Forecast		
	2004	**2010**	**2015**	**2020**
Electricity	3.194,29	5.212,24	5.633,21	5.994,24
Heat	530,00	4.198,99	4.376,74	4.592,51
Total	**3.724,29**	**9.411,23**	**10.009,95**	**10.586,75**

Ktoe
Source: DEIAGRA elaborations
NB: It has to be taken into account that about 500 Mtoe are stocked

27.4 The foreseen demand of biomass

In this section, on the basis of the estimated demand of solid biomass presented above, an estimate is presented for the demand of energy crops and other biomass source which would derive from the context pictured above. After this preliminary estimate, the following paragraphs will show some different scenarios, based on different hypothesis in the level of self sufficiency for energy crops.

27.4.1 The demand of energy crops in the UE

Given the extent of the foreseen demand of **electricity** from biomass obtained by energy crops (see table 27.3), the yields in toe/ha (see Table 27.11) and given the supposed contribution of each energy crop[411] to the production of electricity (silo maize 70% and other cereals 30%), the areas are defined, which would be necessary to satisfy the electricity demand needed to achieve the EU targets (see Table 27.2).

Table 27.11 – Energy crops areas to comply with EU targets: electricity

	Toe/ha	2004	2005	Forecast		
				2010	2015	2020
Silo maize for solid biomass (direct burning)	2,50	9.632,00	10.732,80	15.701,42	16.969,56	18.057,14
Cereals* for solid biomass (direct burning)	1,43	7.216,78	8.041,56	11.764,30	12.714,45	13.529,32
Maize for biogas	2,50	9.199,54	10.261,03	15.011,25	16.223,64	17.263,42

Ha
Source: DEIAGRA elaborations
** other than maize*

[410] It is assumed that the yields of transformation of bio-gas into electricity and heat are 35% and 80% respectively. See also box 2.1.
[411] About 15% of the total bio-gas production is represented by agricultural residues, of which a very low percentage (about 2%) is represented by energy crops.

Silo maize and other cereals cultivated areas (for electricity production) would have to increase about 88% respectively (from 2004 to 2020) given the above mentioned assumptions, in order to comply with the targets.

Given the extent of the foreseen demand of **heat** from biomass obtained by energy crops, the yields in toe/ha and given the supposed contribution of each energy crop to the production of heat (silo maize 70% and other cereals 30%), we define the areas which would be necessary to satisfy the heat demand (see Table 27.6) needed to achieve the EU targets (see Table 27.5).

Table 27.12 – Energy crops areas to comply with EU targets: heat

	Toe/ha	2004	Forecast		
			2010	2015	2020
Silo maize for solid biomass (direct burning)	2,50	2.240,00	17.746,69	18.497,93	19.409,87
Cereals* for solid biomass (direct burning)	1,43	1.678,32	13.296,72	13.859,59	14.542,86
Maize for biogas	2,50	1.526,40	12.093,10	12.605,02	13.226,44

Ha
Source: DEIAGRA elaborations
** other than maize*

Given the above-mentioned assumptions the area dedicated to the production of silo maize for direct burning of solid biomass (for heat production) would have to increase from 2.240 to 19.409 ha from 2004 to 2020, whereas the area dedicated to the production of other cereals for the same purposes would have to increase from 1.678 to 14.542 ha. Furthermore, the area dedicated to the production of maize for bio-gas would increase about 767% from 2004 to 2020.

Given the extent of the foreseen demand of **bio-fuels** for transport – i.e. bio-ethanol and bio-diesel – (see table 27.9), given the yields in toe/ha (see Table 27.13) and given the supposed contribution of each energy crop to the production of bio-diesel (rapeseed 90% and sunflower 10%) and bio-ethanol (wheat, barley, rye and maize – depending on the agronomical and climatic conditions - 70%; sugar beet 30%), we define the areas which would be necessary to satisfy the bio-diesel and bio-ethanol demand needed to meet the EU targets (see Table 27.8)[412].

Table 27.13 – Energy crops areas to comply with EU targets: bio-fuels for transport

	Toe/ha	2004	2005	Forecast		
				2010	2015	2020
Rapeseed	**1,10**	1,42	2,00	8,57	9,13	9,77
Sunflower	**0,88**	0,20	0,28	1,19	1,27	1,36
Cereals	**1,43**	0,12	0,90	4,57	4,63	4,68
Sugar beet	**3,85**	0,01	0,08	0,42	0,43	0,43
		1,75	3,27	14,75	15,46	16,23

Million Ha
Source: DEIAGRA elaborations
** elaborations made on bio-diesel (rapeseed and sunflower) and bio-ethanol (cereals and sugar beet) data*

Given the above-mentioned assumptions rapeseed cultivated area for the bio-diesel production would have to increase **from 1,4 million hectares in 2004 to 9,8 million hectares in 2020** and cereals cultivated area for the bio-ethanol production would have to increase from 120.000 to 4,7 millions hectares in 2020.

25.4.1.1 The additional land use 2010 to comply with the EU targets in different scenarios

The following tables describe the potential impact deriving from the fulfilment of the EU targets in terms of land use (additional land to be destined to energy crops in 2010 towards the area destined to energy crops in 2004).
Three different scenarios are considered:

[412] The area which is necessary to comply with the EU objectives in terms of bio-fuel production is estimated through the ratio between the energy crop *i* 's production to comply with the EU targets (given the contribute of the energy crop *i* to the production of a well defined bio-fuel) and the yield toe/ha of the specific crop.

1) the foreseen demand by sector of energy use (electricity, heat and transport), given the EU targets, is entirely covered by bio-energy sources and solid biomass produced within the EU-25 ("scenario 100");
2) the foreseen demand by sector of energy use (electricity, heat and transport), given the EU targets, is covered by bio-energy sources and solid biomass produced within the EU-25 for 75% ("scenario 75");
3) the foreseen demand by sector of energy use (electricity, heat and transport), given the EU targets, is covered by bio-energy sources and solid biomass produced within the EU-25 for 50% ("scenario 50").

Table 27.14 – Additional land use in 2010 to comply with the EU targets

		scenario 100					scenario 75					scenario 50				
		Additional land use 2010					Additional land use 2010					Additional land use 2010				
	Land use 2004	for biofuels	for biogas	for biomass	Total	*var. %*	for biofuels	for biogas	for biomass	Total	*var. %*	for biofuels	for biogas	for biomass	Total	*var. %*
Cereals	**52,30**	4,571	0,035	0,060	**56,97**	*8,9%*	3,428	0,026	0,045	**55,80**	*6,7%*	2,286	0,017	0,030	**54,63**	*4,5%*
of which					-					-					-	
- maize	6,50		0,035	0,030	6,56	*1,0%*		0,026	0,023	6,55	*0,7%*		0,017	0,015	6,53	*0,5%*
- other cereals	45,80	4,571		0,030	50,40	*10,0%*	3,428		0,023	49,25	*7,5%*	2,286		0,015	48,10	*5,0%*
Oilseeds (1)	**6,30**	9,757	-	-	**16,06**	*154,9%*	7,318	-	-	**13,62**	*116,2%*	4,878	-	-	**11,18**	*77,4%*
of which					-					-					-	
- rapeseed	4,00	8,567			12,57	*214,2%*	6,425			10,43	*160,6%*	4,283			8,28	*107,1%*
- sunseed	2,00	1,190			3,19	*59,5%*	0,892			2,89	*44,6%*	0,595			2,59	*29,7%*
- soyabeans	0,30				0,30	*0,0%*				0,30	*0,0%*				0,30	*0,0%*
Protein crops	**1,40**				**1,40**	*0,0%*				**1,40**	*0,0%*				**1,40**	*0,0%*
Flax and hamp	**0,20**				**0,20**	*0,0%*				**0,20**	*0,0%*				**0,20**	*0,0%*
Silage (2)	**5,00**				**5,00**	*0,0%*				**5,00**	*0,0%*				**5,00**	*0,0%*
Total arable crops	**65,20**	14,328	0,035	0,060	**79,62**	*22,1%*	10,746	0,026	0,045	**76,02**	*16,6%*	7,164	0,017	0,030	**72,41**	*11,1%*
Compulsatory set-aside (3)	1,90				1,90	*0,0%*				1,90	*0,0%*				1,90	*0,0%*
of which non food oil seed	0,50				0,50	*0,0%*				0,50	*0,0%*				0,50	*0,0%*
Voluntary set-aside	3,10				3,10	*0,0%*				3,10	*0,0%*				3,10	*0,0%*
Total set aside	5,00				5,00	*0,0%*				5,00	*0,0%*				5,00	*0,0%*
Total COP	**70,20**	**14,328**	**0,035**	**0,060**	**84,62**	*20,5%*	**10,746**	**0,026**	**0,045**	**81,02**	*15,4%*	**7,164**	**0,017**	**0,030**	**77,41**	*10,3%*
Sugar beet	**2,20**	0,424			2,62	*19,3%*	0,318			2,52	*14,5%*	0,212			2,41	*9,6%*
Total COP + sugar beet	**72,40**	14,752	0,035	0,060	**87,25**	*20,5%*	11,064	0,026	0,045	**83,54**	*15,4%*	7,376	0,017	0,030	**79,82**	*10,3%*

ha
Source: DEIAGRA elaborations
NB:
Source for land use 2004: European Commission, Directorate-General for Agriculture, "Prospects for agricultural markets and income in the European Union 2006-2013" (July 2006).
** biomass: auto-consumption excluded*
(1) on non set aside area
(2) excluding grass silage
(3) 5%

Referring to **"scenario 100"**, given the above-mentioned assumptions and given the estimates of the areas necessary to comply with the EU targets concerning bio-fuels, bio-gas and biomass, the total area destined to the production of arable crops would be expected to increase around **21%** from 2004 to 2010. The areas dedicated to the production of cereals and oilseeds would have to increase about **9%** and **155%** respectively. This scenario would be technically unfeasible for the following reasons:

1) agronomical limitations (issues related to crop rotation for rapeseed, which is the most common crop for bio-diesel production);
2) extremely intense competition for land between energy crops and crops for food/feed use, with the associated perturbations in the markets of agricultural commodities;
3) commitments of the Blair House agreement (for oilseeds areas under the NFSA regime).

Referring to **"scenario 75"**, the total area destined to the production of arable crops would have to increase around **15%** from 2004 to 2010. The areas dedicated to the production of cereals and oilseeds would have to grow by around **7%** and **116%** respectively. This scenario would be technically unfeasible – at least as regards oilseeds cultivation - for the same reasons highlighted for "scenario 100", while it would be more plausible as regards the cultivation of bio-ethanol crops.

As regards to **"scenario 50"**, the total area destined to the production of arable crops would have to increase around **10%** from 2004 to 2010. The areas dedicated to the production of cereals and oilseeds should increase by **4%** and **77%** respectively. From a technical standpoint, this scenario would be the one most close to feasibility also as regards the cultivation of oilseeds.

The way in which the above scenarios might become reality would certainly be geographically differentiated according to the following factors:

1) effectiveness of support policy at Member State level targeted at the downstream levels of the bio-energy supply chains;
2) present distribution of the overall production capacity in the bio-energy sector among the different bio-energy supply chains (bio-ethanol; bio-diesel; bio-gas; direct burning of solid biomass) in each Member State;
3) kinds of energy crops most suitable to the agronomical conditions specific to each Member State (e.g. as regards bio-diesel crops, sunflower might be preferable to rapeseed in the Mediterranean areas: this could make issues related to crop rotation less relevant).

Box 27.2 – Scenarios in case of increases in yields

Increase in energy crops yields

If an average growth in crops yields is hypothesised, equal to 1% per year[413], the total area necessary to satisfy the additional demand of biomass (see estimates above) decreases.

	2004	scenario 100		scenario 75		scenario 50	
	millions ha	millions ha	var. % 2004	millions ha	var. % 2004	millions ha	var. % 2004
Yield +0% per year till 2010							
Total COP + sugar beet	**72,40**	**87,25**	20,5%	**83,52**	15,4%	**79,81**	10,2%
Yield +1% per year till 2010							
Total COP + sugar beet		**82,72**	14,2%	**79,20**	9,4%	**75,70**	4,6%
Yield +1% per year till 2020							
Total COP + sugar beet		**75,62**	4,4%	**72,43**	0,0%	**69,25**	-4,3%

Though an average growth in crops yields of 0,5-1% per year is plausible, it has however to be underlined that the effects of such hypothesis are not enough to change dramatically the outcomes of the scenarios referred to year 2010 featuring no growth in crops yields (especially as regards their technical feasibility with respect to rapeseed cultivation)

Indeed, it is the time period for the achievement of targets (second last row versus last row in the table) which is decisive in improving the feasibility of the scenarios.

27.4.2 The demand of solid biomass in the UE

As far as the demand of solid biomass is concerned, given the estimated demand of solid biomass and bio-gas for direct burning, for electricity and heat[414], we estimate the demand of solid biomass different from energy crops.

The demand of solid biomass has been expressed in terms of Ktoe without estimating the demand in terms of areas. This choice can be justified in the following sense:

- as regard the category "forestry and wood", the heterogeneity of sources implies difficulties in estimating a well defined yield per hectare;
- as regard the category of "agricultural residues", the heterogeneity of sources and the fact that there is no specifically dedicated areas implies difficulties in estimating a well defined yield per hectare.

[413] See also EC – DG Agri in the document "*Prospects for Agricultural Markets and income in the European Union*" for the identification of a possible yearly rate of yield grow.

[414] See Table 27.3 and Table 27.6 respectively.

Table 27.15 – Demand of solid biomass other than energy crops in the EU

	2004	Forecast		
		2010	2015	2020
Solid biomass* for direct burning (heat)	1.992,00	15.792,50	16.460,15	17.271,89
Solid biomass* for direct burning (electricity)	8.565,60	13.963,21	15.090,79	16.061,85
Solid biomass* for biogas (heat) (1)	194,79	1.557,07	1.621,93	1.702,50
Solid biomass* for biogas (electricity) (1)	1.191,36	1.936,05	2.092,42	2.226,24
Total	11.943,75	33.248,82	35.265,29	37.262,48

Ktoe
Source: DEIAGRA elaborations
(1) Excluding landfills and sewage sludge
(*) Other than energy crops
Market demand for solid biomass excluded the share burned directly

Following table 27.15, the demand of solid biomass other than energy crops is expected to increase from 11.900 Ktoe in 2004 to 37.000 Ktoe in 2020.

27.5 Main findings

In the hypothesis that the targets set at EU level are achieved, and that the relative importance of the shares of each typology of energy source is not going to change with respect to year 2004, the main findings to highlight are the following:

1) The final demand of solid biomass in the three sectors of energy use (electricity, heating, transport) – excluding self consumption and biogas from landfills and sewage sludge - increases from around 14 Mtoe to around 61 Mtoe.
2) The portion of the final demand of solid biomass (see point 1) covered by energy crops increases from 2 to 24 Mtoe. This increase is almost entirely attributable to the foreseen increase in the demand of bio-fuels.
3) The intensity of the competition for land between energy crops and crops destined to food/feed uses varies according to:
   - the extent of biomass and/or bio-energy sources import from third countries (the extent of the area under energy crops varies from 7,5 to 15 million ha in the scenarios considered).
   - the evolution of average crop yields.
4) Given the main technical limitations[415] associated to the scenarios studied, the one most close to feasibility (in particular as regards the cultivation of oilseeds) appears to be the scenario featuring a foreseen demand of biomass from energy crops covered by EU-25 production for 50% ("scenario 50"). In such scenario, the total area destined to the production of arable crops would have to increase around **10%** from 2004 to 2010 in order to meet the targets set for bio-energy use. The areas dedicated to the production of cereals and oilseeds should increase by **4%** and **77%** respectively.

28 CAP SUPPORT, NON-CAP SUPPORT AND OTHER FACTORS

Generally speaking, results from the analysis of the EU market of biomass, bio-energy sources and energy from biomass, show **a very dynamic situation**, having rapidly evolved especially since 2003.

An important factor determining this dynamism and responsible for the fast development of the sector, is certainly to be identified in **policy measures** (see chapters 5 and 6), which in recent years have been adopted – at both primary production and processing level - with the objective of fostering the production and use of renewable types of energy.

[415] Agronomical limitations (issues related to crop rotation for rapeseed, which is the most common crop for bio-diesel production); extremely intense competition for land between energy crops and crops for food/feed use, with the associated perturbations in the markets of agricultural commodities; commitments of the Blair House agreement.

Relations between the policies and the market in the relevant sectors

As highlighted in the answer to the EQ 9, the development of the volume of bio-energy produced in the **electricity sector** has been mainly driven by the relevant non-CAP measures (feed-in tariffs; tradable green certificates combined with quota obligations) implemented both at EU and at Member State level[416]. Such development has promoted an increase in the demand of the bio-energy sources which are most commonly used in the generation of electricity, namely solid biomass and bio-gas. This has in turn resulted in an increased demand for the types of biomass which are most suited to direct combustion and for the ones which are most commonly used for the production of bio-gas. Only a relatively limited portion of such demand was covered by biomass produced in the EU from energy crops grown with the support the relevant CAP measures. The areas cultivated under the NFSA regime and the AEC with the energy crops which are most relevant for the production of bio-gas (maize above all), and hence the quantities of biomass obtainable from such areas, are modest in absolute value (about 88% of the 240.000 tons of maize that we estimated as being produced on the area under the AEC and NFSA in 2005 were destined to bio-gas production). The cultivation of energy crops which are most relevant for direct burning (short rotation forestry above all) was practised on very limited areas under the AEC and the NFSA regime (less than 18.000 ha in 2005). The rural development measures concerning the support for planting multi-annual biomass crops and those concerning forestry can play – in theory at least - a role with respect to the production of biomass destined to direct combustion; however, this role has been quite limited so far (see EQ 4). The same can be said for the funding of projects featuring on-farm production of biogas.

No relevant policy framework is in place in the EU with respect to the promotion of the use of bio-energy in the **heating sector**. Nevertheless, among the relevant CAP measures, all the ones which can promote an increase in the supply both of solid biomass for direct combustion and of feedstocks for bio-gas production can play – in theory at least - a role in this respect. These measures can be identified:

- in the rural development ones aimed at supporting the planting of multi-annual biomass crops and concerning forestry (with respect to the production of solid biomass for direct combustion);
- in the AEC and the NFSA regime (as regards especially the cultivation of short rotation coppice and grass for direct burning and the production of feedstocks for bio-gas production from cereals and grass).

As highlighted in the answer to the EQ 9, the increase in the supply of bio-fuels (bio-diesel and bio-ethanol) needed to cover the demand in the **transport sector** has been mainly driven by the relevant non-CAP measures (tax exemptions / reductions; mandatory blending of bio-fuels into conventional fuels) implemented both at EU and at Member State level[417]. Such increase in the supply has in turn resulted in an increased demand for biomass suited to bio-fuels production. It has to be noted however that a relevant part of the increased supply of bio-ethanol has been covered by imports from third countries. Biomass imports from third countries have instead played a much more limited role in providing the feedstocks needed for the production of bio-fuels (mostly in the case of bio-diesel). Among the relevant CAP measures, the NFSA regime and the AEC (in order of importance) have played a relevant role in providing the biomass needed to produce bio-fuels, mainly by promoting the cultivation of substantial areas under oilseeds destined to bio-diesel production (areas of much lesser importance were instead grown with energy crops for bio-ethanol production under the AEC and the NFSA regime). However, a portion of set aside land cannot be destined to the cultivation of energy crops destined to the production of bio-fuels because of the absence of processing plants at a reasonable distance. Finally, it is important to remember that a substantial area (about 1 million ha) is cultivated outside specific regimes with oilseeds for bio-diesel production and, to a lesser extent, crops destined to the production of bio-ethanol.

The evaluation of CAP measures (especially EQ9) has shown that a crucial role has been played by policy measures operating at the downstream activities level (industry, final demand) (see chapter 6[418]), while a less decisive role can be imputed to CAP measures (see chapter 5[419]).

The decisive role of incentives can be easily explained by considering that the production of energy from biomass still remains **economically less competitive** if compared with that of energy from traditional

[416] Indeed in the answer to the EQ 9 we have seen that – apart from peculiar situations – the bio-energy supply chains would not be economically viable without the additional support granted by non-CAP measures at EU and Member State level.
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[418] For further information on the matter, see also the annex to the Outlook and Recommendations.
[419] For further information on the matter, see also the annex to the Outlook and Recommendations.

sources (see § 11.2). In this framework, the policy measures operating on the downstream activities or the consumption (feed-in tariffs, tax exemption, green certificates, etc.) highly influence the actual possibility to produce (and use) bio-energy and consequently volumes of production in each Member State. Data regarding the last years show how production results to be highly developed in those Member States where the level of "support" (direct or indirect support) and/or the level of "extension" of this support (for instance, existence and dimension of quotas for bio-fuels in duty exemption regime) are higher.

Besides policy measures and incentives, several factors are likely to deeply influence the diffusion of energy from biomass. The presence/absence of these factors have already had some relevant effects on the present development of the BESC in the different Member States and regions, and the capacity of correctly individuating and managing them may become a necessary requirement in the next future.

On the basis of the analysis developed in the context of the study, as well as literature and bibliography[420], a series of relevant limiting factors can be identified, as described below.

Technical and economic barriers

- **Competition with fossil fuel**, which still remain economically more convenient than the bio-fuels, as highlighted in the market analysis (see § 11.2).
- The often **small size of bio-energy markets**, as well as the fact that biomass by-products are relatively new commodities. As a consequence markets may result immature and unstable, and – also due to a certain still existing policy uncertainty - it could be difficult for firms and operators to sign long-term and large-volume contracts.
- **Technical standards for bio-fuels**, which remain important obstacles for their use. As an example, the review of the EN 14214[421] standard is demanded by most operators, as it would increase the range of oils and raw materials which could be processed in bio-diesel and used as blended components in mineral oil fuels without significant effect on fuel performance.

Conflict with food and feed production and land availability

- Considering the structure and the present situation of the EU agriculture, the increase of areas destined to energy crops – needed to sustain the internal production of bio-energy – might determine a competition for land. The actual level of this competition will depend on the balance between EU internal production and import of solid biomass[422].Energy crop production in marginal areas in fact may result not economically sustainable, because of low yields which could result non consistent with the relatively high production costs of biomass. On the other hand, the destination to energy purposes of productive areas presently destined **to food production**, may have some negative consequences on the food market. Although food security is not likely to constitute a problem in developed countries, the detraction of a high share of land to food destination could result in a relevant raise in import of raw materials, or even in a displacement of food industries, with some effects also on prices and final markets. The increase registered in the price of rapeseed during the last year could be seen in this light.
- The use of by-products and agricultural residues[423] for energy purposes, could result in a scarcity in the **fodder market**, with consequent likely increases in price. Such scarcity might be partially limited by the possibility to use by products from the bio-fuel production as feedstock for animal feed[424].

Logistical and trade barriers

- Still existing **technical difficulties** regarding the **transport of biomass**, due to a lack of technologies able to increase the final density of most biomass types. Local transportation by truck (both in biomass exporting and importing countries) can result to be a high cost-factor, likely to influence the overall biomass cost.

[420] Faaij, Junginger et al., *Opportunities and barriers for sustainable international bio-energy trade: towards a strategic advice of IEA task 40*, www.fairbiotrade.org
[421] The standard EN 14214 imposes limitations to oils and feedstock which can be used for the production of bio-diesel. The partial or total elimination of such limitations would be likely to favour the use and diffusion of bio-diesel.
[422] See also § 7.2.
[423] According to the market analysis (§ 7) the main by-products and agricultural residues can be identified in the following: short rotation wood from forestry thinning, wood felling residues, straw from cereals, other residues from food and industrial crops, sawmill waste, manure, sewage sludge, organic fraction of municipal waste, used vegetable oils and fats
[424] Oil cake, glycerine, beet pulp, DDG's, CO2, (see also market analysis, § 7).

- The lack of significant volumes of biomass locally concentred, which could also hamper **logistics**. A reduction of cost would probably be achievable through an enlargement of shipping volumes on a regular basis.
- **Long distance transport costs**, which have been increasing in recent years and could constitute an important obstacle to international trade.

29 POLICY RECOMMENDATIONS

Recommendation 1

Given the limited effectiveness of AEC at its current level, a decision needs to be taken whether to increase the amount of the AEC significantly in order to increase its effectiveness, or to abolish the measure and seek to promote the cultivation of energy crops through other, more effective tools. In any case, in pursuing the objective of increasing the production of energy crops, support measures would be needed, as it was demonstrated that the cultivation of energy crops, and more in general the production of bio-energy, would not be able to survive without being promoted through public policies.

Recommendation 2

As the NFSA regime was identified as an effective instrument to achieve the objective of promoting the development of energy crops, its continuation would be recommended, unless other equally effective measures would be put in place.

Recommendation 3

Where a limited uptake of rural development measures specifically related to bio-energy production is caused by a limited awareness of farmers about this possibility, improving the flow of related information is recommended.

Recommendation 4

As the organisation and the relationships among the different levels of the bio-energy supply chains are an essential factor for their development, the different forms of coordination, both horizontal and vertical, need to be developed. This concerns especially the creation of organisations of energy crops producers and the implementation of inter-industry agreements between such organisations and the organisations of biomass processors.

Recommendation 5

As the systems aimed at monitoring the implementation of the relevant policies during the evaluation period did not permit obtaining sufficiently specific data and information, the following improvements are needed:

- A complete picture of the implementation of rural development measures specifically targeted at promoting bio-energy production is needed. Data requirements concern the number of beneficiaries, the type of projects financed, the agricultural area concerned where relevant, and the budget.
- Information systems on the relevant markets in the bio-energy supply chains should cover the following data: areas, production, yields of energy crops without specific regime; systematic price series for the main agricultural products according to their use (food/feed, energy, other non-food uses).
- Further improvements aimed at allowing for a thorough analysis of specific issues emerged in this study concern: an assessment of the actual capacity of CO_2 emissions abatement and of fossil fuel saving of the various types of bio-energy (based on a full life cycle approach); an assessment of actual environmental impacts of the energy crops CAP measures (based on empirical studies).