HORIZONTAL ACTIVITIES INVOLVING SMEs

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BIOPROS

Solutions for the safe application of wastewater and sludge for high efficient biomass production in Short-Rotation-Plantations

Collective Research Project

D2 – Report on the state-of-the-art in agricultural production, trading and application

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PREFACE

This report comprises the results from the work accomplished under task 1.2 of the Collective Research project BIOPROS "Solutions for the safe application of wastewater and sludge for high efficient biomass production in Short-Rotation-Plantations" which is co-financed by European Union's the 6th Framework Programme. The report was elaborated under leadership of the Czech Biomass Association (CZ BIOM) with support of the following partners:

- EUBIA (EU)
- ASAJA (Spain)
- CBAO (Bulgaria)
- UFU (UK)
- KZRKiOR (Poland)
- ETKL (Estonia)
- ZSR (Poland)
- CONF (Italy)
- SK-BIOM (Slovakia)
- BIOMASA (Slovakia)

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CONTENT

List of used abbreviations

EC	European Commission
EU	European Union
EU25	Current 25 member states of the European Union
exp.	for export
exptl.	on an experimental basis
ha	Hectare
MJ	Mega Joule
n.d.	not determined (a certain standard etc.)
PJ	Peta Joule
SRP	Short Rotation Plantation
SAPS	Single Area Payment Scheme (currently in use for new member states)
SPS	Single Payment Scheme (applied to old member states)
t	ton (1 ton = 1,000 kg.)
TJ	Tera Joule
tr. costs	transport costs
transp.	used for transport

EXECUTIVE SUMMARY

Current biomass production

In all countries wood is the predominant biomass source utilised at the moment. Most common are wood chips, based on waste wood coming from the timber industry, further also forest wood.

Grown biomass – whether energy crops or energy forests – are with the exceptions of the UK only grown on an experimental basis. If there are any attempts in practical application, only very small areas of land are devoted for this purpose.

Straw (agricultural residues) also significantly contributes to the overall biomass supply, especially in an agriculture based country such as Poland, or in Slovakia. This does not necessarily mean that straw is actually used for energetic purposes, it may remain used, but both countries have stated a high amount of current straw production.

Biogas based on biomass (biomass for the production of biogas) plays no role so far. Most biogas plants run today are run on wastewater, in which case they are no real biogas plants but rather anaerobic wastewater treatment plant, where biogas is a side product. There are further biogas plants based on animal waste, of which there are a few dozens in Poland, the Czech Republic, furthermore there are a few plants on communal waste and landfill gas. In none of the countries questioned a biogas plant is run on biomass.

Funding and trading structures

Only few countries offer special funding for SRP. Countries that do offer subsidies for the growing of SRP show that these subsidies do not necessarily lead to an increased development of SRP.

There is little to be said about current trading structures since in most countries there is no market for SRP yet. There does not seem to be an unanimous opinion on whether direct contacts between farmers and end consumer or the using of “trading agents” between producer and end user is preferred.

INTRODUCTION

The chapters are divided according to the definition of this Subtask in the BIOPROS workplan. The subtask was described in 7 bullet points, which more or less have been used as chapter titles within this report.

A detailed questionnaire was sent to each partner asking for quantitative data on the different topics. On the point «trading structures» the partners had the opportunity to formulate a short text. The data asked for in the questionnaire had been exhaustive in order to give the partner the opportunity to provide very detailed data if they were available. If very detailed data was not available, it could not be requested from the partners that this detailed data was provided. It was therefore not expected that the questionnaire would be filled in completely, but expected to be filled in with the key data. This explains why some of the fields in the table have remained empty.

The data of the individual countries had been difficult to compare since each country uses individual categorisation methods, e.g. forest residues and firewood are sometimes used interchangeably: Some countries state their forest residues as „forest residues“ some as „firewood“, some do state both. Nevertheless, the data obtained for chapter 1 “current biomass production for heat and electricity generation” has been summarised in one table. Data on current subsidies, set-aside land etc. has also been compared in one table.

Additional data, not used in comparative analysis, can be found in the ANNEX where “raw data” has been included from the individual filled-in questionnaires.

1 CURRENT BIOMASS PRODUCTION AND PRICES FOR BIOMASS

The table below should give an idea on the amount of energy that is produced or used for energetic purposes. In some countries the use of biomass for other purposes is also significant, however since energy generation is the primary usage of biomass, we concentrate on the description of biomass for energetic purposes. The table compares different biomass categories such as wood, straw, SRP etc. among each other and between different countries. Forest wood and wooden residuals are one of the mostly-used categories, followed by straw and agricultural residues. Wooden residuals (waste wood from industry) are very easily and cheap to gain – if they are residuals from the wood or paper industry they are readily available at hardly any cost. Forest wood is also abundantly available, however its exploitation – gaining forest wood – might be more expensive because it needs to be collected and dried. This is the reason why forest wood in many countries is not used at its full potential.

Nevertheless, both **wooden residuals** and **forest residuals have limited availability**. Wooden residuals obviously through the fact, that they are linked to production of paper, saw mill output etc. and forest residuals because only limited amounts of forest residuals may be exploited from the forest. Although both categories may contribute to an increased use of biomass, their potential is clearly limited and will not be sufficient to meet EU renewable energy (biomass) targets in the long-run.

Different is the situation with **SRP**: Although very hesitantly practised at the moment – only the UK and to some extent Italy growing SRP on a commercial basis – this category has by far **the largest potential** in relative and absolute terms in the long-run. This is especially true in the light of large amounts of set-aside land available in the individual countries, which in the future might increase due to a gradual shift away from food production.

The table also depicts prices for the different biomass categories which shall give an idea on the competivity among the different categories of biomass. Wooden and agricultural residuals are the cheapest category (because they are waste products which are simply available), processed biomass (such as pellets) and forest biomass are more expensive. Fossil fuels, apart from coal, are considerably more expensive than any kind of biomass.

Tab. 1: Current biomass production (TJ/y) and market price (€/GJ) for electricity and heat production

	Poland		**Estonia**		**Czech Republic**		**Slovakia**		**North. Ireland**		**Italy**	
	TJ/y	€/GJ	**TJ/y**	€/GJ	**TJ/y**	€/GJ	**TJ/y**	€/GJ	**TJ/y**	€/GJ	**TJ/y**	€/GJ
Wood-chips	**5,230**	4.5	**12.3**[1]	2-4	**2,684**[2]	2.50	**1,250**	2.8	**-**		**384**	3
Wood-pellets	**1,260**	4.8	**exp**	2.1	**230**	6.96	**370**	5.1	**714**		**3,160**	11
Wood-briquetts	**-**	-	**-**	-	**490**	6.93	**700**	5.7	**-**		**-**	
Forest residues	**25,184**	3.75	**370**	1.9	**2,250**	3.60	**7,300**	2.0	**95.2**	34		3
Firewood	**11,532**		**9.2**[3]	1.15 - 1.6	**?**	2.96	**-**		**-**		**189,000**	5.4
SRP wood	**0**[4]		**0**	-	**10**	3.2 - 5.7	**0**		**15.9**	80	**1,350**	2.8
Energy crops	**0**	-	**0**	-	**90**	3.41	**0**		**0**		**0**	
Straw	**96,200**	2.25	**-**	0.65[5]	**0.24**	3.34	**25,500**[6]	0.6-1.7	**0**[7]		**-**	
Hay	**1,300**	2.5	**-**	-			**-**		**-**			
AR[8]							**3,100**[9]	2-3.9	**-**		**133,430**	-[10]
AIR[8]									**-**		**20,460**	0.9
WIR							**11,500**	0.6	**-**		**98,600**	0.83
PR					**8,408**	-	**-**		**-**		**2,550**	0.83
Peat	**-**	-	**2,678**	1.9	**-**	-	**-**	-	**-**	-	**-**	-
Coal	**-**	5.57	**-**	2.25 - 3	**-**	1-3	**-**	3.33	**-**	10.1	**-**	9.69
Light fuel oil	**-**	18.28	**-**	15.48	**-**	14	**-**	14.88	**-**	12.3	-	7.18
Heavy fuel oil		4.81	**-**	-	**-**	-	**-**	-	**-**	12.8	-	6.89
Natural gas		7.71		0.25		9.31		10.31		0.1		13.92

[1] 2,118 m^3

[2] incl. saw mill waste

[3] 1,590 m^3

[4] „0“ means that SRP is not grown for commercial use, but only on an experimental basis

[5] In agriculture

[6] of which: cereals straw: 10,400, maize straw: 9,400, sunflower straw: 2,800, rape straw: 2,900

[7] Straw is almost exclusively used for winter bedding of livestock

[8] if not explicitly stated: included in hay, straw

AR = agricultural residues, AIR = agro-industrial, WIR = residues wood industry,

PR = residues paper industry

Explanations

Forest residues and firewood are sometimes used interchangeably: Some countries state their forest residues as „forest residues“ some as „firewood“, some do differentiate between the two (like Poland). The same applies to „straw“ and „agricultural residues“, which are also used interchangeably. In fact no country apart from Italy named agricultural residues as a distinguished category.

Bulgaria

In Bulgaria the European Directive on the support of renewable energy sources (2003/30/EC) has not been adapted into national legislation yet. Also other support mechanisms such as investment grants for the use of renewable and biomass sources are almost non-existent. Biomass is used for heating purposes by private households. This makes up more than 3% of primary energy consumption in the country. In total 3.5 % of primary energy consumption in the country are covered by wooden biomass. Within this share of 3.5 % households have the largest share (93 %), the industry uses 7 %.

[9] from: orchard, vineyard, pasture

[10] transport costs

2 BIOMASS PRODUCTION FOR BIOFUELS AND INDUSTRIAL PURPOSES

Tab. 2a Biomass production for biofuels and industrial purposes (TJ/y)

	Poland	**Estonia**	**Czech Republic**	**Slovakia**	**North. Ireland**	**Italy**
Biofuel						
Rape-seed (methylester)	12,315	-	1,313	-	10 ha	22
for bioethanol	0	0	- (exptl.)	-	0	(see „other“)
Other	6,850[11]	-	-	-	0	5279[12]
Total	19,165	-	-	-	0	
Biomass for industrial purposes						
SRP		(700 ha)[13]	-	-	0	945
Energy crops		-	-	-	0	-
Wood chips (waste wood)		-	2,000	-	0	-
Forest wood	46,953	-	-	-	440	28,970
Straw	176,976	-	-	-	0	-
Potatoes	-	(120 t starch)	-	-	0	-
Total	223,929	-	-	-	0	35,870

[11] of which: rye: 5,950 ha; maize: 900 ha

[12] of which: sugar beet: 20; wheat 5,000 (this must be wheat production for food-purposes also); sunflower: 259

[13] newly established hybrid aspen plantations to be used in the paper industry

Tab. 2b Future potential for biomass for biofuels and industrial purposes (PJ/y)

	Poland	**Estonia**	**Czech Republic**	**Slovakia**	**North. Ireland**	**Italy**
Biofuel						
Rape-seed (methylester)	25	-[14]	18	-	-	22.8[15]
Bioethanol		-	7	-	-	-
Other	10.95[16]	-	10	-	-	0.534[17]
Total	55.95	-		-	-	-
Biomass for industrial purposes						
SRP		-	n.d.[18]	-	-	-
Energy crops		-	n.d.	-	-	-
Wood chips (waste wood)		-		-	-	-
Forest wood	50	-	n.d.	-	-	-
Straw		-	n.d.	-	-	-
Other		?	-	-	-	-
Total		-	-	-	-	-

Conclusions

None of the countries states an explicit potential for biomass use for industrial purposes. This is probably due to the fact, that most studies on future potential focus on energy generation and solely describe the potential for energy generation.

[14] An additional biodiesel plant with a capacity of 50,000 t biodiesel is planned for 2006

[15] including sunflower and soya bean. Figure for a capacity of 600,000 t biodiesel

[16] of which: rye: 5.95; maize: 5

[17] fruit, molasses, wine, wine derivates, cereals

[18] all studies that have analysed future potential have not distinguished between energetic and industrial use – thus there are no independent figures for industrial purposes

3 ELABORATION OF ACTUAL UTILISATION POTENTIAL

It is difficult to make comparing remarks on the potential in the different countries, especially since the term potential may be used in different ways. We may speak about theoretical, technical, economic potential. In most cases in this report the technical potential is given, which can be defined as the total resource limited by the technology used. The term *technical potential* applied for the resource size means the amount of resource that may be produced, harvested or extracted using the currently available technologies, e.g. the harvesting machinery (Pisářek, 2004). The *economic potential,* on the other hand, is the resource on which economic constraints are applied, it means the technical potential that can be provided at economically profitable levels, e.g. at or for less than a given cost.

We can observe that wooden biomass, already now the biomass source with the greatest potential, still has some potential for the future. However, the currently used wooden biomass is mainly derived from waste wood (forests and timber wood) whose further potential is obviously limited. The growing of SRP, on the other hand, is an option allowing the use of fallow land, which in most countries is very large in size and allows a significant increase in cultivation area. In the Czech Republic, for example, there are 0.5 mill. ha of fallow land at the moment. If only *half* of this land was used for the cultivation of SRP or energy crops, Czech Republic´s renewable energy target for 2010 (8 % electricity from gross consumption) could be met based on energy crops and SRP alone! This represents an impressive potential which is similar in some of the further countries. If the individual countries have stated the potential for SRP and energy crops, the potential for energy crops is always larger than the potential of SRP.

Tab. 3: Set aside land

	Poland	**Estonia**	**Czech Republic**	**Slovakia**	**North. Ireland**	**Italy**
in ths. ha	1,495	400	500	300	39	219
% of total arable land	9	33	14	20	4.5	2.6

Due to the fact that it is difficult to compare the actual potential of different countries we rather focus on the share of **SRP potential** *within* an individual country. For the individual countries results see also the countries' reports in the ANNEX.

Poland also states straw as the biomass source with the most potential (130 PJ), followed by potential for rape seed for methylester production (25 PJ). From a technical point of view, the amount of forest wood could be merely doubled: With 25 PJ currently used for energy production, there is an additional potential of 18 PJ. For forest wood used for industrial purposes, the same can be said: To a current production of 50 PJ corresponds a technical potential of 50 PJ. For SRP, a potential of 157 PJ is stated for 2010 and 294 PJ for 2020 (for large power and heating plants) which is a very high figure.

Estonia prognosticates a high potential for SRP. Based on an assumption that 100,000 ha of presently abandoned land will be used (only a quarter of the totally available land) 40.5 PJ of energy would be produced.

Slovakia has also a large potential in wooden and agricultural biomass, the potential for energy crops and SRP has not been elaborated yet.

In the Czech Republic energy crops will be most significant in the future (potential of 240 PJ), the potential for SRP is moderate (11.5 PJ) but it has to be said that due to rather unfavourable economic and legal framework conditions for SRP at the moment this study has favoured the use of energy crops. With improved framework conditions for SRP a slight shift from energy crops towards SRP might be possible. The potential of forest biomass is also considerable high, stronger current use of forest biomass is limited by the relatively expensive exploitation of forest biomass.

Italy states its largest potential for straw and agricultural residues (233 and 238 PJ), wood waste (210 PJ) and forest residues (168 PJ). For the potential of SRP and energy crops no estimate has been made.

The largest absolute potential for SRP has been stated by Northern Ireland with 305 PJ (theoretical potential if all land capable of being cultivated was used).

4 CURRENT HEAT AND ELECTRICITY PRODUCTION

Tab. 4: Current energy production based on biomass and future outlook

	Poland	**Estonia**	**Czech Republic**	**Slovakia**	**North. Ireland**	**Italy**	**Bulgaria**
Current trend							
Heat generated (PJ)	103.75	9	37.9	14.3	-	167	3.5 % (of total prod.)
Installed capacity for electricity (MW_{el})	5150	152	-	21.4	-	312	0
Electricity generated (GWh)	2,846	30	1,154	153	-	3,630	0
CHP - GWh	-			(very low)	-	244 (IEA)	0
CHP - MWel	-			-	-		0
Installed capacity for heat (MW_{th})	2,860	-		-	-		?
Future trend							
Heat generated (PJ)	29.52		207 (target for 2020, heat and el)	-	-		-
Installed capacity for electricity (MW_{el})	1,020			-	-	60	-
Electricity generated (GWh)	10,000			1,300	-	324	-

5 TECHNOLOGIES USED, TENDENCIES

All countries use mainly „classical“ technologies: Stoves and ovens for biomass heating in households, biomass boiler for larger heating plants. For electricity production electricity generation via a steam turbine or combustion engines are most common, in some cases also gasification processes. Co-generation is rare and inventive technologies such as the Stirling motor, micro-gas turbine etc. are almost unseen. Pilot projects exist in the Czech Republic, where an Organic Rankine Cycle (ORC) with 7 MW_{th} on biomass has been realised in Třebič, Central Bohemia, ORC projects have also been realised in Tirano and Dobbiaco in Italy. Examples of the successful application of SRP can be seen in Helechosa de los Montes, Spain, where a cogeneration unit with 1.3 MW_{el} runs on, among other, eucalyptus; and in Eggborough, UK, where a highly efficient gasification power station runs on SRP.

Co-firing (combustion of biomass in conventional coal plants) is occurring in Poland, the Czech Republic, for Slovakia and Italy no figures are available. The tendency in Poland for co-firing is rising. There is no co-firing in Estonia, since there are hardly any coal power plants. Coal power plants ensure only 5 % of the electricity production, most electricity is produced on the basis of oil. The environmental advantages of co-firing are that biomass can be used with very little extra investment cost. The investment costs required for the transformation of a conventional coal-firing plant into a co-firing plant are a lot smaller then the investment costs necessary for a 100 %- biomass plant. Moreover, co-firing plants are often built on large-scale basis and therefore likely to work with a high efficiency and low emission production. Co-firing can therefore help to reduce the use of fossil fuels (thus also CO_2-emissions) at low costs. Co-firing usually requires large amounts of biomass and **can therefore help to increase the demand for SRP**.

6 TECHNICAL REQUIREMENTS

Tab. 6: Technology standards in (in mg/m^3 unless specified otherwise)

	Poland	**Estonia**	**Czech Republic**	**Slovakia**	**North Ireland**	**Italy**
Emission limits – **private** heating systems		P<10MW (g/GJ)	< 0.5: n.d.		n.d.	
SO_2	800	10	n.d.	-	n.d.	n.d.
CO	n.d.	400-1200	n.d.	-	n.d.	n.d.
C_xH_y	n.d.	48	n.d.	-	n.d.	n.d.
PM_{10}	n.d .	-	n.d.	-	n.d.	n.d.
Emission limits – **industrial** heating systems	< 100 MW (mg/m3)	10MW<=P <50MW **(g/GJ)**	0,5-50 MW		Waste Managem. Regul. (1996), Env. Prot. Act (1990), Poll. Prev. Control Act (1999)	
SO_2	800	0	250	200[20]	50	200
CO	n.d	200	250	250	250	200
C_xH_y	n.d	-	50	50	-	n.d.
PM_{10}	n.d.	-	-	-	200	30
NO_x	400[19]	-	650	650	-	-
dust particles	100	-	250	150	-	-
Harmful substances - halogenated hydrocarbons - heavy metals			n.d. (unless chemically treated wood is used, this wood is treated like dangerous waste)	ONORM and EU norms are (will be) setting standards, no Slovakian norm yet	Cd, Tl, Hg: 0.1mg m^{-3} Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V: 1mg m^{-3}	n.d.

[19] from 1.1.2008, until then: 600 mg/m3

[20] For new plants

7 SUBSIDIES

Within the Community Agricultural Policy (CAP from here on), all countries (new and old members) are subject to a payment of a flat rate per ha of agricultural land, which means no differentiation between different crops grown and therefore also no differentiation for SRP. Most "old" member states (Northern Ireland and Italy in this report) are subject to the Single Payment Scheme (SPS). This scheme has been created in 2003 and enables farmers to obtain aid independent of production and allows them to choose what to produce. Moreover they are entitled to energy crops aid, which had also been established during the CAP reform in 2003, and consists of 45 €/ha. New member states had been given the choice between SPS or the Single Area Payment Scheme (SAPS); the SAPS being a compromise solution for new member states but in its principles (flat rate per agricultural land) comparable to the SPS. All new member countries opted for the latter one. *(For more information on SAPS and SPS see report "Analysis of relevant legislation", subtask 1.2)*

As mentioned above, payments do not differentiate between different crops. Since the growing of SRP is more costly than the growing of conventional agricultural commodities, the cultivation of SRP is not being encouraged neither with SAPS nor SPS.

Some countries offer explicit subsidies for the growing of SRP, which are listed in Tab. 5. However, if we compare this subsidy to the actually SRP growth in the given countries, it becomes obvious, that the subsidy does not seem to overcome barriers for SRP. This may have two reasons: 1) Either the subsidy is too low, that means in spite of the subsidy the financial return of SRP is not guaranteed or 2) the subsidy is high enough and does cover the higher costs of SRP but there are other barriers (other than financial) limiting the development of SRP.

Tab. 7 subsidies for SRP

	Poland	**Estonia**	**Czech Republic**	**Slovakia**	**North. Ireland**	**Italy**
CAP	SAPS, 74.94 €/ha from national sources, 63.15 €/ha from EU for most agricultural commodities (wheat, rape-seed etc.)	Single Area Payment Scheme (SAPS) (34.8 €/ha)	Single Area Payment Scheme (SAPS) (72 €/ha)	Direct Payments of 55 € for maintained land, 71 € for agricultural land	Single Farm Payment (SPS),	Single Payment Scheme (SPS), Energy Crops Aid (45 €/ha)
Subsidies for SRP	55 €/ha – but *not* the flat-rate as listed above → overall support for SRP is therefore lower than for other commodities	No particular support for SRP yet	2,500 € / ha for the foundation of SRP	2,200 € / ha for afforestation, that means also for foundation of SRP	2,900 €/ha 100% establishment grant, provided by Dept. of Agri. and Rural Develop., Forest Service	In Veneto Region: Up to 2,500 €/ha for max. 4 ha (not to be combined with EU or other aid).
Area of SRP (ha) or energy value (TJ) of SRP	5,500 (small areas, mainly experimental)	0 (only expermtl.)	100 ha	0 (only expermtl.)	15.9 TJ	1,350 TJ

Bulgaria

In Bulgaria no subsidies for energy crop production are available yet. The subsidy available in direct payments for rape seeds is 125,000 € for 2006 (compared to 2,800,000 € for wheat and barley.

8 TRADING STRUCTURES

Tab. 8 Trading patterns

	Do farmers make **direct contact** with the processor / end-user or do **farmers sell their products to traders** who then sell the biomass to the end-user?	Local, national or export-based market?	Increased demand in one region?	Is current trading structure suitable for SRP biomass?
Poland	Both trading patterns in use. Coal wholesalers serve as traders, buy wood from auctions organised by Government Forests.	Local and global: imports from: Belorussia, Ukraine and Slovakia Wide-spread biomass use for local heating (bought locally).	Not particular. General growing of the market, increased demand.	-
Estonia	Both trading patterns in use	Most produced peat, pellets and 13.4 % of firewood are exported	Near harbours due to export	No experience yet. Direct contacts prefered.
Czech Republic	Rather direct contact.	In some cases (forest wood, wood pellets) export-based	Increased demand in regions where co-firing occurs, significant price distortions.	Very few contacts between potential producers (farmers) and end users. Farmers lack awareness of their selling opportunities. Fear of not having a reliable buyer is large barrier for potential SRP farmers.
Slovakia	Farmers sell they products via traders	Export-based (90 % destined for export)	In several regions higher prices can be observed thanks to export demand	Yes
Northern Ireland	Only one trading structure within Northern Ireland, operated by Rural Generation Ltd. Company supplies wood-fired boilers in addition to dried wood chip, furthermore planting and harvesting services, as well as designing and installing dirty water irrigation systems and sewage sludge injection systems.	Demand is largely from small-scale (hotels, leisure centres) commercial markets. Willow biomass should be generated within approximately 15 miles radius of end-user		

Export tendencies

Generally it can be said that in countries with general “lower income” (new member states) strong export tendencies can be observed. In the Czech Republic, for example, two thirds of the pellets and briquettes produced are exported to Austria or Germany (90,000 t out of 137,000 t in 2004). In Poland 97 % of all produced pellets have been exported (114,000 t out of 120,000 t) in 2004. In relative prices, wood pellets are quite an expensive fuel for Czech or Polish households, whereas heating with wood pellets in Austria is financially advantageous compared to “conventional” fuels, such as gas. Wood pellets in the Czech Republic are

especially high due to the fact that they are not exempt from VAT, moreover the production costs are relatively high. In any case it is important to notice this difference in relative prices which leads to export tendencies. The same applies for forest wood, which is fairly expensive to exploit and which is also predominantly designated for export. **This increased export demand can lead to short-term biomass shortages** and **price increases** in the exporting country, which can destabilise the local biomass market, however, in the long-term a high export demand will **encourage the increasing of biomass producing capacity** which allows good prospects for SRP.

A closer look – biomass market and trading situation in Italy

The market

- pellets from industrial waste wood only commodity for which market exists
- well developed market, 41 pellet producers with an installed capacity of > 20 000 t/year
- constant growth in pellet production and boilers sale (the latter increased by 30 % in the last 1-2 years)
- the use of forest residues is limited, reason being high drying costs
- 80 % of biomass production located in the North of Italy

The industry

The market for wood pellets is very concentrated, with two large producers producing more than 20,000 t/year (360 TJ), three companies manufacturing about 8-10,000 t/year and the remaining producers producing only small dimensions.

There are many small producers, whose businesses are limited at local or regional scale. Local stove and boiler producers sign agreements with pellet producers to ensure a safe supply for their boiler customers. The market is localised – small pellet producers producing on local or regional scale.

Barriers for increased use of SRP

- no economic incentive for farmers to plant SRP, fear of long-term commitment (10-15 years), no contracts fixed yet
- natural limiting factors: soil rich in clay (difficult transport → limited harvest period), lack of water in Central and Southern Italy

Future outlook

- the wood manufacturing industry is facing shortages of raw materials (increasing importing costs etc.) and can therefore be expected to increasingly depend on SRP
- dissemination activities towards the energetic use of biomass (supported by the trade union Confagricoltura)
- two Governmental-Regional programming agreements might give hope to an increased energetic use of biomass: i) the Programming Framework on energy and the environment between the Lombardy Region and the Ministries of the Environment and Treasury (2001); ii) the Programming Agreement between MATT and the Abruzzo Region (2004), whose scope is to valorise biomass in Abruzzo.
- successful example has been set: 6 MW-CHP in Lombardy Region that among other biomass uses wood of 1,500 ha of poplars

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These are the references and sources used by the author of the report, the partners' references are included – if available – in the annex.

ANNEXES

A1 Extracts from filled-in questionnaires from individual countries

Poland

Tab.: Demand, potential and prices for renewable primary products

	Biomass production (GJ/y)	**Current market price (€/GJ)**	**Yield of biomass (GJ/ha/y)**	**Technical Potential (PJ)**
Biomass for electricity and/or heat production				
Wood-chips	5,230,000	4.5		
Wood -pellets	1,260,000	4.5-5.2		3.5
Forest residues	25,184,000	3.75		18
Other wooden biomass – please specify	11,532,000			11.5
Energy crops (Miscanthus etc.)	-		100	
Straw	96,200,000	2.25	25-39	130.2
Other – please specify - hay	1,300,000	2.50	65	
SRP	(5,500 ha)			294
Grown biomass used for the production of biofuels (bioethanol, methylester etc.)				
Rape seed	12,315,000	8.76	62.5	25
Sugar beat	0			
Wheat	0			
Sunflower	0			
Potatoes	-			
Other – rye	5,950,000	4.7	46.4	5.95
Other - maiz	900,000	4.7	105.5	5.00
Total of biomass for biofuels	19,165,000			55.95
Grown biomass used for industrial purposes (eg. pulp and paper industry, timber industry)				
SRC, Energy crops	-			
Forest wood	46,953,600	4-6		50
Other – please specify - straw	176,976,000	2-3	25-39	
Total of biomass for industrial purposes	223,929,600			
Grown biomass used for the production of biogas				
Total of biomass for biogas	0			

Tab.: For comparison – local market prices for fossil fuel , Euro

	Coal	**Light fuel oil**	**Heavy fuel oil**	**Natural gas**
Euro/GJ	5.57	18.28	4.81	7.71

1 Euro = 4 PLN

Tab.: Technical requirements for utilisation of agricultural biomass

	Private heating systems	**Industrial heating systems**
Emission limits SO_2 CO CxHy PM_{10}	To 100 MW: 800 mg/m^3 not determined in norms not determined in norms not determined in norms not determined in norms	To 100 MW: 800 mg/m^3 not determined in norms not determined in norms not determined in norms not determined in norms
Technical standards for solid biofuels	not determined in norms	not determined in norms
Chlorine content (PCDD/PCDF)	not determined in norms	not determined in norms
Harmful substances - halogenated hydrocarbons - heavy metals - toxic substances	not determined in norms	not determined in norms
Other – NO_x	To 500 MW: 600 mg/m^3 to 31.12.2007 400 mg/m^3 1.01.2008-31.12.2015[1)]	To 500 MW: 600 mg/m^3 to 31.12.2007 400 mg/m^3 1.01.2008-31.12.2015
Other – dust particles	To 500 MW: 100 mg/m^3	To 500 MW: 100 mg/m^3
Other – biomass standards for biofuel from auctions		Calorific value>8 GJ/t Moisture<40% Granulation<10 mm Or granulation>120 mm
Other – wood chips		Calorific value>7 GJ/t Moisture<60% Ash<1%

[1)] Actual value for new sources

Tab.: Tendencies of market development towards the use of renewable primary products – technologies

	Current use			**Future trend**		
	Number of installations 112 360	Installed capacity		Number of new installations planned 25 300	Planned installed capacity [1)]	
		MW_{el} 5 150	MW_{th} 2 180		MW_{el} 1 020	MW_{th} 2 860
Total Heat generated [TJ]		-	103 750 TJ	25 000	-	29 520
Total Electricity generated		2 846GWh	-	300	10 000	-
Please try to further specify the technology						
Biomass heating	110 395		6 065 MW_{th}	25 000	0	10 000
Steam turbine	4	109 MW_{el}	220 MW_{th}	20	32	94
Gas turbine	0			20	20	44
Combined cycle gas turbine (gas turbine combined with steam turbine)	0			40	140	310
Combustion engine	19			180	800	1 800
Microturbine	0	0	0	?-	25	75
Stirling motor	0	0	0	?-	?-	?-
ORC cycle	0	0	0	?-	?-	?-
Fuel cell	0	0	0	?-	?-	?-

Combined heat and power (CHP)[4]

- Installed capacity = 7,330
- Planned capacity = 11,210

Co-firing

- Installed capacity = 50[2] MW
- Planned capacity = 600[3] MW

[1] To 2010 according to Renewable Energy Strategy

[2] Part to biomass combustion

[3] To 2010 for biomass combustion part

[4] Obviously, many of the above listed technologies might be run as CHP; here the total figure of CHP

Tab.: Available subsidies

	From: **National sources** (Ministry of Environment, other)[2)], Euro[3)]	From: **EU-funds**[1)], Euro
Non-food production		
Set-aside land	74.94	63.15
Grassland	74.94	63.15
Growing of willow, poplar	55	0
Growing of other energy crops (e.g. Miscanthus)	0	63.15
Rape-seed (Methylester)	74.94	63.15
Hemp (Canabis sativa L.)	74.94	63.15
Other – rosa multiflora	55	0
Food-production		
Wheat	74.94	63.15
Sugar beat		63.15
Rape-seed (oil production)	74.94	63.15
Sunflower	74.94	63.15
Other agricultural production - hop	250	63.15
Other agricultural production - rye	74.94	63.15

[1)] land subsidy

[2)] supplementary subsidy

[3)] 1 Euro = 4, 00 PLN

Level of existing trading structures

Biomass trade has begun to develop since 2004. There are a few power stations and heating plants on this market. They make biomass auctions. The transport firms and coal wholesale traders start: buy wood from Government Forests (mainly on auctions organized by Government Forests), make chips from wood, and supply them to power stations, and heating plants. They are acting as brokers. Some enterprises involved into energy production grow willow plantations themselves. The other make contracts directly with farmers. Big boiler houses (e.g. 8 MW) organize special own service units for: straw harvesting on farmers field, transport, storage and supplying straw to the boiler.

The biomass trade structure in Poland is both local and global. There is an import from: Belorus, Ukraine and Slovakia. The biomass brokers are preparing for briquette production, for supplying the demand from power stations and heating plant.

There is existing very strong local demand on biomass in Poland. More and more energetic enterprises are preparing to the biomass cofiring. There are plans for small heat and power plants building. The biomass market in Poland is still in creation phase. It seems that there will be different market models. Now there are two main trends:

- Brokers which are preparing biomass from energy plants (chipping, briquetting)
- Direct contacts between farmers and heating plants (especially for big straw market)

Slovakia

Demand, potential and prices for renewable primary products

Source: Proposal for Conception of agricultural and forest biomass for energetic purposed utilisation, approved by Government of SR, December 2004

Data in the first column, starting from straw (agriculture biomass) represent potential yearly production suitable for energetic purposes – as the real present use is minimal and only at experimental sites up to now.

	Total Biomass production (GJ/y)	**Current market price (€/GJ)**	**Yield of biomass (GJ/ha/y)**	**Technical Potential (PJ)**
Biomass for electricity and/or heat production				
Wood-chips	1,250,000	2.800	90	
Wood -pellets	370,000	5.135	90	
Wood briquettes	700,000	5.714	90	
Forest residues	7,300,000	2.000	90	16.9
Indus. wood residue	11,500,000	0.600	90	26.5
Wood from SRP (no matter whether used as chips, pellets or other purposes)	0	0	0	22
Energy crops (Miscanthus etc.)	0	0	0	
Straw (from cereals)	10,400,000	0.700	37.948	?
Maize straw	9,400,000	1.756	83.024	
Sunflover	2,800,000	0.900	45.818	
Rape straw	2,900,000	0.588	28.155	
Residue - orchard	3,100,000	3.90 2.00 2.01 2.00	38.750	
- vineyard				
- pasture				
Total of grown biomass (in case you could not specify individual categories)	28,600,000		39.776	
Grown biomass used for the production of biofuels (bioethanol, methylester etc.)				
Rape seed	?	?	?	11
Sugar beat	0			
Wheat	0			
Sunflower	0			
Potatoes	0			
Other – please specify	0			
Total of biomass for biofuels	?	-	-	11
Grown biomass used for industrial purposes (e.g. pulp and paper industry, timber industry)				
SRC	0			-
Energy crops	0			?
Forest wood	5,900,000 m^3 (wood consumption in wood processing and paper industry)	?	?	?
Other – please specify	0			
Total of biomass for industrial purposes				

	Total Biomass production (GJ/y)	**Current market price (€/GJ)**	**Yield of biomass (GJ/ha/y)**	**Technical Potential (PJ)**
Grown biomass used for the production of biogas				
Maize	0	0	0	
Grass	0	0	0	
Other – animal excrements	6.9	0	0	
Total of biomass for biogas	0			

Tab.: For comparison – local market prices for fossil fuel

	Coal	**Light fuel oil**	**Heavy fuel oil**	**Natural gas**	
Euro/GJ	3.333	14.881	--------	10.312	

Tab.: Technical requirements for utilisation of agricultural biomass

	Private heating systems	Industrial heating systems
Emission limits dust SO_2 NO_x CO CxHy PM_{10}	No limits at present	 250 $mg.m_r^{-3}$ 200 $mg.m_r^{-3}$ 650 $mg.m_r^{-3}$ 850 $mg.m_r^{-3}$ 50 $mg.m_r^{-3}$. ----------
Technical standards for solid biofuels	----------	No specific norm is valid in Slovakia for solid biofuels, DIN, ONORM or prepared EU norms are used by producers
Chlorine content (PCDD/PCDF)		?
Harmful substances - halogenated hydrocarbons - heavy metals - toxic substances	----------	No specific norm is valid in Slovakia for solid biofuels, DIN, ONORM or prepared EU norms are used by producers
Other – please specify	--------	

Tab.: Tendencies of market development towards the use of renewable primary products – technologies

	Current use					**Future trend**				
	Number of instal-lations	Installed capacity		Energy generated (per year, eg. 2004)		Number of new installations planned	Planned installed capacity [1)]		Planned energy generated (per year)	
		MW_{el}	MW_{th}	GWh (El.)	PJ (Heat)		MW_{el}	MW_{th}	GWh (El)	PJ (Heat)
Total Heat 2004	400	-	1,350	-	9.817*		-			89.9**
Total Electricity 2003	4	21.4 (2002)	-	153 (2002)	-	4		-	1300	-
Please try to further specify the technology										
Biomass heating	400	-		-			-		-	
Steam turbine	?									
Gas turbine	?									
Combined cycle gas turbine	?									
Microturbine	0									
Stirling motor	0									
ORC cycle	?									
Fuel cell	?									

*„Proposal of an utilization conception for agricultural and forest biomass to energy“, Report No 2297 / 2004-100, Ministry of Agriculture of the SR

**Proposal of biomass potential for energy sector in 2020, Ministry of Agriculture of the SR

Co-firing p**lanned capacity** 20 % of installed capacity (330 MWt) in Zvolen heat plant and 30 % of installed capacity in 98 MWe fluid boiler ENO-A in Nováky Power Plant

Tab.: Subsidies available in your country

	From: **National sources** (Ministry of Environment, other) (e.g. €/ha)	From: **EU-funds,** (e.g. €/ha)
Non-food production		
Set-aside land	?	?
Grassland	4,133 Sk/ha	
Growing of willow, poplar	Costs for afforestation of agricultural land (1st year) – 84,000 Sk/ha, 80 % EAGGF, 20 % state budget No subsudies for growing in present	
Growing of other energy crops (eg. Miscanthus)		
Rape-seed (Methylester)	-	-
Hemp (Canabis sativa L.)	-	-

- Since 1. 5. 2004 direct flat-rate subsidies (SAPS) for ha of used agriculture land is 2 099.70 SKK /ha from EAGGF.
- POP payments co-financing EU and SR – 2,717.40 SKK /ha

Level of existing trading structures

Existing trading patterns in the field of biomass for energy use – do farmers make **direct contact** with the processor / end-user (industry; power and heating plant operators, CHP operator etc.) or do farmers sell their products to traders who then sell the biomass to the end-user?

- Farmers sell their products to traders who then sell the biomass to the end users

Is the trading structure **local** (=short distances between location where biomass is generated and end user) or **national** or **export based**?

- Export based (90 %)

Is there increased demand for biomass in one region (eg. due to large co-firing power plants, export etc.)

- NO, in more regions due to biofuel producers, or export

Is the **current trading structure suitable for SRP biomass?** or should new concepts (as for example direct contacts between biomass producer and end user) be introduced?

- Yes, it is suitable.

Czech Republic

Tab.: Demand, potential and prices for renewable primary products

	Biomass production (GJ/y)	Current market price (€/GJ)	Yield of biomass (GJ/ha/y)	Technical Potential (PJ)
Biomass for electricity and/or heat production				
Wood-chips	8,043,981	1.83	-	13.5
Wood -pellets	720,000	6.96	-	?
Forest residues	2,250,000	3.60	-	64.1
Wood from SRP	10,000	3.2-5.7	50-190	11.25
Energy crops (Miscanthus etc.)	50,000	3.4	45-135	240
Straw (corn)	40,000	3.34	?	6.1
Straw (rape seed)	200,000	3.34	60	9.8
Cellulose residuals	8,408,747	?	-	?
Grown biomass used for the production of biofuels (bioethanol, methylester etc.)				
Rape seed	1,313,000 (MPO)	?		9
Bioetanol	0			18
Total of biomass for biofuels	1,313,000 (MPO)			
Grown biomass used for industrial purposes (eg. pulp and paper industry, timber industry)				
SRC	0			
Energy crops	-			
Forest wood	?			
Waste wood	2,000,000	1.8	-	-
Grown biomass used for the production of biogas				
Total of grown biomass for biogas (mainly energy crops)	0 (current biomass plants are based on animal or communal waste)			10

Size of set-aside land in your country: 0.5 Mil. ha Set-aside land in % of total arable land: 14 %.

Tab.: For comparison – local market prices for fossil fuel

	Coal	Light fuel oil	Heavy fuel oil	Natural gas	
Euro/GJ	1 – 3.1	14	--------	9.13	

Tab.: Technical requirements for utilisation of agricultural biomass

	Private heating systems	**Industrial heating systems**
Emission limits SO_2 CO CxHy PM_{10} Nox dust particles	n.d.	 250 250 50 - 650 250
Technical standards for solid biofuels		
Chlorine content (PCDD/PCDF)	n.d.	n.d.
Harmful substances - halogenated hydrocarbons - heavy metals - toxic substances	n.d.	n.d., unless chemically treated wood is used. In this case the wood is considered as hazardous waste
Other	CEN/TS 14588 (terminology and definitions is in place)	

Tab.: Tendencies of market development towards the use of renewable primary products – technologies

	Current use					**Future trend**	
	Number of installation	Installed capacity		Energy generated (per year, 2004)		Planned energy generated (el. + heat combined) (PJ)	
		MW_{el}	MW_{th}	GWh (El.)	PJ (Heat)	Target 2010	Target 2020
Total Heat		-		-	37.9		
Total Electricity			-	592.7	-		
Total heat and el (PJ)					42.1	110	207
Of which							
Biomass households				-	19.5		
Biomass other than households				592.7	18.5		
Biofuels					1.31 transp		
Split according to biomass source							
Biogas					0	5	9
Ethanol					1.31	7	18
Metylester						5	7
Grown biomass						25	105
SRP						4	8
Straw						20	30
Firewood						14	18
Wood waste						10	12

Co-firing Installed capacity ca. 20 MW (biomass share), electricity generated: ca. 1000 GWh (2004) Planned capacity: not known

Tab.: Available subsidies

	From: **National sources** (Ministry of Environment, other) (€/ha)	From: **EU-funds** (€/ha)
Non-food production		
Grassland		
Growing of willow, poplar	2500 (for creation of plantation)	
Growing of other energy crops (eg. Miscanthus)	172.4	-
Rape-seed (Methylester)	Being decided at the moment	
Hemp (Canabis sativa L.)		
Bioethanol production	Subsidy programme being prepared at the moment (subsidy given out through tender procedure)	
Food-production		
Wheat	63 €/t	

Sources:

Czech Statistical office

Prognosticating the long-term potential for renewable energy in the Czech Republic, 2003 (VaV/320/10/03), Czech Ministry of the Environment

Váňa, Biomasa pro energii (1) Zdroje, 2002, www.biom.cz (straw potential)

Abraham, Kovářová, Kuncová, 2004, Ekonomika a konkurenceschopnost biopaliv, www.biom.cz

Statistics for Renewable Energy Sources 2004, Czech Ministry of Trade and Industry

Italy

Tab.: Demand, potential and prices for renewable primary products (see next page)

	Biomass production (GJ/y)	**Current market price (€/GJ)**	**Yield of biomass (GJ/ha/y)**	**Technical Potential (PJ)**
Biomass for electricity and/or heat production				
Wood-chips	384×10^3	3.00	192	?
Wood –pellets	3.16×10^6	10.12	192	?
Forest residues	-	3.00		168
Other wooden biomass – please specify - firewood	189×10^6	5,40	?	?
Wood from SRP (no matter whether used as chips, pellets or other purposes)	1.35×10^6	2.8	170	?
Energy crops (Miscanthus etc.)	Produced only in field trial	-	259	
E.crops (Panicum virgatum)	Produced only in field trial	-	172	
E.crops (Sorghum)	Produced only in field trial	-	336	
E.crops (Arundo donax)	Produced only in field trial	-	255	
E.crops (Cardoon)	Produced only in field trial	-	124	
E.crops (Kenaf)	Produced only in field trial	-	158	
Straw	-	2.5	96	233
(Agricultural residues)	133.43×10^6	Transport cost		237.99
(Agri-industrial residues)	20.46×10^6	0.9	?	25.12
Residues from wood industry	98.6×10^6	0.83	?	210
Residues from paper industry	2.55×10^6	0.83	?	4.59
Total of grown biomass (in case you could not specify individual categories)				
Grown biomass used for the production of biofuels (bioethanol, methylester etc.)				
Rape seed	22×10^3	10 - 19	26	See sunflower
Sugar beat	20×10^3	16.9	112	See wheat
Wheat	5.0×10^6	14.43	31	2.52
Sunflower	259×10^3	11 - 14	41	22.8
Potatoes				
Other – please specify -Fruit -Molasses -wine	-		?	0.099 0.142 0.140

	Biomass production (GJ/y)	**Current market price (€/GJ)**	**Yield of biomass (GJ/ha/y)**	**Technical Potential (PJ)**
-wine derivates -Cereals				0.101 0.052
Total of biomass for biofuels				
Grown biomass used for industrial purposes (eg. pulp and paper industry, timber industry)				
SRC	945 x 10^3	2.8	270	
Energy crops	-			
Forest wood	28.97 x 10^6	3.00		
Other – please specify				
Total of biomass for industrial purposes	35.87 x 10^6			
Grown biomass used for the production of biogas				
Maize	-			6.48
Grass	-			
Other – please specify	-			
Total of biomass for biogas	-			

Size of set-aside land in your country: _219.1 x 10^3 ha_ Set-aside land in % of total arable land: _2.6__

Tab.: For comparison – local market prices for fossil fuel

	Coal	**Light fuel oil**	**Heavy fuel oil**	**Natural gas**	
Euro/GJ	9.69	7.18	6.89	13.92	

Tab.: Technical requirements for utilisation of agricultural biomass

	Private heating systems	**Industrial heating systems**
Emission limits SO_2 CO CxHy PM_{10}	 No limits No limits Not required No limits	 200 mg/Nm3 200 mg/Nm3 Not required 30 mg/Nm3 (total dust)
Technical standards for solid biofuels	Combustion	Combustion
Chlorine content (PCDD/PCDF)	Not specified	Not specified
Harmful substances - halogenated hydrocarbons - heavy metals - toxic substances	 Not specified Not specified Not specified	 Not specified Not specified Not specified
Other – please specify	-	Total Organic Carbon, NO2

Private heating < 35 kW

Industrial heating > 20 MW

DPCM 8/03/2002 Decree of the Ministry Council President: Discipline of the combustible characteristics with relevance for the atmospheric pollution and technical characteristics of combustion plants

Tab.: Tendencies of market development towards the use of renewable primary products – technologies

	Current use					Future trend				
	Number of instal-lations	Installed capacity		Energy generated (per year, eg. 2004)		Number of new installations planned	Planned installed capacity [1)]		Planned energy generated (per year)	
		MW_{el}	MW_{th}	GWh (El.)	PJ (Heat)		MW_{el}	MW_{th}	GWh (El)	PJ (Heat)
Total Heat	41	-	193	-	167.44		-			
Total Electricity	31	312	-	3.63 x 10^3	-		60	-	324	-

Tab.: Available subsidies

	From: **National sources** (Ministry of Environment, other) (e.g. €/ha)	From: **EU-funds,** (e.g. €/ha)
Non-food production		
Set-aside land	-	Decoupled
Grassland	-	-
Growing of willow, poplar	- provision of Veneto Region for afforestation for Energy, see below	
Growing of other energy crops (e.g. Miscanthus)	-	45 (carbon credit)
Rape-seed (Methylester)	-	45 (carbon credit)
Hemp (Canabis sativa L.)	-	
Other – please specify Sunflower corn	-	45 (carbon credit) 45 (carbon credit)
Food-production		
Wheat	-	Decoupled
Sugar beat	-	Decoupled
Rape-seed (oil production)	-	Decoupled
Sunflower		Decoupled
Other agricultural production		Decoupled

Due to the CAP (Community Agricultural Policy) Reform which has introduced the decoupling of the subsidy, a single farm payment for EU farmers, independent from production, is provided and, depending on specific decision for each country, a limited

coupled elements may be maintained to avoid abandonment of production. Italy has chosen the full decoupling, therefore no specific subsidy is provided for different crops. For energy crop a carbon credit of 45 €/ha is provided by EU for a total amount of 1,500,000 ha all over Europe.

With reference to Short Rotation Plantation some specific agricultural provision were provided by the Regional Development Plan (2000-2006) (Veneto, Molise, Lombardia, Piemonte, Friuli Venezia Giulia) and at the moment new RDP are under discussion for the years 2007-2013, but no information is available at this stage. Only Veneto Region as set some provisions (not cumulative with EU or other aid) in the Regional Law n. 14, 2/05/2003: Agri-forestry interventions for biomass production („This regional law promotes and foster the agri-forestry-energy production chain by providing specific contribution for wooden plantation for energy purposes, or for dedicated biomass plantation within a range of minimum 0.3 and maximum 4 hectares. Beneficiaries are all the subjects entitled to farm agricultural land in the Veneto Region. The contribution cover all the cost spent actually for the plantation up to 2,500 €/ha. Permanent grassland and grazing land are excluded".