



**4FCROPS**

**Future Crops for  
Food, Feed, Fiber and Fuel**

## WP5 Regulatory framework (CRES)

### Deliverables 15

**CRES, Biomass Department**



## Summary

In WP2 of 4FCROPS the most promising non-food cropping systems were proposed and analyzed for a total number of 15 non-food crops (annual and perennial ones) that were selected as the most promising for biofuels production (liquid and solid) as well as for fiber production. Policies and driving forces both at European and national level play important role in the successful establishment of non-food cropping systems in EU agriculture.

In WP5 the regulatory framework for non-food crops was investigated. The work in WP5 started with the record of the existing policies and driving forces of the fibre and fuel crops in both European and national level and the information that had been collected presented in the Deliverable 15 entitled "Report on existing policies".

The main European policies on EU level were: *White Paper on energy policy, White Paper on RES & Action Plan, Green Paper on security of energy supply, Directive 2001/77/EC on renewable electricity, Directive 2003/87/EC on emission trading, Directive 2003/30/EC on liquid biofuels, Directive 2004/8/EC on cogeneration, 2008/109/EC and the New Renewable Directive (2009/28/EC).*

At the same time the national supports were established for the cultivation of energy crops in some European countries such as: for cultivating rape seed in Finland and for the establishment of willow in Sweden.

It is estimated that in 2007 the total cultivation area of energy crops was 4 Mha that is mainly referring to the cultivation of rapeseed for biodiesel production and cereals for bioethanol production. These crops were cultivated in order the target of 5.75% biofuels by 2010 to be achieved. The bigger part of this area was subsidized with 45 Euros per ha, while at the same time set aside land as well as land that have been realized through CAP reform was also used.

It should be pointed out that a total area between 50,000 and 60,000 ha is being cultivated for the production of solid biofuels from rapeseed, willow, poplar and miscanthus. This area is expected to be increased in the future taking under consideration that the National Biomass Action Plans that each members state was adopted.

The most crops that cultivated in EU27 for fibre production are: flax, hemp and cotton. It is reported that in 2007 the total area of cultivation for flax was 78500 ha, for fibrous hemp was 18750 ha, while for cotton was 460000 ha.

## 1. Review of existing policies for non-food crops in EU27

### Policies

The cultivation of non-food crops (for both fibre and fuel production) is not a new concept but their market remain disorganised. Bioenergy is of major importance because it is having been estimated to have the greatest technical potential in short and medium-term in Europe among the renewable energy resources. Bioenergy can contribute to energy security, to boost economy, and to reduce environmental impacts including global warming.

The main policies that so far have been promoted the Bioenergy and the biofuels are:

- **White Paper on energy policy**
- **White Paper on RES & Action Plan**
- **Green Paper on security of energy supply**
- **Directive 2001/77/EC on renewable electricity, Directive 2003/87/EC on emission trading**
- **Directive 2003/30/EC on liquid biofuels, Directive 2004/8/EC on cogeneration.**
- **A special subsidy of 45 Euros/ha for cultivating energy crops, Council Regulation (EU), 1782/1003.**
- ***2008/109/EC and the New Renewable Directive (2009/28/EC) - Biomass Action Plan***

The promotion of electricity from renewables is high priority in European Union for three main reasons; it includes the security and diversification of energy supply, the environmental protection and social and economic cohesion. The Directive 2001/77/EC follows up the White Paper on renewables that set a target for 12% of gross inland energy consumption from renewables for EU-15 by 2010 and the electricity represented 22.1%. This target was reduced to 21% with the EU enlargement in 2004. This directive concerned the electricity produced from non-fossil renewable energy sources; wind, solar, geothermal, wave, tidal, hydroelectric, biomass, landfill gas, sewage treatment gas and biogas energies. Through this directive was also constituted an essential part of the measures needed to comply with the commitments made by EU under the Kyoto Protocol on the reduction of the greenhouse gas emissions.

In 2005, RES electricity accounted for about 15% of the total EU consumption. Based on current policies and actions, the Commission believes that this figure will reach 19% in 2010 that is very close to the target for 21% electricity from RES in EU25 {COM(2006)}.

It should be mentioned that the progress varied a lot among the EU countries and there were countries such as Germany, Denmark and Spain that are on course to achieve their 2010 targets, while other countries like

France, Italy and Austria were far from being so. It is reported that the electricity produced from biomass covers only the 2% of the total EU production and its growth has been accelerating in recent years.

**Kyoto protocol** is the chief instrument for tackling climate change. It contains the undertaking entered into most of the industrialized countries to reduce their emissions of certain greenhouse gases (which are responsible for global warming) by an average of 5% compared to the levels of 1990 during the period 2008 to 2012.

The Kyoto Protocol tackles emissions of six greenhouse gases: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>).

The EU members between 2008 and 2012 have to reduce their emission by 8%. The Kyoto protocol entered into force in 2005 and several industrialized countries have refused to ratify the protocol (such as USA, Australia).

EU has made significant progress in fulfilling Kyoto Protocol commitments mainly due to the implementation of the European Climate Change Programme as well as measures specific to certain sectors (transport, industry, energy, etc.) and additional domestic measures.

The **Directive 2003/30/EC** on liquid biofuels aimed to promote the use of biofuels or other renewable fuels to replace diesel or petrol for transport purpose in each member state. The directive sets a European target of 5.75% substitution of conventional fuels with biofuels by December 2010.

In this Directive there are two targets; 2% of all gasoline and diesel for transport purposes placed on their market by 31/12/05 and 5.75% by 31/12/2010.

The Directive aimed at increasing the share of renewable energy in the transportation sector (currently dominated almost entirely by fossil fuels) and to reduce emissions of CO<sub>2</sub>, CO, NO<sub>x</sub>, VOC (volatile organic compounds) and other particles harmful to human health and the environment.

The main types of biofuels were: bioethanol, biodiesel, biogas, biomethanol, biodimethylether, bio-ETBE, bio-MTBE, synthetic biofuels, biohydrogen and oil produced from oil plants.

In 2007 a progress report on the use of biofuels in EU member states was submitted and according to that the share of biofuels at the end of 2005 was 1% (instead 2% that was the original target) and it is reported also that the share of biofuels in 2010 will be 4% (instead of 5.75% that was the original target).

On 23 January 2008, the European Commission has published a Proposal for a Directive [COM (2008)19 final] on the promotion of the use of energy from renewable sources for the 27 European Member States. The directive is a part of the Energy and Climate package accepted by the European Council in December 2008 (This Directive is inside the Climate Package). This law will take the superior position in the renewable energy promotion. The Directive has been designed to boost the use of renewable energy in the EU to 20% by 2020. National targets are laid down in the Directive in order to

meet that goal. Additionally, each member state shall have a minimum, binding 10% target for the share of energy from renewable sources in transport in 2020. The Directive will stimulate both, the use of biomass for bioenergy and transportation biofuels for the next twenty years. Each member of the European Union had to prepare their own renewable energy action plan by 30/6/10. The Renewable Energy Action Plans are wonderful opportunities to influence the RES policy and energy crop support.

As mentioned above bioenergy is estimated to have the leading position in the development of renewable energy usage. The European Environmental Agency report (2006) showed that biomass from agriculture provides the largest bioenergy potential in a long-term. The environmentally-compatible bioenergy potential from agriculture could reach up to 142 MtOE by 2030, compared to 47 MtOE in 2010 (EEA 2007). This potential is contingent upon assumptions regarding the farmland area available for energy crop production in each member state, the competition with food and export markets, the impact of environmental constraints and the yield of the assumed bioenergy crops. Approximately 85% of the potential estimated by EEA will come from only seven member states (Spain, France, Germany, Italy, the United Kingdom, Lithuania and Poland). Total land area corresponding to the estimated potential is 14 Mha in the EU-25 in 2010 and app. 20 Mha in 2030. Three scenarios for 2010, 2020 and 2030 will be developed in order to estimate the available land for energy crops cultivation per European country. It should be mentioned that in the framework of the country renewable action plan a biomass action plan was also included.

It is expected that there will be a shift from first-generation biofuels (plant oil, biodiesel and ethanol from cereals, sugar beet or potatoes) into second-generation biofuel production from ligno-cellulosic material. The second-generation biofuels can use various feedstocks, including agriculture and forestry residues as well as dedicated energy crops.

**Perennial energy grasses (PEG)** and **short rotation coppice (SRC)** are key examples for such crops and usually characterized by high yields per hectare as well as mostly low environmental pressures. However, sustainable methods in biomass cultivation, harvesting, transportation as well as technological breakthrough in refining processes are needed before commercialization of these next generation biofuels from non-food feedstock can take place. It can be expected that the perennial energy grasses (switchgrass, giant reed, miscanthus, reed canary grass, etc) and the short rotation coppice (willow, poplar, salix, eucalyptus, etc) will become more important in the crop mixes in the future (probably in the next decade) when new technologies enter the market and bio-heat options are further developed. Despite the fact the cultivation of both PEG and SRC are considered as a very promising renewable energy option for the future their cultivation in Europe is still very limited. Current plantations are mostly grown on an experimental basis, with the exceptions of the UK, Sweden, Finland and to some extent Italy (Barto 2006). According to the investigation of AEBIOM (2007) the total area of perennial crops in the EU-25 amounted to some 50,000 ha in 2006. This included short rotation coppice and perennial

grasses. Short rotation coppice area mainly willow plantations in Sweden (12,500 ha), Poland (9,000 ha) and the United Kingdom (4,000 ha). Miscanthus is cultivated in Italy (7,500 ha), United Kingdom (4,000 ha), Austria (3000 ha) and Ireland (150 ha). In Finland there are considerable large areas of reed canary grass cultivated on peat lands (12,000 ha). Especially, for reed canary grass quite high targets have been set from the Finish Government for 2010 (150000ha).

Biofuels and bioliquids produced from waste and residues, other than agricultural, aquaculture, fisheries and forestry residues, need only fulfill the sustainability criteria set out.

An aid of **EUR 45 per hectare** was offered to farmers who cultivated energy crops. It was applied on a Maximum Guaranteed Area of 1500000 ha for the whole Europe. The farmers that received this subsidy were the ones that cultivated energy crops under a contract between the farmer and the processing industry concerned. This subsidy was introduced in 2004 as part of the Common Agricultural Policy in order to stimulate the biofuels production. In 2004 the total area of cultivation of biofuel crops was only 0.31 million ha, while in 2007 reaching 2.84 million hectares and the EU's €90 million budget is unable to cope and in October 2007 it was decided this subsidy to be reduced. In 2007 the farmers received this subsidy only for 70% of the land that claimed for this subsidy.

#### **Biomass Action Plan and NREAP**

Biomass Action Plan is a new energy policy with three main objectives: competitiveness, sustainable development and security of supply. The Biomass Action Plan identifies three sectors in which the use of biomass should be prioritized, namely heat production, electricity production and transport. In the transportation sector, the Biomass Action Plan set out the objectives of biofuels production; 5.75% in 2010 and 10% in 2020.

In terms of balancing domestic production and imports, the Commission's approach is to:

- ◆ Propose the amendment of standard EN 14214 to facilitate the use of a broader range of vegetable oils for biodiesel, to the extent feasible without significant ill-effects on fuel performance (the current standard indeed limiting the commercialization of biodiesel in the EU to rape methyl ester).
- ◆ Address the issue of amending the biofuels directive (directive 2003/30/EU) so that only biofuels whose cultivation complies with minimum sustainability standards count towards its targets.
- ◆ To maintain market access conditions for imported bioethanol in conformity with trade agreements currently in force.
- ◆ Pursue a balanced approach in ongoing free trade agreement negotiations with ethanol-producing countries/regions.
- ◆ Support developing countries that wish to produce biofuels their domestic markets.

## Area of cultivation of non-food crops in EU

In Europe (2007) the total cultivation area of non-food crops was 4Mha and is referring mainly to the cultivation of oilseeds and cereals.

The main mechanisms supporting the cultivation of non-food crops are:

- The support of 45 euro per ha
- The use of the set aside land as well as
- The common agricultural policy that released fields that used to be cultivated with other traditional crops.

In the figure below presented the area of cultivation of energy crops EU27 from 2003 until 2007 (Figure 1). In the table 1 presented in detail the cultivation area of energy crops for solid biofuels (source EnCrop project).

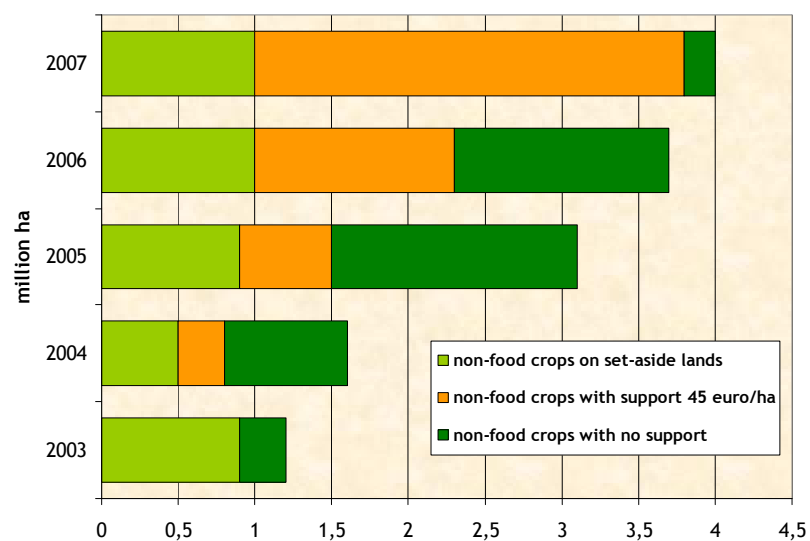


Figure 1. Area of cultivation of non-food crops in EU27

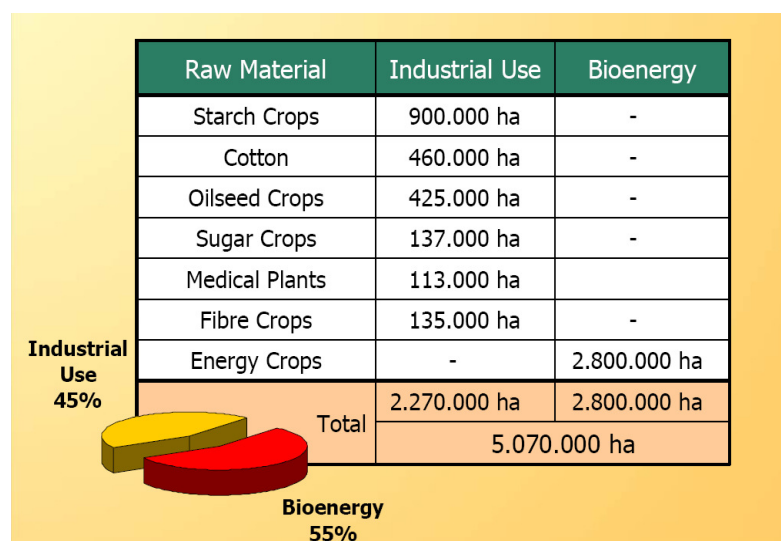


Figure 2. Area of cultivation of non-food crops in EU27 (in 2005)

In 2005 (source: FRN, ERMA) it had been estimated that the area of cultivation of non-food crops was 5070000 ha and 55% of this area was cultivated for bioenergy and the rest for industrial uses.

The most crops that cultivated in EU27 for fibre production are: flax, hemp and cotton. It is reported that in 2007 the total area of cultivation for flax was 78500 ha, for fibrous hemp was 18750 ha, while for cotton was 460000 ha.

**Table 1: Energy crops in different Member States (Jossart, 2009)**

Country	Crops	Driving forces	Pricing & Support schemes
<i>Sweden</i>	Reed canary grass - 6-700 ha Hemp - 800 ha Willows - 13-15,000 ha	CO2 tax of about 70 €/t Large market/demand for biomass Support scheme for SRF plantation (500 €/ha now)	Farmers receive a subsidy for establishment costs of the willow.
<i>Finland</i>	Reed canary grass - 20,000 ha	Large market/demand for biomass Mix with peat Emission Trading /biomass as zero emission factor	Agricultural subsidies for cultivating reed canary grass are the same as the subsidies for other field crops (500 - 700 €/ha/year).
<i>UK</i>	Willows - 4000 ha Miscanthus - 1000 ha	Limited wood resources Energy crop support schemes (800 - 1000 £/ha) ROCs for electricity-advantage for crops	
<i>France</i>	Willows - some 100 ha Miscanthus - 1300 ha	Sugar reform fund (64 M€ available) drying pulp Diversification from alfalfa pellets Waste water treatment/water table protection/sewage sludge	
<i>Denmark</i>	Willows - 3000 ha	High biomass price	
<i>Germany</i>	SRC - 1000 ha Miscanthus - 325 ha Crops for biogas - 500,000 ha	Electricity support schemes and bonuses Biogas in network Advanced biofuels	
<i>Austria</i>	SRC - 100 ha Miscanthus - 250 - 400 ha	Market for biomass/pellets Feed-in price for bioelectricity/biogas	Electricity production from biogas has a fixed feed-in tariff of between 11.30 cent/kWh (power > 1000 kW) and 16.95 cent/kWh (power < 100 kW) that is guaranteed over 10 years. In year 11 the plant owner gets 75 % of this feed-in tariff and in year 12, 50 %. For energy crops, the Austrian plant owners got an additional commodity bonus of 4 cent/kWh in 2008.
<i>Italy</i>	Miscanthus - 50 ha SRC - 5100 ha	Electricity support schemes (attractive for biogas) Sugar reform	Since January 2009, there is a green certificate mechanism that supports production of electrical energy only from utilisation of biofuels: small plants (< 1MW) receive a tariff of 0.22 €/kWh, whereas bigger plants receive the green certificates (based on a variable market price), plus an additional 10 % bonus.
<i>Poland</i>	Willows - 300 - 1500 ha	Agriculture potential Legislation on biomass for power (max % from forest wood)	
<i>Romania</i>	Willows - 50 ha	Land potential	



As it is presented in Table 1 pricing and support schemes are being reported in Sweden for cultivating willow, in Finland for cultivating reed canary grass, in Austria and Italy for energy crops in general.

The main energy crops that being cultivating for solid biofuels are: willow, poplar, reed canary grass and miscanthus (Table 1).

In Finland the agricultural subsidies for cultivating reed canary grass are the same as the subsidies for other field crops (500 - 700 €/ha/year). In 2007 the area of cultivation of reed canary grass was 20400 ha but in 2015 a target for 150000 ha has been set.

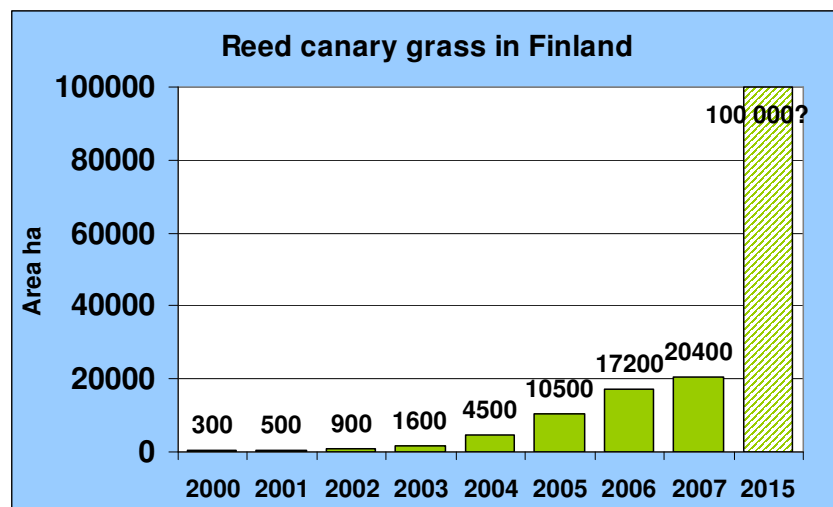


Figure 3. Area of cultivation of reed canary grass in Finland (source: Pahkala, Madrid workshop 2009)

In Portugal the area of cultivation for eucalyptus in 1995 was 675100 ha and in 2005 were 649800 ha. Eucalyptus in Portugal is being used for paper and pulp production only.

### Parameters that should be taken under consideration in the insertion of the non-food crops in EU27 agriculture

For successful *co-existence* of food and non-food crops it is quite crucial to not to cultivate these crops in areas that really needed for food and feed production. It should be started from the areas that are left fallow or set-aside or the lands that will be realized from the shift of previous cultivation (such as tobacco, sugar beets, cotton, etc).

The non-food crops that will be selected to be cultivated for fibre and/or fuel production it would be better to have alternative markets. For instance oil crops that will be cultivated for biodiesel production if can be consumed be the people when the biodiesel market will face problems can be shift to oil production for human consumption.

For the annual non-food crops it is quite important to could be included in the existing rotation systems in order to avoid the monoculture. In some cases the introduction of the non-food crops when inserted in the existing rotation systems could lead to yields increases of the traditional annual crops.

Important parameters that should be taken under consideration for the insertion of the non-food crops in the existing agricultural systems will be the **CAP 2020**, the scenarios for **Climate change**, the cultivation of the non-food crops should follow the **sustainability criteria**, the **life cycle analysis** as well as the **environmental analysis (biodiversity, soil erosion, greenhouse emissions, etc)** should be compared with the conventional crops and the scenarios of cultivate these crops in **Indirect Land Use Change** or **Direct Land Use Change** should be analyzed.