

# STUDY ON IMPLEMENTING THE ENERGY CROPS CAP MEASURES AND BIO-ENERGY MARKET

## Short summary

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### Objectives and scope of the study

The study provides:

- an analysis of the European Union (EU) bio-energy market;
- an evaluation of energy crops Common Agricultural Policy (CAP) measures: decoupling, non food on set aside regime, aid for energy crops, rural development measures (investments in agricultural holdings, processing and marketing of agricultural products, non-industrial processing and marketing of forest products/afforestation, adaptation of rural areas);
- an outlook for future market developments and policy recommendations.

It covers:

- the main sources of bio-energy: bio-ethanol, bio-diesel, bio-gas, direct burning of biomass;
- the main energy crops (rape seed, soybean, sunflower seeds, sugar beet, maize, barley, rye, potatoes, wheat, willow, miscanthus, grass), plus agricultural residues;
- the following sectors of bio-energy use: electricity, transport and heating.

The market analysis covers the EU-25, whereas the evaluation proper covers the EU-15, from 1992 to 2006.

### Methodology

The **market analysis** consists of a presentation of supply and demand of biomass and bio-energy, an analysis of pricing mechanisms for bio-energy, of the profitability and competitiveness of energy crops and bio-energy and an assessment of the effects on the reduction of CO<sub>2</sub> emissions and the saving of fossil fuels. It was based on the analysis of statistics from different sources, on estimates and on qualitative information from literature, public and private institutions, stakeholders and case-studies.

The general methodology applied for the **evaluation questions** was the following:

- Defining the models of intervention logic of the measures studied.
- Identifying the relevant issues, the judgment criteria and the related indicators.
- Collecting and elaborating the needed data and information (data from the market analysis; quantitative data on the implementation of the measures from DG AGRI; data on the profitability of energy crops from case studies; qualitative information on the implementation of rural development measures from literature and from public institutions).
- Formulating judgments for each evaluation question.

## Main features of the bio-energy market

The following table presents the 2005 levels of production and consumption of the different sources of bio-energy studied.

Sector of bio-energy use	Bio-energy source	EU Production level Mtoe** 2005	EU Consumption level Mtoe** 2005	Share of bio-energy (2005)	Sources
<b>Electricity</b>	From direct burning-solid biomass*	3,35	3,35	1,43% of total final consumption	EurObserv'ER
	<i>Of which from energy crops and agricultural residues</i>	<i>0,013</i>	<i>0,013</i>	<i>0,4% of electricity from direct burning of solid biomass</i>	<i>Estimates</i>
	From biogas	1,3	1,3	0,5% of total final consumption	EurObserv'ER
	<i>Of which from energy crops and agricultural residues</i>	<i>0,23</i>	<i>0,23</i>	<i>17% of electricity from biogas</i>	<i>Estimates</i>
<b>Heat</b>	From direct burning-solid biomass*	1,6	1,6	2% of total heat demand	<i>Estimates</i>
	<i>Of which from energy crops and agricultural residues</i>	<i>0,0064</i>	<i>0,0064</i>	<i>0,4% of heat from direct burning of solid biomass</i>	<i>Estimates</i>
	From biogas	0,424	0,424	0,6% of total heat demand	EurObserv'ER
	<i>Of which from energy crops and agricultural residues</i>	<i>0,063</i>	<i>0,063</i>	<i>15% of heat from biogas</i>	<i>Estimates</i>
<b>Transport</b>	Bio-fuels	3,33	n.a. (1,87 in 2004)	1,1% of total fuel consumption	EBB Statistics;
	Bio-diesel	2,87	n.a. (1,5 in 2004)	1,6% of diesel consumption	EurObserv'ER 2005;
	Bio-ethanol	0,46	n.a. (0,371 in 2004)	0,4% of petrol consumption	European Barometer of Ren.Energies; Ebio; DG Agri.

\* Excluding final consumption.

\*\* Mtoe = Million ton oil equivalent

The area under energy crops has been **increasing** over the last years, from about 235 000 ha in 1993, to 1 175 600 ha in 2003 and around 2 445 700 ha in 2005. The EU production of **bio-energy** has **increased rapidly** during the last years. From 1995 to 2005, the use of solid biomass for energy purposes increased by around 48%; in the same period the production of bio-gas almost tripled and that of bio-fuels increased almost tenfold. As regards bio-ethanol, around 0,13 Million ton oil equivalent are currently **imported from third countries** (mainly Brazil).

As regards the **electricity sector**, electricity generated from energy crops and agricultural residues is generally more expensive than electricity obtained from fossil fuels. When additional support by Member States pursuing Directive 2001/77/EC is considered, electricity from energy crops and agricultural residues becomes competitive with the other sources in a significant number of Member States.

As regards the **heating sector**, heat generated from energy crops and agricultural residues through direct combustion in boilers shows in some cases similar costs to heat generated from other biomass and from fossil fuels, strictly depending however on feedstock prices.

Finally, as far as the **transport sector** is concerned, both bio-diesel and bio-ethanol produced in the EU are seldom competitive with fossil fuels in the absence of support measures. Conversely, if support in terms of excise duty exemptions is granted, both bio-fuels may be placed on the market at competitive prices in most Member States. Finally, bio-fuel production costs in the EU are higher than those registered in other major producing countries, such as Brazil and the USA.

## **Conclusions of the evaluation questions**

### *Effects on the production of energy crops*

The area under the **aid for energy crops** has increased from around 305.000 ha in 2004 to 560.000 ha in 2005, reaching about 1,2 million ha in 2006 (provisional figure). It has been a decisive incentive to introduce energy crops **only** where market margins for the energy crops are negative or tight or wherever it makes an energy crop more profitable than the most common alternative (non energy) crop. This was observed in four cases in two regions out of ten cases studied in six regions. Therefore, the **effectiveness** of the aid for energy crops has been **limited to specific situations**<sup>1</sup>. In the other situations, it is probable that the aid for energy crops has some deadweight effects which diminish its efficiency. Indeed, other promoting factors have played an important role, in particular the **additional support** at Member State level and/or non-CAP support at EU level, and **favourable systemic factors** (e.g. organisation of the supply chain and availability of adequate infrastructures).

Around 835.000 ha of energy crops were cultivated under the **non food on set aside regime** in 2005. It acts as an **incentive** to the farmer to introduce the cultivation of energy crops through both the avoided cost of land maintenance (with respect to fallow set-aside), and the fact that on set aside land there is no feasible gainful alternative to the cultivation of non food crops. The rate of compulsory set aside on one hand, and the Blair House obligations on the other, are limiting factors to an increase in the cultivation of energy crops under this regime. However, within those two limits, the measure has been an **effective** incentive in promoting the primary production of energy crops. An advantage of the measure is that it achieves its effects with no additional cost for the EU budget.

### *Effects on the production of bio-energy*

Should the **non food on set aside regime** be terminated, the total supply of energy crops would probably decrease, to an extent which was not possible to quantify. The **aid for energy**

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<sup>1</sup> Here it is worth reminding that the scope of the evaluation is limited to the EU-15 and the period until 2006. Therefore it does not cover the 10 new Member States.

**crops** has had effects on the volume of bio-energy only where it has been decisive in introducing the energy crops. Therefore, the measures have had an **effect on the absolute level of the volume of bio-energy**, which was not quantifiable. As concerns **the increase in the volume of bio-energy which occurred between 2003 and 2005**, it cannot be explained by the sole expansion of energy crops under specific regimes, which have not played a decisive role in this respect.

The level of implementation of the **rural development measures** specifically related to bio-energy, as well as the number of supported projects was found to be very limited at the EU level. The effect of rural development measures on the volume of bio-energy has therefore to be considered **limited**.

The **synergies** identified between the aid for energy crops and the non food on set aside regime on one hand and the rural development measures on the other hand, have had effects on the volume of bio-energy to a **limited** extent, and have concerned only specific situations.

#### *Possible unintended effects*

The measures which have the potential to favour or to discourage the cultivation of certain kinds of energy crops are the following:

- in the pre-decoupling context, the **arable crop area payments** (non-eligibility for area payments of some kinds of energy crops and possible differentiated payments by type of crop);
- in the post-decoupling context, the **partially coupled payments**;
- the **specificity concerning energy sugar beet** before the reform of the CMO for sugar in 2006 (renounce to set aside payments under the non food on set aside regime; non eligibility for the aid for energy crops).

However, **none of the identified measures has caused in practice significant unintended effects on the relative shares of the different energy crops**.

The **aid for energy crops** could distort competition between energy and food/feed crops. However, the substitution of food/feed crops with energy crops seems to be mostly due to factors other than the measure (e.g. changes in price dynamics). Furthermore, such substitution has concerned only a very limited portion of the total usable agricultural area in the EU-15 (about 0,2% in 2004 and 0,4% in 2005). It can be therefore concluded that the aid for energy crops **has not caused significant distortions in the competition between energy crops and crops for food/feed use** at EU level over the evaluation period.

#### *Effects on the competitiveness*

The **aid for energy crops** can have direct effects on biomass prices, which were however found to be generally **too limited** to contribute significantly to allow energy crops and bio-energy gained from them being competitive to other energy sources. As regards the **non food on set aside regime**, its effects on price are only indirect ones, whose extent could not be quantified. However, some qualitative considerations suggest that its contribution has probably been **modest**. The **contribution of the measures to the competitiveness of the sources of bio-energy** is therefore **limited**: in the cases studied, the aid for energy crops corresponded, in the case of electricity generation from biomass, to 1,4% of the full cost of an energy unit and, in the case of bio-fuels production, to 4-6,5% of such cost. In comparison, in the cases studied, the additional support granted at Member State level corresponded, in the

case of electricity generation from biomass, to 19-62% of the full cost of an energy unit and, in the case of bio-fuels production, to 64-105% of such cost.

Indeed, it is **at present impossible**, with the available technologies and with the present levels of biomass prices, **that most of the bio-energy supply chains** under study **may survive without additional support at Member State level and/or non-CAP support at EU level** (feed-in tariffs, tax exemption, green certificates, etc.).

#### *Effects on farmers' income*

The contribution of the aid for energy crops and of the non food on set aside regime to the **diversification of income of farmers** has been **very modest**: the diffusion among farmers of the cultivation of energy crops under the two regimes has been very low. The **portion of farm income** that can be attributed to energy crops cultivation under the two measures was on average **not relevant** in nearly all the representative situations studied. Thus, the contribution of the measures to the **achievement of a fair standard of living for the EU farmers** has **not** been **significant**. Finally, the contribution of the two measures to the **creation/maintaining of jobs in rural areas** has also **not** been **significant**.

#### *Environmental effects*

In the scientific literature, the estimates on the **saving of fossil fuels** and the reduction of **CO<sub>2</sub> emissions** achievable through the use of bio-energy vary widely. The absence of a consolidated state of the art induced the evaluation team to focus on the sole consumption stage. As regards the **electricity** and the **heating sectors**, the contribution of the measures to the reduction of CO<sub>2</sub> emissions and the saving of fossil fuels can be considered **negligible**. As regards the **transport sector**, the upper limit of the contribution of the non food on set aside regime and the aid for energy crops to reduced CO<sub>2</sub> emissions and the saving of fossil fuels for the EU-25 was estimated in:

- A fossil fuel displacement of approximately 2,02 billion litres diesel (attributable to bio-diesel use) and 0,42 billion litres petrol (attributable to bio-ethanol use), corresponding to about 0,9% of total diesel consumption and to about 0,3% of total petrol consumption in the EU.
- A reduction of CO<sub>2</sub> emissions of approximately 1,76 Mt CO<sub>2</sub>, of which 1,49 Mt CO<sub>2</sub> avoided through the use of bio-diesel and 0,27 Mt CO<sub>2</sub> avoided through the use of bio-ethanol.

However, the actual contribution of the non food on set aside regime and especially of the aid for energy crops is probably **significantly lower**, because ~~the~~ only a share of the total volume of bio-fuels produced stems from the measures and because only the stage of consumption was considered in the analysis.

The cultivation of energy crops under the **aid for energy crops** has had, according to the available information, limited **environmental effects** over the evaluation period since it has mainly replaced conventional crops with similar agricultural techniques and similar environmental effects. The cultivation of energy crops under the **non food on set aside regime** (replacing fallow set-aside) may have led to a reduction of environmental risks as regards the nitrogen leaching and the organic soil content and to higher environmental risks as concerns pesticides, water quantity, and biodiversity. As regards soil erosion and carbon sink, a general trend could not be identified. The effects depend anyway widely on site-specific

conditions, and on the management of fallow set aside land with which energy crops are compared. As the area under the two measures represents a very limited share of the total EU-15 usable agricultural area (in 2005 less than 0,6% for the non food on set aside regime and 0,4% for the aid for energy crops), the environmental effects *at EU level* deriving from the two measures *until now* should be considered **limited**.

## Recommendations

1. Given the limited effectiveness of the **aid for energy crops** at its current level, a decision needs to be taken whether to **increase the amount** 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.
2. As the **non food on set aside regime** was identified as an effective instrument to achieve the objective of promoting the energy crops, its **continuation** is recommended, unless **other effective measures** are put in place (this concerns in particular measures that could allow overcoming the constraint of the Blair House Agreement).
3. Where a limited uptake of **rural development measures** specifically related to bio-energy is caused by a limited awareness of farmers about this possibility, improving the flow of related **information** is recommended.
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.
5. As the systems aimed at **monitoring** the implementation of the relevant policies during the evaluation period did not permit obtaining sufficiently specific data, 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 a thorough analysis of specific issues emerged in this study concern: an assessment of the actual capacity of **CO<sub>2</sub> 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.