EBA
European Biogas Association

Indirect Land Use Change

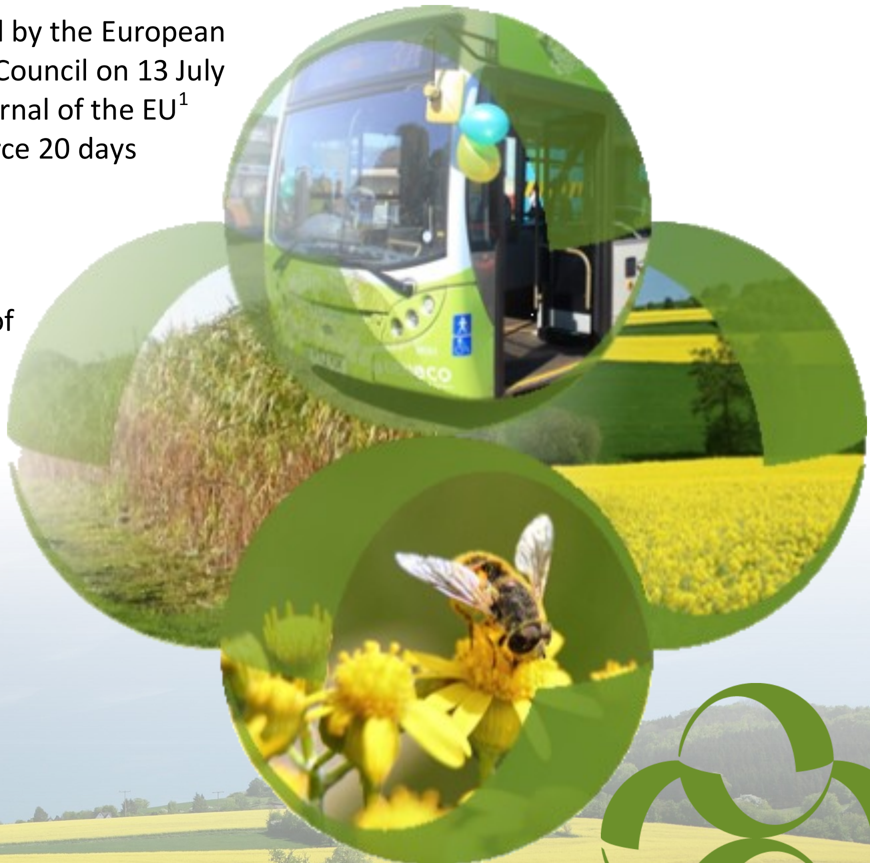
EBA's analysis on biofuels' iLUC legislation: SWOT and financial perspectives on the use of crops

Indirect Land Use Change

In April 2015 a compromise agreement was reached by the European Parliament and the Council on the European Commission's Indirect Land Use Change (ILUC) proposal. ILUC amends the Fuel Quality Directive (98/70/EC) and the Renewable Energy Directive (2009/28/EC) which both include clauses inviting the European Commission (EC*) to provide a report to review the impact of ILUC on greenhouse gas emissions and address ways to minimise it.

The ILUC Directive was formally adopted by the European Parliament on 28 April 2015 and by the Council on 13 July 2015. It was published in the Official Journal of the EU[1] on 15 September 2015 entering into force 20 days after, i.e. on 5 October 2015.

This document explains strengths, weaknesses, opportunities and threats of the ILUC Directive for the biogas sector.



** Please see the list of abbreviations on th elast page*

Strenghts

- No ILUC accounting
- Energy crops' cap relatively high
- Calls for sustainable transport measures after 2020
- Grasses and cover crops as advanced feedstock
- Country targets and plans for advanced biofuels to be published

No ILUC accounting. The so-called ILUC factors will not yet be taken into account in the overall greenhouse gas (GHG) emission calculation. The Directive merely requires fuel suppliers/Member States (MS) to *report* on **actual (mean) values** and by the European Commission (EC) on both mean values and ranges. However, the Commission shall come up with a report in 2017 evaluating the effectiveness of the Directive and providing scientific evidence on land use change. If appropriate, it may be accompanied by a legislative proposal to include ILUC factors in the sustainability criteria.

Energy crops' cap is relatively high. The contribution of biofuels produced from cereals and other starch-rich crops, sugars and oil crops is limited to **7%** of the final consumption of energy in transport. This is 2% higher than in the initial Commission proposal and 1% higher than what the Parliament was suggesting.

Calls for sustainable transport measures after 2020. The Commission is requested to present without delay a comprehensive proposal for a cost-effective and technology-neutral post-2020 policy which promotes the deployment of renewable energy sources (RES) and emission reduction in transport. By doing this, it is intended to create a long-term perspective for investments in sustainable biofuels with low ILUC risk. Such proposal could include the equivalent of the current RES target in the transport sector (10% renewable energy by 2020) for the 2020-2030 period.

Grasses and cover crops as advanced feedstock. "Food and feed crop residues (such as straw, stover, husks and shells), grassy energy crops with a low starch content (such as ryegrass, switchgrass, miscanthus, giant cane, cover crops before and after main crops etc), industrial residues (including from food and feed crops after vegetal oils, sugars, starches and protein have been extracted), and material from biowaste" are recognised as advanced feedstock. This means that the 7% cap does not apply to these substrates and also that they will count twice towards the 10% transport target while contributing to national sub-targets for advanced biofuels. This incentivises the use of alternative crops in biogas production.

Country targets and plans for advanced biofuels to be published. The European Commission will publish MS' targets and plans for advanced biofuels which will increase transparency and, presumably, peer pressure to establish appropriate measures for advanced biofuels.

Weaknesses

- The advanced biofuels target weak and non-binding
- Support for energy crops exceeding cap to be phased out
- GHG emission reduction of 60% for new plants too high
- Multiple counting towards advanced target for electric transport
- No Commission reporting on relative share of biomethane

The advanced biofuels target is weak and non-binding. MS will set an indicative **0.5%** sub-target for advanced biofuels within 1.5 years. The target is much lower than what was previously discussed among the institutions: the Parliament was recommending a 2.5% target and the Council was for a long time supporting a target of 1%. As most biogas feedstocks are identified as 'advanced' (under Annex IX of ILUC) and since these are double-counted, EBA was also advocating for a higher target.

Support for energy crops exceeding cap is to be phased out. Because of the requirement to limit the amount of biofuels produced from energy crops, MS will phase out support of biofuels exceeding the 7% cap.

GHG emission reduction of 60% for new plants is too high. The GHG emission saving from the use of biofuels will be at least 60 % for biofuels produced in new installations. Note that this requirement is technically impossible to meet in the case of biogas production with maize since natural gas is a low GHG emission fossil comparator, particularly when compared to oil products which are used for liquid biofuels.

Multiple counting towards advanced target for electric transport. The electricity consumption from RES will be considered to be **2.5 times** the energy content consumed by **electrified rail transport** and **5 times** consumed by **electric road vehicles**. These incentives for electric transport are higher than for advanced biofuels and do not promote technology-neutrality.

No Commission reporting on relative share of biomethane. The Commission is required to report by the end of 2017 on the relative share of bioethanol and biodiesel on the EU market, ignoring, once again, the gaseous biofuel.

- **Double cropping**
- **Increased use of advanced non-food crops (grasses with low starch)**
- **Derogation for crops grow on degraded land**
- **ILUC mitigation through yield increases**
- **Develop schemes certifying that biofuels do not displace food production**
- **New EU biofuels legislation under 2030 framework**

Opportunities

Double cropping. The ILUC Directive limits the amount of biofuels from cereals and starch rich crops grown as *main crops.* Thus, second crops are not capped.

Increased use of advanced non-food crops (grasses with low starch). The recognition of grasses with a low starch content as advanced biofuels will presumably encourage their use in agricultural biogas plants.

Derogation for energy crops grown on degraded land. There is a bonus (29 gCO_{2eq}/MJ) for biofuel biomass obtained from restored degraded land. In addition, energy crops grown on degraded land and which fall under the cap have the possibility to be excluded from this ceiling.

ILUC mitigation through yield increases. It has been recognised that yield increases in agricultural sectors through intensified research, technological development and knowledge transfer for food and feed crop-based biofuels, as well as the cultivation of a second annual crops on areas which were previously not used for that, can contribute to mitigating ILUC.

Develop schemes certifying that biofuels do not displace food production. Possibility to develop schemes by MS and/or the EC reliably proving that the biofuels produced did not displace production for other purposes and are therefore so-called 'low-ILUC risk biofuels', produced in accordance with the EU sustainability criteria.

New EU biofuels legislation under 2030 framework. In the context of the 2030 framework for climate and energy policies the EC will present legislative proposals promoting sustainable biofuels after 2020 in a technology-neutral manner. Thus, new measures for the continued promotion of biofuels after 2020 have been promised.

- **Possibility of ILUC accounting in the future, including non-food crops**
- **Waste hierarchy interpretation by Member States**
- **Possible lower national caps on energy crops**
- **Possibe change of accounting methods for energy crops**
- **Possible lower advanced targets in certain cases**
- **Possible additional sustainability criteria for non-land using feedstock and non-food crops**

Threats

Possibility of ILUC accounting in the future, including non-food crops. Under the ILUC text, the Commission is encouraged to further study and monitor the possible impact of non-food crops on ILUC. Research results shall be included in the evaluation of 2017.

Waste hierarchy interpretation by Member States. To note that there is only a little risk of ambiguous interpretation on biowaste recycling (composting) as separated biowaste is explicitly listed in Annex IX.

Possible lower national caps on energy crops. Member States are free to set lower than 7% caps on energy crops. A few MS have seriously considered this option.

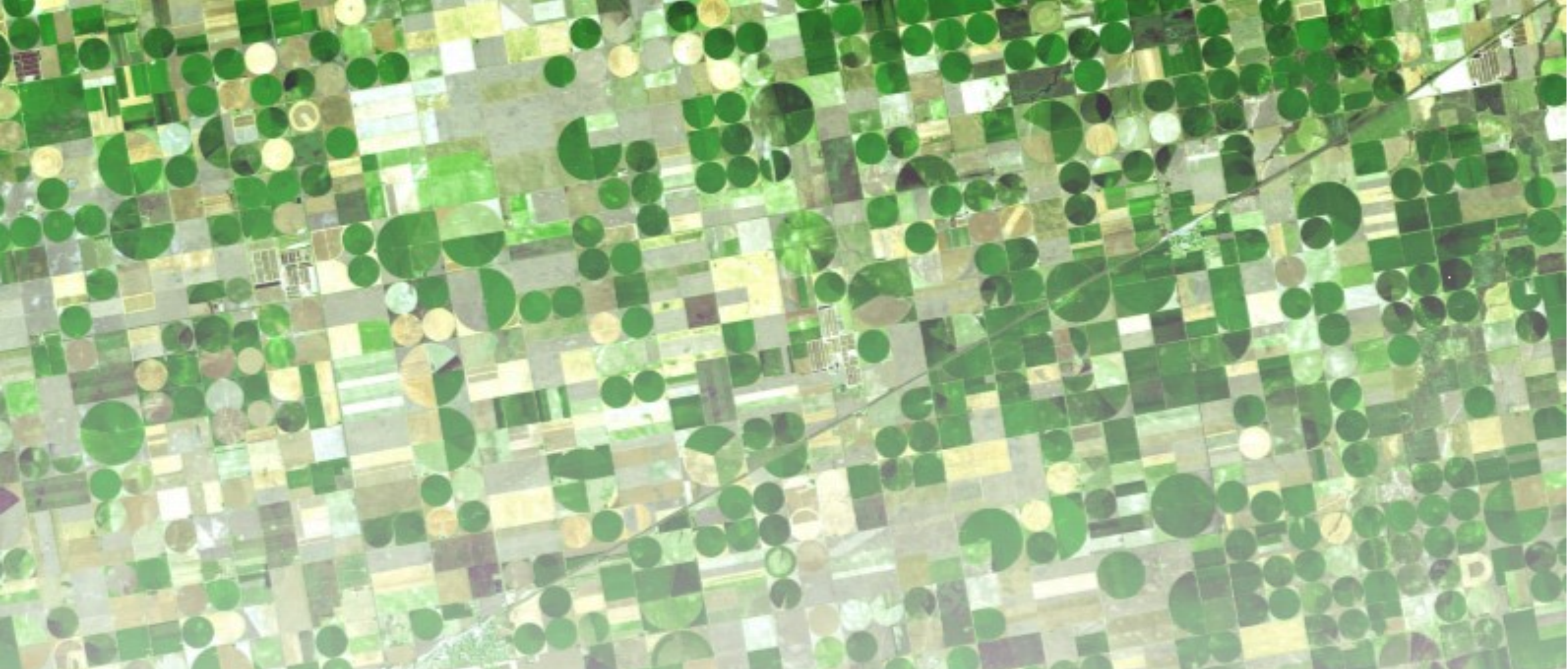
Possible change of accounting methods for energy crops. The EC keeps under review Annex IX and land use of non-food crops. Thus, feedstock listed as ‘advanced’ may change in the future.

Possible lower advanced targets in certain cases. Based on certain grounds, MS have the possibility to set a subtarget for advanced biofuels which is lower than 0.5%.

Possible additional sustainability criteria for non-land using feedstock and non-food crops. A possibility for a review of measures after the EC submits the reports in 2016 and 2017 on the assessments on how the current measures ensure sustainability of biofuels and limit ILUC effect.

Summary of the SWOT analysis

The final compromise agreement on the ILUC dossier is clearly much more positive than the initial proposal of the European Commission: the cap on conventional biofuels was raised from 5% to 7%; the Annex IX on the feedstock of advanced biofuels includes most biogas feedstock including cover and catch crops; ILUC accounting was removed. However, even though the agreement is now there, political and legislative stability are still missing: in only two years’ time (2017), the Commission will come up with a comprehensive report examining the effectiveness of the ILUC Directive which will possibly be accompanied by further legislative proposals to restrict biofuels’ impact on land use. Also public acceptance of biofuels is at stake since numerous profane campaigns were launched which focus on biofuels’ threats to food security and the environment. Therefore, it is important and helpful to carry out and publish scientific results demonstrating that biofuels do not displace food production and that ILUC effects can be mitigated in several ways such as intensified farming. The possibility of growing cover crops or secondary crops for biogas production is welcomed as part of sustainable farming practices but is often questioned because of cost-effectiveness. The second part of this analysis examines the financial features of alternative crops in biogas production.



Catch/cover crops contribution to biogas (biomethane) production for fuel: financial perspective

A catch crop is a fast-growing crop that is grown simultaneously with, or between successive plantings of main crops. Cover crops are plants grown on agricultural lands, either within or outside of the regular growing season, with the primary purpose of improving or maintaining ecosystem quality. These crops have a potential as supplementary energy biomass, generating direct revenue for the farmers while fulfilling at the same time ecological functions, such as reduction of nitrate leaching, erosion reduction, nitrogen fixation and carbon sequestration. Nutrients are usually recirculated into the soil with the digestate that as an organic fertiliser replaces mineral fertilisers. Additionally, these crops can help farmers to fulfil the 'greening' measures established in the Common Agricultural Policy.

Many possible types of crops with different characteristics can be used as catch crops and cover crops incl. legumes, cereals, grasses, clovers, brassicales, cruciferous species and species of other plant families. They can be all, annual, biennial and perennial species.

Catch/cover crops under ILUC

The new EU legislation on indirect land use change (ILUC) amending the Renewable Energy Directive and the Fuel Quality Directive promotes more sustainable use of crops through double cropping and the energetic use of low-starch grassy crops under the definition of 'non-food cellulosic material': "feedstocks mainly composed of cellulose and hemicellulose, and having a lower lignin-content than lingo-cellulosic material; it includes food and feed crop residues (such as straw, stover, husks and shells), grassy energy crops with a low starch content (such as ryegrass, switchgrass, miscanthus, giant cane, cover crops before and after main crops etc.), industrial residues (including from food and feed crops after vegetal oils, sugars, starches and protein have been extracted), and material from biowaste". Informally speaking, biomethane produced from such material is an advanced biofuel and contributes therefore twice towards the target of 10% renewable energy in 2020 and also to the national sub-targets of advanced biofuels. Maize, on the other hand, that is commonly used as a biogas substrate is capped under the 7% limitation imposed for cereals and starch-rich crops.

This analysis aims at determining on whether the use of catch and cover crops in biogas production can be also economically reasonable. Three countries with different climate conditions and soil properties were selected as case studies: Germany, France and Sweden.

Catch/cover crops in Germany

Some of the most common catch crops used for German biogas production are: oil radish, white mustard, feeding rape, forage kale, forage rye, horsegram and sorghum.

Maize results however in much higher methane yields than any alternative crops which together with transport distances and area related costs are decisive factors when substrate is selected for biogas production. Only sorghum (grown only to a small extent so far), sugar beets and in some regions whole crop silage come close to that yield. In order to reach an equivalent energy output, alternative crops need larger areas of land.

The Bavarian State Research Centre for Agriculture has made a comparative study on costs of using different crops for biogas production. When purely costs are taken into account – without considering required working hours and sensitivity analyses – the comparison between maize and grass silage is the following:

Table 1: Compilation of costs in €/ha and €/Ton fresh matter with digestate as fertiliser

	Maize silage 33% dry mass		Grass silage 35% dry mass	
Net yields in silo/warehouse	43.5 t/ha		24.3 t/ha	
Means of production, interest rate	792 €/ha	t	565 €/ha	23 €/t
Fixed and variable machinery costs	272 €/ha	6 €/t	157 €/ha	6 €/t
Harvest and transport (external)	273 €/ha	6 €/t	457 €/ha	19 €/t
Digestate application	122 €/ha	3 €/t	74 €/ha	3 €/t
Overhead costs/hail insurance	74 €/ha	2 €/t	50 €/ha	2 €/t
Production costs free silo	**1,060 €/ha**	**25 €/t**	**832 €/ha**	**34 €/t**
Fixed and variable silo / warehouse costs	134 €/ha	3 €/t	84 €/ha	3 €/t
Substrate model	125 €/ha	3 €/t	70 €/ha	3 €/t
Supply costs free fermenter	**1,319 €/ha**	**31 €/t**	**986 €/ha**	**40 €/t**

Source: LfL, Biogas: Was kosten Substrate frei Fermenter?, 2008

Also this study shows that even though the grass silage as feedstock would theoretically be less expensive, the net yields are so much lower that grass silage could economically hardly compete against maize silage. Another report, prepared by the consultancy BB Göttingen GmbH[2], suggests that the use of mixture of wild plants as biogas substrate could be profitable only in the case that such plants would be grown as a result of "Greening" requirements of the Common Agricultural Policy (CAP) of the EU. The measures foreseen by Greening include crop diversification and maintaining an "ecological focus area" of at least 5% of the arable area. The former requires that a farmer cultivates at least 2 crops when his arable land exceeds 10 hectares and at least 3 crops when his arable land exceeds 30 hectares. The different crops shall represent different sorts of species, for example cultivation of different clovers does not fulfil the requirement. The latter measure can be fulfilled by means of several different options: fallow land, catch crops, buffer strips alongside water bodies and forests, etc. According to the analysis of German Biogas Association[3], biogas plants can very well be suited to help farmers to combine ecology and economy: the cultivation of catch and cover crops as well as buffer strips would bring along ecological and financial benefits.

Thus, the deployment of non-food cellulosic material as biogas substrate in Germany requires additional support to be economically reasonable.

Catch/cover crops in France

The use of dedicated energy crops for biogas production is limited by law in France[4] whereas intermediate crops (i.e. catch crops) can be digested freely. Traditionally, the French biogas plants have used different industrial waste streams as substrate but since 2008, the number of agricultural biogas plants has increased rapidly: in only two years, 2011-2013, the amount increased from 48 to 140 plants. This boom is at least partly taking place as a result of strong political support: France shall have 1,000 agricultural biogas plants by 2020.[5] With this target, the country aims to increase farmers' energy self-sufficiency and to mitigate nitrate leakage. Consequently, this regulatory framework can potentially lead to a significant increase of catch crops and rotational crops in French biogas production. The French Environment and Energy Management Agency (ADEME) estimated within the framework of the European GreenGasGrids—project that by 2030, 15%-30% of biogas substrates could be composed of intermediate crops.[6] Some of the most common catch crops in France are raygrass, meslin, rye, sorghum and oats.

ADEME carried out a study in 2009[7] about environmental, economic and energetic performance of different crops in biogas production. Each crop was considered in the context of two cycles in succession, either as mono-cropping or double-cropping:

Table 2: Environmental, economic and energetic performance of different crops in biogas production

Crop	Land efficiency MWh/ha	Energy efficiency[A]	Cost efficiency EUR/MWh
Mixture of grasses	14.8	7.1	34.2
Sorghum in rotation with wheat	64.6	14.5	10.9
Triticale in rotation with maize	21.7	4.8	37.9
Forage maize (without irrigation)	31.8	6.6	32.5

[A] *primary energy produced by anaerobic digestion compared to fossil energy input*

Source: ADEME, Methanisation Agricole et utilisation de cultures energetiques en codigestion, 2009

According to the results of the study, only sorghum seemed financially profitable and the digestion of energy crops was back then considered reasonable only in certain amounts when co-digested with other substrates. France is geographically a large country having therefore very diverse landscape and soil properties. In a study carried out in summer 2012[8], ADEME concluded that in the southern regions of the country, the most suitable intermediate crops from energetic point of view would be the species with high production level (maize, sorghum and foxtail millet) or alternatively tropical species (millet). In the northern regions, mixtures of cereals and grasses prove the most interesting. The same report reveals differences in the economic performance depending on the use of biogas: when biogas was used to fuel CHP, the assumed efficiency of cogeneration was 37% and the selling price of electricity 17.7 c€/kWh. Alternatively if biogas was upgraded and fed into the grid (however, the end use can still be electricity), the assumed efficiency of the upgrading unit was 98% and the selling price of biomethane 11 c€/kWh. Given these default figures, the results demonstrate that digestion of all studied intermediate crops for biomethane production generate positive gross margins whereas in the case of cogeneration, only the crops with high production (maize, sorghum) are economically attractive.

ARVALIS-Institut du Végétal has been studying winter and summer catch crops[9] for biogas production and it reached the conclusion that due to their low productivity levels, the price of such crops remains relatively high. This could be lowered for example by replacing mineral fertilisers with digestate or by a new support scheme; the current Feed-in tariffs and other regulatory conditions are not favourable to biogas from any crops. Arvalis-Institut du Végétal is anticipating a more active role for farmers in future discussions and projects to increase the profitability of catch crops.

Catch/cover crops in Sweden

In Sweden only a few percentage points of the total biogas production come from energy crops but the amount is slowly increasing in order to meet the relatively high demand in the transport sector. A study of the University of Lund[10] compared resource efficiency of different crops used for biogas production. The compared crops were hemp, fodder beet, maize, triticale, a mixture of grass and clover, and winter wheat. The table below summarises the results of the study.

Table 3: Resource efficiency of different crops used for biogas production

Crop	Land efficiency MWh per ha/a	Energy efficiency[A] Energy output as a fuel compared to primary energy input	Cost efficiency[B] SEK per KWh (1 SEK = approx €0.1)	GHG emission efficiency[C]	
				CO2 reduction %	t CO_{2eq} per ha/a
Hemp	21	2,3	1,0	92	5,7
Beet (Beet + bagasse)	**45**	2,5	0,8	73	**9,8**
Maize	29	2,6	0,8	93	8,0
Triticale	25	**2,8**	**0,7**	78	6,0
Mixture of grass and clover	22	2,5	0,8	**117**	7,8
Winter wheat	25	2,5	**0,7**	87	6,4

[A] Upgraded and compressed biogas compared to primary energy input using mineral fertiliser

[B] Silage crops with full digestate valuation

[C] Scenario with mineral fertilisers, emission reduction compared to fossil comparator

Source: Lunds Universitetet: Energigrödor för Biogasproduktion, Delar 1-3, 2012-2013

As the table demonstrates, none of the crops is clearly better than the others when the different factors are taken into account. It is notable however, that in Swedish conditions, maize does not rank highest in any category. The price of maize silage in Sweden is significantly higher than in Germany. The price of grass silage in Germany and the grass mixture used in this study is in turn similar. When only cost efficiency is taken into account, the cereals are rated highest but the grassy crops and beet bagasse are not costlier than maize.

Ley grasses and legumes are already among the most used crops in Swedish biogas production; they have excellent soil-improving properties and can be grown on large marginal areas in Sweden that are not profitable from the agricultural point of view. Additionally, Swedish farmers can get financial compensation for growing such nitrogen-fixing plants on their lands[11] thus making multiple cropping and cover cropping more interesting from the financial point of view.

The economics of harvesting crops for biogas production is currently a topic of several Swedish research projects especially at the University of Lund and at the Swedish University of Agricultural Sciences.

Conclusions

The deployment of different catch/cover and rotational crops for biogas production is still at a very early stage but the possible future contribution of such feedstock to agricultural biogas production has been recognised. Several scientific and technical studies in different countries have been or still are carried out. The topic is certainly interesting since digestion of such crops could increase agricultural biogas production and thereby farmers' energy self-sufficiency while enhancing food production and sustainable agriculture. With the increased total yield iLUC is considerably mitigated as has been showed recently by an IEA Bioenergy workshop.[12] Anaerobic digestion of cover crops would also increase nutrient recycling: digestate is an organic fertiliser and second product of AD which includes nearly 100 % of nutrients needed by the plants. In addition cover crops prevent erosion by ensuring that the soil is not left bare during the cold season.

The remaining challenge relates to financial feasibility of digesting cover crops. Based on the results of this study, such "non-food" crops with lower yield and other less favourable properties when compared to maize, seem to be still dependent on EU policies and national support schemes. However, there are several factors and measures that should be considered when maize (as a sin gle crop) is compared to catch and cover crops. Particularly the greening measures under the Common Agricultural Policy could enhance the use of alternative crops if the ecological functions of growing such crops and harvesting them for biogas production were fully recognised, i.e. those crops could contribute to fulfilling ecological focus areas. Furthermore, when farmers grow such crops instead of traditional starch-rich crops and cereals, they do not need to introduce additional ecological focus areas. Also the savings in the fertiliser use should be considered: some cover crops such as different grasses require only limited fertilisation and other crops can be fertilised by digestate. Thus, the economic dominance of maize over catch and cover crops is not as obvious as it seems at first sight. The future studies should therefore examine the topic from multiple perspectives taking into account the diverse profits of cover and catch crops.

Glossary

ILUC Indirect Land Use Change
MS Member States
EC European Commission
GHG greenhouse gas
RES renewable energy sources
RED Renewable Energy Directive (2009/28/EC)
FQD Fuel Quality Directive (98/70/EC as amended in 2009/30/EC)

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[3] *Dr. Stefan Rauh: Greening – diese Möglichkeiten haben Biogasanlagen. Biogas Journal 2/2015*

[4] *The law n° 575 relatif à la transition énergétique pour la croissance verte, Art. 112*

[5] *MEDDE, 1 000 méthaniseurs à la ferme en 2020 : lancement du plan "Énergie Méthanisation Autonomie Azote"*

[6] *ADEME, Une vision pour le biométhane en France pour 2030*

[7] *ADEME, methanisation agricole et utilisation de cultures Energetiques en codigestion*

[8] *ADEME, Étude au champ des potentiels agronomiques, méthanogénes et environnementaux des cultures intermédiaires à vocation énergétique, rapport final, 2013*

[9] *Research programme called CIBIOM. Marsac & Besnard : « Cultures à Vocation Énergétique – Un itinéraire technique spécifique » in Perspectives Agricoles, April 2015, p. 58-60 ; Marsac et al. « Multicriteria assessment of French cropping systems including energy catch crops » in 23rd European Biomass Conference and Exhibition, June 2015*

[10] *Lovisa Björnsson, Mikael Lantz, Lunds Universitetet: Energigrödor för Biogasproduktion, Delar 1-3, 2012-2013*

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