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On the Future of Biogas Generation and Utilisation

Suggestions for comprehensive ecological improvement by the Agriculture Commission at the German Federal Environment Agency (KLU)

For our Environment

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KLU is a committee of independent experts. The committee advises the Federal Environment Agency, putting forward concrete proposals for more environmentally friendly agriculture.

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1. Bioenergy - Background and Starting Point

1. As a response to the nuclear disaster of Fukushima, the German Government decided to phase out nuclear energy by 2022. Fossil energy carriers are to be almost entirely replaced by renewable energy over the next 40 years because of their damaging effect on the climate, their finite availability and also because it would reduce the country's dependency on imports. By 2050, 80% of Germany's gross electricity consumption is to be covered from renewable sources. According to a study published by the UBA in 2010, it will be possible to base the entire electricity supply on renewables by 2050.[1]

2. The energy turnaround is Germany's greatest challenge since reunification - in social, economic and ecological terms. By switching to renewable energy carriers, Germany wants to achieve long-term security of supply, reduce emissions of greenhouse gases to a climate-friendly level and avoid the risks associated with nuclear energy. A study by the UBA suggests that by 2050, greenhouse gas emissions in Germany can be reduced to 70 million tonnes of CO2 equivalents - a reduction by 90% compared to today's levels.[2] The switch to renewable sources of energy is essential in the process.

3. In 2012, the share of renewables in Germany's final energy consumption was 12.6 %.[3] Of these, a large proportion (approx. 67%)[4], comes from bioenergy, with 42.9 percent being used for heat, 11.6 percent for biofuel and 12.5 percent for power generation. All three have in common that this energy - if only partially for electricity- is generated from biomass. In scientific terms "biomass" is defined as matter of organic, not fossil origin,[5] and according to the Biomass Ordinance, biomass comprises all energy carriers of plant or animal origin. In the following text, biomass will be defined as biogenic raw material. The energy generated from biomass can be used in solid, liquid or gaseous carrier form for various applications, i.e. heat, fuels and electricity. In principle (certain conditions being met), bioenergy can be stored and its supply controlled, which gives it the flexibility to be used anywhere anytime, e.g. to overcome power shortages and ensure a continuous supply.[6,7] The bioenergy supply (for power generation) do not directly depend on variable conditions, as do solar and wind energy.

4. According to the German Government's development targets, the share of renewables should rise to at least 35% for electricity, to 14% for heat and to 12% for fuel by 2020.[8] Some of these figures are based on the National Biomass Action Plan of 2009 and its assumption that until 2020 the available area for energy and raw material crops would be extended from 2.5 to 4 million hectares of arable land. Such crops are known as NaWaRos (nachwachsende Rohstoffe - renewable raw materials). The lower limit of 2.5 million hectares was almost reached in 2012, when 962,000 hectares of arable land were used for the cultivation of energy crops for biogas production (predominantly maize), while crops for biofuel production (mainly rapeseed; figures of 2012, declining) were grown on over 1.1 million hectares. A further 0.4 million hectares were used for the cultivation of NaWaRo crops as raw material.[9]

5. These developments produced far-reaching consequences through competition with food and animal feed producers for the available land, bringing the conflict between renewable energy production and climate protection, conservation and environmental protection to a head. Thus, the bioenergy boom led to several worrying anomalies that have been pointed out already by various bodies. Attempts to remedy these have been made since in several amendments to the EEG, the Renewable Energy Sources Act.[10, 11, 12, 13, 14] Another problem that has been highlighted in the studies and is currently under debate is the topic of greenhouse gas emissions from renewables, caused by direct and indirect land use changes (LUC/ILUC[15]).[16] Energy generated from biomass is not greenhouse gas-neutral, and although the energetic use of biomass releases no more carbon dioxide than was taken out of the atmosphere during the cultivation of the energy crops, a comprehensive greenhouse gas balance must factor in emissions from the production chain. These would include the use of fossil energy not only to produce fertilisers and pesticides for the treatment of crops, but also nitrous oxide emissions from the fertilised land, as well as possible indirect changes of land use that result in the release of greenhouse gases. This is why stakeholders in science and politics, including the KLU, insist that GHG emissions caused by indirect land use change

must be included when calculating a comprehensive climate balance[17] for bioenergy from biomass crops.[18] So far, there has not been a unanimously accepted method of including GHG emissions in the climate balance calculations. However, the majority of calculation methods show that some biofuels may actually have a larger carbon footprint than their fossil counterparts.[19] Therefore, it should be a minimum requirement for all bioenergy types - whether for heat, fuel or power - generation - to demonstrate that their use would reduce emissions in comparison to fossil alternatives. This has been stipulated for biofuels and power from liquid biomass in the relevant sustainability regulations,[20, 21] whereas no such sustainability criteria and requirements have so far been developed for solid and gaseous bioenergy carriers at European or national levels. The scope of the sustainability regulations mentioned above (biofuels and power from biomass) should be extended to heat and power generation from solid and gaseous biomass. Section 64b of the EEG 2012 makes provisions for issuing statutory instruments to regulate power generation. These should be implemented.

6. In 2012, the Federal Environmental Agency (UBA) outlined in a report how a sustainable and resource-friendly use of arable land and biomass could be achieved in view of an increasing population, and limited (even decreasing) availability of land worldwide. Furthermore, the conservation of woodland and biodiversity at a global level and the protection of soil and water are paramount, while adaptation to climate change must also be addressed.[22] Among other things, the UBA advises that use of existing agricultural land for food production and the utilisation of renewable raw materials (with subsequent reuse for energy production - i.e. cascading use) should be given priority over direct use for energy production. In the mid to long term, industrial countries like Germany should generate bioenergy from residual and waste material only (these include material from forest thinning, biotope and countryside management). The UBA is of the opinion that the use of biomass crops, including raw wood, for energy generation should no longer be encouraged and strategies and procedures developed that will make the use of biomass crops obsolete in the mid- to long-term. Energy generation from organic residual material and waste biomass should be promoted instead, as this would not take up additional land and, as far as we are currently aware, would not have any serious negative impact on the environment.[23] This type of energy production should be rewarded with special subsidies if it can combined with further positive side effects, such as slurry digestion (reduction of GHG emissions, see objective point 61)

In the transport sector, the energy utilisation options include hydrogen, renewable methane, partial or complete reliance on batteries or on synthetically produced hydrocarbons.[24] It is absolutely paramount that this is underpinned by efficiency increases in vehicles and the gradual phasing out of the biofuel quota. Overall, only those renewable energy pathways should be pursued that can be shown to have a significant positive effect on climate protection. Indirect effects must be factored in. Not only the greenhouse gas footprint, but also land use and availability of resources must be given more consideration on a global scale when developing support schemes for bioenergy. Funding must be directed towards those options that have the highest GHG avoidance potential[25]. It is also assumed that the proportion of bioenergy in the energy mix will be decreasing in the future.[26]

7. Continuing the work of the UBA and in view of ongoing controversies regarding the ecological rationale behind current bioenergy funding, the KLU finds it is essential to have a fresh discussion on the need and importance of desirable and sustainable bioenergy, taking into account the side effects that have come to light and to identify promising models. In the interests of transparency and plausibility, KLU feels that criteria must be established that will facilitate a change of direction and the definition of new objectives.[27] In a next step, we must establish what instruments must be in place to support the development of bioenergy in the future. For the KLU, this seems to be indispensible for all types of bionenergy carriers. The most contentious development at national level, and, from an environmental perspective, a rather alarming one, is the funding of renewable power generation by converting biomass crops into biogas and then into electricity.[28] The operation of biogas plants has a dramatic impact on regional agricultural production and material flows. More maize is grown for energy, while the use of manure-based fertilisers and plant-based digestates goes hand -in- hand with an intensified or changed use of land (ploughing up grassland). All of these change the face of agriculture and result in clashes with the protection of nature and the environment, especially in the intensive livestock farming

regions of Germany, due to nutrient surpluses in the soil. With the reform of the common agricultural policy, the Greening proposals emphasise the protection of grassland - not at a regional level as before, but right down to the level of individual farms. Nutrient surpluses are also an issue in terms of achieving the objectives set by the WFD (Water Framework Directive). While the objectives mentioned under point 36 should generally apply to all bioenergy carriers, they will be applied to power generation from biomass here.

8. It is crucial that during the upcoming review of biogas policy, all aspects of biogas production must be considered. In other words, not only the aspect of meeting energy needs, but also ecological, economic and social aspects, positive as well as negative, must be looked at. These include repercussions on tenancy rates for farmers, dairy farms, organic farming, biodiversity, crop rotation, climate issues, eutrophication, erosion, food prices, trading of agricultural products etc. Subsidies for biogas-to-power should therefore be modified in order to foster only those schemes that avoid the negative implications that have now been identified.

2. Biogas – its legal Framework and undesirable Developments from an environmental Perspective

9. An essential component of energy supply is to provide sufficient electric power at an affordable price. As explained above (point 1), the energy turnaround policy aims to supply at least 80% of gross power from renewables by 2050. According to a study by the BMU (German Federal Environment Ministry), wind energy and photovoltaics will be the most important energy carriers.[29] Scenario A[30] suggests that in 2050, 260 terawatt hours (TWh) per annum will be generated by wind energy and 63.8 TWh by solar energy, whereas the share of bioenergy in power generation will be only 59.2 TWh. By then, biogas is expected to contribute 28.1 TWh. Compared with 2012 (20.5 TWh or 3.4% of gross electricity consumption)[31] a further development of this energy resource would be required.

10. The Renewable Energy Sources Act (EEG), first approved in 2000 and amended three times since (in 2004, 2009 and 2012[32]), provides the legal framework for the provision of electricity from renewables. The subsidy structure and tariffs for biogas production from biomass and its conversion into power proved so attractive and successful that in 2012, over 7,500 biogas plants supplied 3,350 MW of electrical energy.[33] Compared to the year the EEG came into force in 2000, the number of biogas plants increased approximately sevenfold from 1050 installations.

11. While in the early stages, mainly traditional agricultural residues (especially slurry and biogenic residues) were used for power generation, the 2004 amendment of the EEG introduced the "NaWaRo bonus" (renewable raw materials bonus), which favoured the cultivation of energy crops over recycled residual material. According to estimates, on average, 80% of the energy produced in today's biogas plants (not of the feedstock used) comes from NaWaRos, whereas a mere 10% comes from waste material and another 10% from manure-based fertilisers (there may be, however, huge regional variation.[34, 35] Although the "NaWaRo bonus" has since been abolished, this seems to be a continuous trend.[36]

12. The introduction of an additional feed-in tariff for feedstock with 30% mass from slurry (EEG amendment 2009: "slurry bonus") was intended to discourage the use of large amounts of biocrops in biogas plants (BGPs). However, linking the "slurry bonus" to the "NaWaRo bonus"[37] had the effect that no more than the required minimum quantity of slurry was added, while the energy production process remained largely based on renewable raw materials. The "slurry bonus" failed to encourage the use of manure-based fertilisers, but produced instead increased windfalls amounting to a cross-subsidy for the use of renewable raw materials, as subsidies were still available for the remaining 70% renewable feedstocks, such as maize silage. The "slurry bonus" could therefore be called "NaWaRo bonus II". More than 70% of all existing BGPs receive the accumulated NaWaRo and slurry bonuses, which add to the exorbitant costs of this energy form. The amended EEG of 2012 abolished the "slurry bonus", but existing installations are exempt from the new rules. An idea conceived to help the environment (biogas plants relieving the problem of excessive slurry) was completely turned on its head when intensive livestock farming was introduced in the first place in order to generate enough slurry to feed the biogas plant. Several such examples have been reported. In these cases, the biogas plant is there to solve environmental problems that would not have existed without the plant.

2.1 Wasting Heat by setting the wrong Priorities

13. Most biogas is mainly converted into power on the premises so that the electricity can be fed into the existing grid and distributed. The conversion process generates a substantial amount of heat as a byproduct, which is used for the operator's own consumption to heat the digester, while 45% is used for external heat utilisation.[38] This means that approximately one third of the heat generated is lost - a waste of valuable resources in the eyes of the KLU. There is certainly room for improvement by reducing heat waste.[39] Economic as well as ecological sense suggests that not only electric power should be used, but also the heat generated (cogeneration of heat and power - CHP). Such dual use was subsidised until the end of 2011 by the CHP bonus. The amended EEG 2012 stipulates that new installations must utilise a minimum of heat

generated (existing plants are exempt). According to the new legislation, each newly established biogas plant must prove that it uses 60% of the heat generated (including own use, such as the heating of slurry). The KLU welcomes this commitment. However, a higher rate of effective heat use would be desirable.

14. In the opinion of the KLU, the biogas sector has been emphasizing power generation at the expense of heat generation and utilisation. In the future, biogas plants that convert biogas into power on location (using residual matter and biomass waste) should be built with heat requirements in mind. Small local heat systems can be highly efficient and offer a whole host of opportunities to heat nearby residential and industrial/commercial buildings.

15. In the past, a number of examples have shown that heat generated through conversion of biogas into power has not always been used very effectively. For example, asparagus fields were heated with waste heat from biogas-power conversion because it was available at low cost and the threshold for receiving the CHP bonus had to be reached. If heat is to be used effectively, future heat demand must become a major control parameter when planning the size of local biogas-power conversion plants.

16. An alternative to the procedure outlined above would be to purify biogas to natural gas standards (biomethane) in a first step. In order to raise its calorific value to natural gas levels, water vapour, hydrogen sulphide and carbon dioxide must be extracted through cooling/exsiccation, desulphurisation and compression. The biomethane thus obtained can be fed into the natural gas grid and distributed.

This upgrading process is costly - no matter whether it is a scheme where biogas is centrally collected from individual biogas plants and conditioned, whether the operation is linear or radial or a mixture of all the above.[40] Its overall advantage is, however, that biomethane can then be transported to a location where it is converted into power and the most effective use of the waste heat is made. It is therefore preferable from an ecological point of view.

17. Biomethane can not only be converted into power, but, like natural gas, be used in existing technical equipment (household, industry or transport) It must, however, be offset against technical and financial outlay for the upgrading (purification) process and injection into the network. In addition, the calorific value must be adapted to the quality of the natural gas in the grid – a process that requires fossil gas. It is therefore not economical for small biogas plants to condition their product and it would make more sense to install a biogas collection system with central conditioning. In 2012, only 107 installations were capable of processing their biogas to biomethane.[41] The KLU recommends that more research should go into increasing efficiency and reducing costs.

18. Biomethane has the same properties as fossil natural gas and can be stored in the same way. This makes it ideal for balancing out supply fluctuations from solar and wind energy, while it is less suitable for providing electricity in the base-load range. In power generation, its primary use should be as balancing power to overcome power supply shortages from other renewable sources.

2.2 Imbalances regarding Use of arable Land and Crop Cultivation

19. The production of biogas can have ecological drawbacks as a result of not or not sufficiently taking into account aspects of agricultural ecology and repercussions from incentives when devising a subsidies plan. What can go wrong will be demonstrated in the following using the example of maize cultivation. The KLU would like to emphasise that the cultivation of other energy crops with similar yield levels, such as sugar beet could have similar repercussions on the environment.

20. The most popular feedstock for the generation of biogas is currently maize silage. Its short growing period, high yields per hectare, high energy content and amenability to silage give the crop the highest methane-per-hectare ratio at low cost (highest land use efficiency). Accordingly, cultivation areas of maize for biogas increased in parallel to the growth of biogas plants all over Germany to 800,000 hectares (2012).[42] There were, however, considerable local and regional variations in growth rates. In addition to the maize grown for energy generation, a further 1.8 million hectares of maize is grown for animal feed - again with great variations between regions, reflecting the growth in livestock husbandry (livestock-rearing industry) in Germany. Both developments

reinforce each other to a certain extent, as maize is needed not only for feeding growing pig and poultry populations,[43] but also for combined in biogas plants. The share of maize in the overall arable area has already reached 22% and in some regions of Germany, maize has become the crop that dominates crop rotation and countryside.

21. The profit margins that can be achieved by maize for biogas lead to distortions on the farm tenancy market and displace other land uses. The days when arable land was set aside - sometimes up to 15% of arable land - in order to avoid overproduction are long gone. Nowadays, dairy farmers with grazing livestock and organic farmers find it difficult to survive, let alone expand because they are unable to compete with subsidised biogas plant operators who can pay higher tenancy rates. Once established, they will plough up grassland to grow maize for silage. This has not only ecological repercussions, but also results in social tension, although the energy produced by BGPs contributes no more than 3.4% of the overall power supply[44] Electricity from other renewables (in particular wind energy) is far more cost-effective[45] and land use-efficient. In order to produce 10 GWh of electricity, an efficient wind turbine needs no more than 0.3 hectares and a photovoltaic installation (mostly on roofs) 8 hectares. In order to generate the same quantity of electricity from a biogas plant fed by renewable raw materials alone (dry fermentation), approximately 400 hectares would be required for the cultivation of the feedstock. This example demonstrates quite drastically that arable land should be reserved for the cultivation of food and animal feed crops.[46]

2.3 Maize - a Blessing turned into a Curse?

22. When grown in concentrated monocultures, i.e. not as part of crop rotation, maize can become a high-level threat to soil and water, according to the Soil Protection Commission[47] (KBU) at the Federal Environmental Agency, causing erosion, soil compaction and leaching of nutrients and pesticides. In addition, the humus in the soil is depleted and the land is also no longer suitable as a habitat for species such as field-nesting birds, leading to an impoverishment of biodiversity. The cultivation pattern also encourages the spread of pests such as corn borer and corn rootworm. Other side-effects are the changes imposed on the countryside, affecting its appearance and hence tourism.

23. Humus depletion through maize can be prevented (according to VDLUFA, the Association of German Agricultural Analytic and Research Institutes, with silage maize, almost the entire organic mass is removed from the field, leaving the soil short of humus -- 580-800 kg of organic C per hectare). This could be achieved by returning the digestates from the biogasification process to the soil as fertiliser, as good agricultural practice requires. Depending on individual conditions, this could almost even out the nutrient balance, which could be further improved by a change of cultivation methods, such as reduced tillage, mulch crops and growing catch crops (e.g. rye for animal feed) before maize. The latter has the added benefit of considerably reducing the risk of erosion and leaching.

24. Change of land use, by contrast, such as ploughing grassland, reinforces the potential negative impacts on soil, climate and biodiversity. As the cultivation of maize has become an economically rewarding option, more grassland is ploughed up and considerable amounts of nitrogen are mineralised and CO2 released through humus degradation. In Germany in 2011, the conversion of grassland on mineral soils led to the emission of 1.4 million tonnes of CO2 from humus depletion and 49,000 tonnes of N.[46] In national greenhouse gas reporting, an overall loss of 17.4 tonnes of carbon and 1.2 tonnes of nitrogen per hectare is factored in for average German soil converted from grassland into arable land. These will be released over a period of 20 years.[48] Supposing that 36% of humus is lost in top soil[49], the estimated loss of carbon is 28 tonnes and for nitrogen 2.2 tonnes per hectare. In field experiments, humus losses of 1-3 tonnes of carbon per hectare were measured during the first year after conversion.[50]

25. Maize is particularly tolerant of manure-based fertiliser, tolerating excessive nutrient supply. This makes it the crop of choice in regions with intensive animal farming, not only because of its high value as animal feed, but also because of its remarkable slurry tolerance. In the autumn, nitrate levels rise as a result of excessive application of slurry. The slurry is spread not only as a fertiliser, but also as a method of waste disposal. This, in turn, leaves high levels of mineral N-fraction in the soil after the maize has been harvested, increasing the risk of leaching just before the

onset of autumn rainfalls with ensuing seepage. The problem is compounded by the fact that for technical reasons, on most farms fertiliser is applied at the time of sowing only and not re-applied during the growing season, although N is taken up by the plants much later. As a result, nutrient input into the system is high, while actual nutrient efficiency is far from optimal. If, in addition, organic nutrients from digestates must be disposed of, the problems are made worse.

26. These effects of maize cultivation for biogas feedstock as well as animal feed are particularly noticeable in the livestock-rearing regions of North-Western Germany. Lower Saxony is one of the German federal states with the highest livestock population (in some regions >3 livestock units per hectare) and the highest biogas plant output. By the end of 2011, approximately 1,300 biogas plants generated approximately 5 million MWh of electricity, accounting for 10% of the overall power supply for Lower Saxony. The number of installations has more than quadrupled since the introduction of the amended EEG in 2004.[51] In the same period, the cultivable area for energy crops (almost exclusively maize) has increased from 4,600 hectares (2004) to 205,000 hectares (2011). The expansion of arable land was achieved at the expense of grassland, with silage maize displacing other crops - mainly spring grain and sugar beet. Around one third of the maize grown in Lower Saxony is now converted into biogas. This development was accompanied by an increase in pig husbandry and the relevant animal feed crops, taking the share of maize crops on agricultural land in some communities over the 40% mark, which has an undeniable visual effect on the countryside.[52]

27. Those regions are the areas where high land use for maize cultivation coincides with a high use of natural fertilisers of animal origin (manure, slurry, dung), imports of such farm fertilisers from the Netherlands and additional nutrients from the renewables share in digestate. In many places, this has led to a local overload in the nitrogen cycle. Nitrate levels in groundwater have been high and continue to rise, mirroring the interactions described above. In short, the environmental problems caused by animal farming have been compounded by biogas production - a truly unholy alliance! A model project in Lower Saxony has shown that in ploughed-up grassland used for energy crops, nitrate levels in water seepage could reach up to 162 mg of NO3/l,[53] A long-term observation carried out by the OOWV[54] (Oldenburg-East Frisian Water Board) at 16 monitoring points showed that mean nitrate levels in groundwater close to the surface have been rising continuously since reaching their lowest point in 2004. It is thought that the cultivation of maize for biogas and the application of digestate are partly to blame.[55]

The situation can deteriorate further if fertiliser management does not meet the requirements of the crops and specific local conditions, especially if, due to limited storage capacity, digestate is spread onto the maize stubble in the autumn in contravention of the Fertiliser Application Ordinance (DüV). Currently, the legally required storage capacity for digestate is 5 months[56] (according to EEG 2012), which, according to the KLU, is too short a period to adapt the application of digestate on the fields to the plants' needs and improve soil conditions, as stipulated by the DüV. There is currently no coherent concept reconciling EEG and DÜV. When maize is grown as a continuous monoculture, the plants' needs would suggest that slurry or digestate are fed into the soil in spring only. If, instead, they are brought to the fields at the end of the vegetation period, when the autumn rain sets in and the humus balance[57] is already negative, this increases the risk of nutrients being leached into surface and groundwater considerably. In view of the overload of manure and digestate in the areas we have looked at, it would be advisable to investigate whether these regions can cope with a further expansion of the combined livestock-rearing and biogas plant sectors or whether it is possible to export nutrient-rich digestate to regions with a need of such nutrients. This would require separation or upgrading processes. Without a trans-regional redistribution plan for nutrient surpluses, it will not be possible to reduce the excess of nutrients in North Rhine-Westphalia and Lower Saxony.

28. The environmental impact on aquatic and terrestrial ecosystems cannot be directly attributed to the cultivation of energy crops because they are diffuse and cannot be immediately identified. Also, environmental effects largely depend on previous land use, operation management and the susceptibility of the location. When evaluating the impact of the cultivation of bioenergy crops, the reference point must be alternative land use because conventional food and animal feed production has its own impact on soil and water quality. For an in-depth evaluation of the

environmental impact and crop-specific growing recommendations, see publications by vTI (2008)[58] and DWA (2010).[59] The KLU recommends the implementation of these suggestions.

29. Compared to other crops, the marginal return of maize is rather high. That is why it is now grown on sub-optimal sites, such as the Schleswig-Holstein geest (high-permeability soils). These marginal sites are often highly environmentally sensitive, which puts them at a higher risk of erosion, nutrient depletion etc. The exclusive use of maize silage for energy generation often results in maize being grown over several consecutive years on the same site in order to ensure the continuous supply of feedstock for biogas plants (contract-linked obligations etc.) As a consequence, organic matter will be lost from the soil, which has substantial negative implications[60] (see point 22 et seq). The loss of humus has a further negative effect on water retention and filtration properties. In order to keep such negative impacts at bay, several organisations and institutions in Schleswig-Holstein published recommendations on the optimisation of maize cultivation.[61] The DWA has developed similar recommendations.[62] Their implementation, however, is only voluntary at the moment.

30. There is another safety risk for the environment and for public health, associated with biogas production and the application of digestate, especially where other components such as waste from kitchens and canteens, fat separators, processing residues etc.) are added. Such hazards must be eliminated – including pollution with heavy metals and trace elements, microbial hazards and pathogens. It is therefore paramount to sanitize the process comprehensively and comply with the requirements stated in the Closed Cycle Management Act (biowaste ordinance and animal waste disposal ordinance) and the Fertilizer Ordinance. Antibiotics residues from animal farming as well as antibiotics-resistant ESBL and MRSA bacteria have also been detected in manure and fermentation products.[63, 64] Thanks to the legal obligation for waste-fermenting installations to sanitise their feedstock, however, agricultural biogas plants actually tend to reduce or kill pathogens in their digesters.

31. Biogas plants themselves can pose an environmental hazard if the required technological standards are not met. Incidents in the past have shown that digestate, slurry and leachate from biogas plants primarily pollute surface water, killing fish and contaminating groundwater. A list of incidents and failures sometimes leading to considerable environmental damage has been published by the association of citzens' action groups "Initiativen mit Weitblick".[65]

32. The increasing production of energy crops can also lead to changes of the agricultural structure with negative ecological impact. Although increased competition for the arable land for food and animal feed production is unlikely to generate food shortages in Germany, there may be shifts in the agricultural trading balance, as demand for agricultural products increases. Thus, the use of land for growing bioenergy crops may increase the need for importing animal feed. The additional animal feed production in third countries may cause local environmental damage, which would be an indirect effect of the expansion of the bioenergy sector in Germany, also known as leakage effect. What is particularly controversial is the conversion of land with high ecological or conservation value (such as permanent pastures, low-level fens and set-aside land). Ploughing up permanent pastures and reinstating set-aside land for the cultivation of energy crops will release climate-damaging greenhouse gases (carbon dioxide and nitrous oxide) and turn erstwhile carbon sinks into carbon sources. Draining grassland in and around marshland led to the release of considerable amounts of greenhouse gases through peat depletion. This process will be accelerated if these sites are ploughed up. According to estimates from national greenhouse gas reporting, the rate of peat depletion will double to 11 tonnes of carbon per hectare per annum if they are used as arable land.46 In 2011, arable land that had been converted from grassland emitted 1.3 million tonnes of CO2.46 Semi-wetland and wetland sites are important biotopes for meadow breeding birds, perennials that like wet soils and marsh vegetation. Ploughing up and converting such highly significant conservation areas contradicts the objectives of the national biodiversity strategy.

33. High subsidies guaranteed by the law gave growers of energy crops the edge over their economically weaker competitors from traditional (dairy and sheep) farms. These are displaced by energy maize growers, as tenancy rates have been rising through the competition in many places. Especially in areas with minimal return it is becoming increasingly difficult to make a profit from farming grazing cattle for dairy

and meat production - so essential for conservation. As good profits can be made from growing energy crops, taking part in conservation programmes and agri-environmental measures is becoming less attractive. Thus, energy crop cultivation indirectly causes costs for environmental protection to soar, while getting in the way of effective environment management, including the switch to organic farming.[66] The additional negative effects on the environment, climate protection and conservation undermine the environmental policy successes of the past 20 years.

3. Calling for Action

34. With the amendment of the EEG, the legislator is trying to respond to the effects on the environment described above and to transform the subsidies structure on the basis of practical experience. The amended EEG 2012 has introduced some steps that will limit the negative environmental effects. The changes include:
• The abolition of the "Nawaro bonus" and/or the "slurry bonus",
• The introduction of two feedstock tariff classes[67], where ecologically friendly feedstocks earn the higher rate of 2 Eurocents per kWh(el),
• The use of maize and grain feedstock is restricted to 60% of the overall feedstock mass.
• Extra subsidies for small slurry-processing biogas plants (up to 75 kWel)[68],
• Minimum heat utilisation requirement (more on this, however, in point 13 et seq)
• Incentives for flexible power production (rewards with special flexibility rewards for BGPs) and
• An obligation to market their products directly for new BGPs > 750 kWel from 2014.

These new regulations are intended to limit the use of maize feedstock in installations. However, within the existing legal and economic framework, any further increase in new installations will lead to more arable land being used for energy crops and hence to increasing competition for arable land.
Although the EEG 2012 introduces some first measures to limit the excessive use of maize feedstock, it does not go far enough, as all existing installations and their feed-in tariffs are legally protected for 20 years. The same applies to installations receiving the "slurry bonus". In their joint recommendations for reducing the cost of further development in the renewables sector, the BMU (Ministry of the Environment) and the BMWI (Ministry for Economic Affairs and Energy) demanded that the "slurry bonus" be revoked from August 1st 2013. This should include installations that began operations between 2004 and 2008. The "slurry bonus" had been introduced in the amended EEG 2009 and applied retroactively to existing biogas plants. However, this recommendation was rejected in March 2013. As the preservation of the status quo for existing biogas plants cannot be legally challenged, it can be expected that under the prevailing conditions, maize will continue to provide a large proportion of feedstock supplies for biogas plants.

35. Nevertheless, the EEG 2012 amendment has already slowed down the rapid and hectic market expansion of biogas. Compared to previous years, fewer new installations were built.[69] However, old tariff schemes may still apply to extensions and retrofitted existing installations, although the slurry and NaWaRo bonuses have been abolished. A decision by the German Federal Court of Justice is still pending as to what constitutes an installation and how retrofitting should be dealt with. In early February 2013, the 2nd EEG dialogue event hosted by the German Federal Government addressed the subject "The Role and Potential of Biogas". The German Federal Government acknowledges that established subsidies mechanisms have led to wide-ranging repercussions and caused considerable costs.[70]

A memorandum with open-ended questions was compiled in preparation of the dialogue. These questions showed that there seems to be disagreement on the continuation of existing subsidies. One of the issues raised regards the availability of arable land for biogas production in the face of mounting tension between agriculture, conservation and countryside management. In this context, the issue of restoring public confidence in the cultivation of biogas crops was raised. Another issue was whether a quota should be introduced to limit the share of land available for the cultivation of biogas crops and whether it made economic sense to continue to subsidise biogas crops, as very little can be done to cut down costs and their utilisation potential is limited. The German Federal Government is looking for solutions. These are mainly directed to alternative crops and feedstocks (residue and waste material). There was also the question whether it made sense to continue subsidising smaller installations at a higher rate.
The KLU welcomes the critical stance the Federal Government is taking on biogas subsidies policy. We take the view that subsidy policies for the development of renewable energies must keep up with the latest insights and counteract emerging anomalies. We will continue to monitor the process closely.

4. Objectives for multifunctional Bioenergy Generation with Environment Protection in Mind

36. The KLU sees an urgent need for a review of the biogas subsidies policy and an efficiency optimisation of existing installations.

It was a political decision to subsidise biogas plants and it was almost exclusively focused on the rapid development of power generation from biomass crops. What it did not take sufficiently into account was land use and ecological synergy effects. A sustainable subsidies policy should look not only at the objective of developing renewable energies, but also at external services which are perhaps not marketable, but socially desirable (joint-benefit products) and make these available to conservation and environmental protection. The existing subsidy policy has created incentives and instruments that clearly clash with conservation as well as climate and environment protection in many respects. No further development of biomass crop-based biogas (NaWaRo biogas) should therefore be subsidised. The KLU is convinced that only those installations should be subsidised that comply with the objectives listed below, which should apply to agriculture in general:

Water protection: There must be benefits for water protection. Deposition of silt and nutrients in surface water must be avoided and nitrate and pesticide contamination of groundwater minimised.

Soil protection Crop cultivation must not damage the structure, humus content, susceptibility to erosion as well as the fertility and productiveness of soils, but enhance them (e.g. legume crops and other humus-building crops).

Biodiversity: Biodiversity must not be compromised by the cultivation of feedstock crops, but enriched (new, more varied crop rotation, creation of wild flower verges for bees, retreat areas and breeding grounds and also grassland).

Climate protection: Subsidised biogas production must save at least 50% of GHG compared to its fossil counterpart[71], indirect land use effects considered.

Agricultural structure: The agricultural structure must at least be preserved or, where possible, improved and developed in ecological terms. Tenancy rates must not be affected and the switch to organic farming must not be obstructed. There must not be competition for land use with dairy farmers and agri-environmental measures.

Food security: The use of feedstock for energy generation must not infringe on the land use for food and animal feed production (no competition for land through biomass crops; utilisation of agricultural residue material and/or exclusive use of crop feedstocks with added environmental services).

5. Optimisation and Reorientation - what Instruments could be harnessed?

37. The preservation of the status quo for existing installations enshrined in the EEG does not leave any scope for retrospectively implemented restrictions. Thus we first point out legal steering instruments relating to procedures and subsidies that could be used in the short term to restrict the further development of maize-based biogasification under the existing status quo protection. Such instruments could make alternative crops and feedstock more attractive by targeting funding towards synergy effects in environmental, nature and climate-protection. The main objective is to make the operation of existing biogas plants more environmentally friendly and to encourage more crop diversity. The restrictions would apply generally if existing agricultural and environmental legislation could be implemented and tightened, irrespective of the actual use of crops (food or animal feed, crops for existing or new installations or recycling). Administrative legislation is there to prevent negative effects of intensive farming methods on soil, water, air and biodiversity. Although the developments criticised in point 22 et seq. are the result of economic advantages for energy crop cultivation, the relevant growing and production methods fall within the remit of agriculture itself. The KLU sees therefore an urgent need to adapt regulatory and sector-specific legislation. Table 1 in the Appendix contains an overview of recommendations and suggestions for practical measures.

5.1 Environmental legislation:

38. 38. Environmental legislation (including the Federal Soil Protection Act (BBodSchG), Federal Soil Protection Ordinance (BBodSchV), Federal Conservation Act (BNatSchG), etc.) defines standards for agricultural production methods. Article 17 of the Soil protection Act defines good agricultural practice in terms of soil protection. This article, however, is no more than a non-binding rule, and contravention is not a sanctionable offence. Good agricultural practice is based on the principle of sustaining fertility and productiveness of the soil. Crops and cultivation methods must be suitable for the soil and the location to comply with the precautionary approach laid out in Article 7 of the Soil Protection Act. Erosion, damage through compaction and structural change of the soil, the loss of humus and a decline in biological activity in the soil must be avoided.

The KLU recommends the tightening of Article 17 and a clear, legally binding definition of what constitutes site-adapted agricultural use. These could be based on the recommendations of the DWA, the vTI and the information sheet from Schleswig-Holstein. The "good agricultural practice for cultivating maize" defined in the latter should be extended to other crops that seem problematic from an agri-environmental perspective (e.g. sugar beet, see point 19) and become legally binding. This would create an instrument that would subject the cultivation of maize and possibly sugar beet for animal feed or energy purposes to legally binding rules. These could then limit the undesirable side effects described under point 19 et seq. The KLU cannot sufficiently emphasise the need for making use of this option.

5.2 Subsidies legislation (Cross Compliance including GAEC):

39. The KLU also deems it necessary to review European subsidies legislation in the agricultural sector and make cultivation of arable land according to local needs, as defined in the GAEC standards, legally binding. Requirements regarding avoidance of erosion and loss of organic matter must be extended and better defined.

5.3 Legislation in the agricultural Sector:

40. The Fertiliser Application Ordinance must be extended to include the agricultural use of digestate. The KLU recommends in particular the inclusion of all digestates from biogas plants (i.e. also crop digestates) within the upper limit of 170kg of nitrogen per hectare and year set for manure-based fertilisers.. The reason is that the nitrogen dynamics of digestate largely resemble those of manure. The release of nitrogen is difficult to predict, and thus a certain amount of mineral N fertilization should be reserved to ensure optimum supply for crops. Nitrogen from digestates should be factored in when it comes to determining fertiliser requirements and planning fertilisation schedules for farms.

Furthermore, the KLU recommends that digestates should be subject to the same environmentally relevant regulations as manure. This would apply, for example, to the Application Ordinance and the establishment of manure registries. The KLU intends to look at the Fertiliser Application Ordinance in detail and identify what changes should be made. These recommendations will be published separately in due course.

5.4 Biogas Plants Ordinance (Biogas-Anlagen-Verordnung):

41. A biogas plants ordinance is currently in preparation. It will contain requirements concerning emission abatement and plant safety. The KLU recommends that for a better climate balance, not only emission thresholds must be defined, but also storage capacity for digestates must be extended to 9 months (with adequate transition periods for existing plants).[72] This would ensure that digestates are stored and applied as fertilisers in line with good agricultural practice (i.e. according to the needs of crops - often in spring only).

5.5 Bioabfall-Verordnung:

42. The KLU has highlighted the problems surrounding the composition of digestate and their agricultural use (see point 30). We recommend that the biowaste disposal ordinance should specify what types of digestate containing what type of feedstock should be applied to what type of land. Applying biowaste in water protection areas should only be permitted in agreement with the competent water regulatory authority. The requirements in Article 52 of the Federal Water Act (WHG) should contain more specific advice on the application of digestate. The recommendations made by the DVGW-BGK (German Technical and Scientific Association for Gas and Water, section for compost quality) on the compatibility of digestates with water protection areas would be a good starting point.[73]

5.6 Biomass Ordinance (Biomasse-Verordnung):

43. The KLU recommends that clover- grass crops and alfalfa (lucerne)-grass crops should be included as main crops in feedstock tariff class (EVK) II of the Biomass Ordinance. The KLU cannot understand why tariffs have so far been paid only when these crops were grown as catch crops. This puts organic farmers in particular, who often use clover-grass crops as main feedstock in their biogas plants, at a disadvantage.

5.7 Renewable Energy Sources Act (EEG) (Erneuerbare Energien-Gesetz):

44. The EEG is the core steering instrument for the promotion of renewable energy in the electric power sector, where biogas is only one of several types of renewable energy championed. In order to implement the basic recommendations for future (new) installations outlined above, the KLU recommends that subsidies for biogas production from biomass crops be abolished immediately and feedstock tariff class (EVK) I be revoked altogether, as it largely applies to NaWaRos. This would make the use of renewable raw materials in new installations no longer profitable and the subsidies-induced expansion of NaWaRo land use for energy purposes would probably come to an end.

Upon abolishment of EVK I, criteria for EVK should be reviewed and some crops that are ecologically more compatible transferred from EVK I to EVK II, provided this is justified by the humus balance.[74]

45. The EEG should offer an incentive for existing plant operators to switch voluntarily to the new EVK II (ecologically compatible materials). This could be achieved by a sufficiently large difference in feed-in tariffs of EVK I (currently 6 Eurocents per kWh) and EVK II (currently 8 Eurocents per kWh)[75] Whether the current difference of 2 Eurocents is sufficient to motivate farmers to switch must be investigated in due course. If this is not the case, this should be rectified. Another incentive could come from a one-off investment bonus for updating equipment in existing renewables-based BGPs to enable them to process alternative feedstocks.

46. In order to create an incentive for the use of material from countryside management and extensive grassland in existing plants falling under EEG 2009 regulations, tariffs for countryside management material should be paid in proportion to the material used, starting from the first tonne, in analogy to regulations in EEG 2012. The energy yield in the

Biomass Ordinance should be adapted to the energy yields that were actually obtained from countryside management material. No minimum threshold for feedstock should be set because often, very small quantities (waste) are used. Existing installations that have already been using over 50% countryside management waste will be protected and continue to receive the tariff they had previously been receiving.

47. The KLU considers the comprehensive and effective use of process heat as a basic criterion for BGPs to receive subsidies (see points 13-18). As a matter of principle, BGPs should be erected only where there is demand for heat. The decentralised supply of heat in rural areas should be given more consideration when choosing a location and authorising the operation of new BGPs. The KLU therefore recommends that the approval of new installations should depend on proof of fulfilling the obligation to use 70% of the heat generated (including own consumption)[76] In order to qualify, individual plants must be designed to accommodate regional power and heat needs. The value (and scarcity) of biomass resources requires optimum utilisation of its energy content. As an alternative, the purification of biogas to gas quality standards should be permitted so that it can be fed into the natural gas grid. This would ensure that the resulting biomethane could be used where power and heat could both be utilised at their optimum efficiency level.

48. Biogas - including biogas from residue and waste material - is storable and should therefore be used to meet peak demand rather than for covering the base load. This would require sufficient storage capacity, additional installed capacity, remote control technology for installations and additional heat storage facilities where applicable.

49. Over and above the restrictions mentioned, the KLU sees a need for incentives that encourage the environmentally-friendly operation of biogas plants. This could be achieved within the scope of the EEG and also as part of the upcoming CAP reform (Greening, agri-environmental measures) (see point 51-54). For the greatest possible efficacy and to encourage as many farmers as possible to use alternative feedstock with positive synergy effects, it would make sense to use both instruments in combination (e.g. using feedstock from extensive growth on ecologically sensitive areas for biogas generation).

5.8 Cap Reform (future Subsidies Legislation):

50. Within its legally binding Greening component, the reform of the common agricultural policy in the EU (CAP) offers various options to encourage biogas-producing farmers in particular to practise more environmental protection while providing feedstock for their BGPs.

51. In an earlier statement[77], the KLU recommended that as part of the Greening component, direct payments should go to three-crop rotations with a maximum share for one specific crop of 45%. An analysis of the Greening component[78] carried out by the vTI revealed that over half of biogas-producing maize farmers do not even comply with the maximum share of 70%, originally suggested by the EU-COM, for three-crop rotation. The KLU therefore re-emphasises its demand for a maximum crop share of 45% within the Greening component. It emphatically recommends the revocation of EVK I. As an alternative, operators of existing plants should be given incentives for switching feedstock. In the absence of such measures, most farmers will probably not take part in the Greening component and rather accept cuts in their direct subsidies.[79] If, instead, EVK I were revoked (for new installations and existing installations were given an incentive for switching) and the 45% crop share were adhered to, this would create an additional incentive for integrating EVK II alternative feedstock into the crop rotation and use it in BGPs.

52. In accordance with its opinions published on the CAP reform, the KLU favours a blanket ban on ploughing up grassland.[75] The conservation of grassland and the designation of ecological focus areas (EFAs; which, according to current negotiations, should initially make up 5% of arable farm land from 2015 and 7% from 2017 if applicable) are further components in the Greeningof direct payments. In the opinion of the KLU, extensive culture of feedstock for BGPs (grass and residues from EFAs) should be recognised as ecologically beneficial land use. The additional incentive of higher tariffs in EVK II (see above) for the use of grassland cuttings and residues from EFAs would make the Greening more attractive. Farmers complying with Greening criteria and using plant material for power generation would be doubly rewarded.

53. Agri-environmental measures could provide further incentives and subsidy opportunities. Residues from such areas could also be used for energy generation. Agri-environmental measures and programmes should therefore be extended and modified to include the use of residual products, as long as these are at the end of cascading use and do not infringe on environmentally compatible farming. Adequate funding of the second pillar would be indispensible.

5.9 Consultation:

54. The KLU recommends an intensive consultation process during which existing plants should be upgraded. The consultation should focus on the reduction of losses (e.g. during feedstock storage), increased efficiency of installations (e.g. fermentation processes) and the optimisation of heat use. Practical monitoring results show that there is considerable room for improvement.

6. Outlook

55. In the view of the KLU, the implementation of the objectives for sustainable, multifunctional biogas production described in point 36 requires a change of direction for the biogas subsidy policy. Not only must regulatory and subsidy-related legislation be harnessed in the short term to curb ecological anomalies in the current subsidy policy for existing installations, but in the future, subsidies should be mainly directed to biogas resources that do not rely on biomass crops, but are based on waste and residue recycling and combine energy production with other environmentally and socially beneficial goods. These include process heat that can be regulated and used effectively. Subsidising these types of biogas production may be cost-intensive, but they pay for additional external services.

56. It is generally true that overloading the agricultural nitrogen cycle in ecological terms (by buying in animal feed, applying manure and digestate), in particular in the livestock-rearing regions of Germany, has resulted in groundwater thresholds set in the Nitrate Directive being exceeded and the objectives of the WFD not being reached. Nutrients contained in digestate are easily available to plants, irrespective of the feedstock they are derived from. Valuable as they are as fertilisers, they can also contribute to a nutrient overload that pollutes water and air. The KLU therefore stresses that before approval, the operator of a new BGP must be able to show that thresholds set by the Fertiliser Application Ordinance regarding organic fertilisers and N-balance surpluses will be adhered to when digestate from biogas production is applied to arable land, and efficient use will be made of the nitrogen. Farm gate balancing should be applied to individual farms. The KLU would also like to point out that the effect of digestate on humus, greenhouse gas emissions and nitrate leaching potential have not yet been sufficiently investigated.

57. In regions with lower livestock populations, small flexible decentralised waste and residue recycling plants and also organic biogas plants ("Bio-BGA") could provide heat, energy and fertiliser in response to demand. As mentioned above, the KLU takes the view that such installations should not only provide flexible power supply, but also decentralised heat supply.

58. The types of BGPs we have in mind in this context are those used in organic farming to produce renewable energy. Since especially in farms that do not rear livestock, applying digestate could help restore nutrients, these biogas plants would provide additional ecological services, using predominantly clover-grass and lucerne-grass feedstock alongside manure. Before a plant is approved, it must be ascertained that the biomass crop cannot be used as animal feed. Clover and lucerne are nitrogen-fixing plants (legumes) with extensive root systems and long-lasting ground cover and have an improving effect on the soil and its fertility. Clover-grass crops play an essential part in crop rotation in organic farming in order to retain soil fertility. In arable farms where it cannot be used to feed livestock, clover-grass crops are predominantly used as green manure and do not generate direct yields and profits. Their use in BGPs represents value added for farms without livestock, as synergy effects in terms of crop rotation, nutrient supply from farm land and weed control can be harnessed. In addition, the versatile production structures and processing activities often found in organic farming may offer opportunities for the use of process heat.[80]

59. The use of ecologically beneficial crops in biogas plants on organic farms not only produce internal synergy effects, but also further important ecological services for water and soil protection and for biodiversity and climate protection (fewer GHG emissions through legume crops, no use of mineral fertilisers, fewer CO2 and N2O emissions due to digestates). These crops comply with the objectives defined under point 36 and should receive more funding in the future as alternative bioenergy resources. The above also applies to conventional farms using clover-grass and similar crops. Many negative effects of silage maize could be abated (e.g. erosion control in high-risk locations, humus rebalance, improvement of soil fertility, crop diversification etc.) if it were partially replaced with clover-grass crops.
In this context, we repeat our demand that clover-grass and alfalfa (lucerne)-grass crops should be included as main crops in feedstock tariff class (EVK) II of the Biomass Ordinance in order to avoid discrimination against organic farmers.

60. Using grassland growth from extensive farming is a further contribution to sustainable, nature-com-

patible energy generation, preserving the diversity of the countryside and the habitats of many endangered plant and animal species. According to estimates by the DVL and the NABU, Germany has an available area potential of approximately 900,000 hectares. The energy potential is 12 PJ per annum and can be increased through energy generation from roadside vegetation by a further 1.2 PJ/a.[81] However, the KLU would like to point out that using extensive grassland growth for energy production only makes sense where it can no longer be used as forage or bedding and such use cannot be introduced. Again, the same principle applies: In cascading use of biocrops, use for energy production should be the final step. There must not be any competition with grazing and livestock farming, as extensive grazing has a place in the preservation of wood pastures, mountain meadows/ pastures, heathland and wetlands with their specific vegetation and characteristics.

Under the above premises, the use of extensive grassland for energy generation provides several ecological benefits with synergy effects for nature conservation and environmental protection. It can ensure sustainable long-term management of the open countryside and sustain its recreational value. It can help to reduce conservation costs, as the disposal of grassland cuttings has so far been a cost factor.

In addition, extensive grassland often occupies sites at risk of erosion, dry or wet locations or flood plains, where it protects soil, groundwater and surface water. Preserving these areas, especially wet, humic sites, helps to protect the climate because ploughing up grassland results in major CO2 emissions. After all, the preservation of extensive grassland and its use in compliance with conservation standards will also preserve meadow-breeding birds and types of habitats, as stated in the Habitats Directive (lowland and mountain hay meadows, wetland meadows etc) with their typical species diversity (e.g. dusky and scarce large blue butterfly species). Using waste material for energy generation can prevent intensive farming and ploughing up grassland and provide the ecological services described above, as long as subsidies for extensive use (energy generation and statutory conservation) represent a viable and profitable alternative to land use such as ploughing up grassland to grow maize crops. The KLU therefore recommends increasing subsidies for extensive grassland management and for energy generation from countryside management residues in the future. In this context, the KLU welcomes that material from countryside management has been clearly defined in the EEG 2012 and the difference to roadside vegetation made clear. In our opinion, the development of suitable harvesting equipment and innovative shredding technology for biogas plants should also receive subsidies. This seems to be the only way that countryside management materials and extensive grassland management can contribute to renewable energy production, while also protecting nature.

61. The KLU favours the continuation of special subsidies for small slurry-processing biogas plants. Agricultural fertilizers of animal origin are residues that accrue anyway and do not require additional area. They comply with objectives defined in point 36. During the fermentation process, nitrogen compounds in slurry are transformed (digested), making nutrients available for plants, while also reducing emissions of greenhouse gases (methane, carbon dioxide and nitrous oxide). These are additional ecological services provided by slurry-processing plants. In order to increase the output of small slurry-processing plants, it makes sense to continue to allow them to use other feedstock up to a maximum of 20% mass. However, the KLU supports the continuation of the subsidy policy for small slurry-processing plants only if alternative EVK II feedstocks are added (see point 44 et seq.)

7. Conclusion and Recommendations

62. The use of biomass grown specifically for energy generation can have negative outcomes for environment protection and nature conservation, as illustrated in our example of maize silage, and will counteract efforts to achieve climate and biodiversity objectives. Referring to the questions raised during the biogas dialogue event held by the German Federal Government, the KLU makes the following suggestions and recommendations:

63. The KLU takes the view that the energetic potential of biomass lies primarily in the use of agricultural residues and other organic waste material, as well as in the use of crops with added ecological services, as defined in point 36. The agricultural sector can realise its potential by using feedstock from grassland, waste material from countryside management (in line with conservation rules), slurry and environmentally beneficial crops and plants (e.g. legumes, wild flowers around fields and on verges, etc.)

64. Any new biogas plants should provide power only where needed to smooth fluctuations in the power supply from other renewable sources. The use of existing biogas plants should be reviewed according to similar criteria.

65. Another precondition for the use of biogas, in the KLU's view, is a comprehensive and effective use of the heat generated. Residue and waste-recycling plants have a potential for the sustainable supply of heat in rural areas that, to date, has neither been sufficiently recognised nor sufficiently funded. We recommend the allocation of more research funding within the sector to provide adequate support for the development and implementation of relevant concepts and strategies.

66. Alternatively, the KLU recommends financial support for feeding biomethane into the gas grid. Funding should cover not only research into efficiency gains and cost reduction, but also the actual construction of such installations.

67. Technological upgrading and the use of the most ecologically beneficial crops (e.g. clover and grass feedstocks) should be made more attractive to operators of existing biogas plants through incentives and bonuses. This would help reduce the negative environmental impact from existing installations still covered by the outgoing subsidies plan.

68. In order to limit damage to the environment through intensive farming, the KLU recommends that legislation in the environmental and agricultural sectors be reviewed and adaptations made to European subsidies legislation.

69. The Common Agricultural Policy of the EU provides incentives for the switch to a more environmentally friendly agriculture including biogas production. In order to be effective, the Greening component should become mandatory and adequate funding of the second pillar should be available. The KLU has clarified its position on the reform of the Common Agricultural Policy in various statements.[82]

70. Furthermore, the KLU recommends that there should be a legal obligation to carry out a regional nutrient analysis of the area in view of the application of digestate before a new biogas plant is approved. What must be prevented is the establishment of biogas plants in regions where the additional application of digestate will result in nutrient overload and not comply with soil and water protection requirements. A legal framework must be created that makes it possible to withhold permission for the construction of further installations in areas suffering already from nutrient overload.

71. The KLU would like to emphasise that Germany has taken a lead role in the world in terms of switching energy supplies. What looked like a recipe for success - biogas from biomass crops - is already being exported to neighbouring countries. To prevent it from turning into a recipe for disaster in environmental terms, the Federal Government should give priority to residue and waste feedstock in biogasification and make operators of existing plants aware of these recommendations.

72. From the KLU's view, it will be necessary to revisit the situation, including legal instruments and their effects and consequences, in due course and evaluate them in a critical light. It may be necessary to make a few practice-relevant amendments that will facilitate sustainable and effective bioenergy generation from residue and waste material.

Table 1

Recommendations and suggestions for a change of direction in biogas funding. In this context, the KLU would like to emphasise that energy saving remains the most cost-effective of all sustainability measures.

Instrument	Restrictions		Incentives	
	Existing plants	**New plants**	**Existing plants**	**New plants**
EEG	**Preservation of the status quo**	• Revokation of EVK I (NaWaRo) • Reclassification of ecologically non-hazardous material (e.g. fodder beet leaves) as EVK II • Mandatory, documentable use of 70% of waste heat	• attractive offer for the switch to the new EVK II (ecologically beneficial feedstock) with substantially higher tariffs than EVK I (essentially renewable raw materials) • one-off investment bonus for refitting existing renewables-based BGPs to enable them to process alternative feedstocks. • Revoking the minimum threshold of 50% for the use of countryside management waste in the EEG 2009, combined with switching offer for existing installation operators, no automatic "NaWaRo bonus"	• Continuation of targeted funding for small recycling plants (small slurry-processing plants, waste digesters) • Subsidies for upgrading to biomethane
Biomass Ordinance			Inclusion of clover-grass and lucerne crops as main crops in EVK II	
Fertiliser Application Ordinance	Comprehensive inclusion of digestate in calculating the nutrient limit of 170 kg N per hectare p.a.			
Environmental legislation:	Tightening of good agricultural practice for agricultural production adapted to site-conditions, irrespective of final use, made mandatory			
Federal Soil Protection Act (BBodSchG Art. 17)	• Extension of storage capacity for digestates to 9 months (with adequate transition periods for existing plants). • Proof of adherence to emission thresholds to improve the climate balance, with transition period for existing installations.			
BGP Ordinance			Greening: Crop diversity Limitation of the maximum share of one crop type to 45%, while abolishing EVK I for new plants and establishing incentives for existing installations as part of the Greening component. Preservation of grassland and ecological focus areas: • blanket ban on ploughing up grassland • recognition of ecologically beneficial land use for extensive grassland management and the provision of feedstock (grass and residues from EFAs) for BGPs Second pillar: • Extension and changes to agri-environmental measures for energy generation from residue material	

Notes

1. UBA (2010): Energy target 2050: 100% renewable electricity supply. Conclusion of the study: "For Germany an electricity supply system based completely on renewable energies by 2050 is technically... feasible...without compromising either Germany's position as a highly industrialised country or modern behavioural and consumption patterns." (op.cit. p. 4).
2. UBA (2013): Germany in 2050 - a greenhouse gas-neutral country
3. BMU (2013): Renewables in Figures At: http://www.erneuerbare-energien.de/die-themen/datenservice/erneuerbare-energien-in-zahlen/erneuerbare-energien-im-jahr-2012/
4. BMU (2013): Development of renewables in Germany in 2012, based on current data of the working group Erneuerbare Energien-Statistik (AGEE-Stat, renewable energy statistics). Diagrams and tables. Updated: February 2013:
5. Kaltschmitt, et al. (2009): Energie aus Biomasse - Grundlagen, Techniken, Verfahren. (Energy from biomass - foundations, techniques, and methods). 2. Heidelberg : Springer Verlag, 2009.
6. SRU (2007): Klimaschutz durch Biomasse. (Climate protection through biomass) Special report. P. 99
7. WBGU (2008): Welt im Wandel. (World in transition) Zukunftsfähige Bioenergie und nachhaltige Landnutzung. (Future-proof bioenergy and sustainable land use) P. 1
8. BMELV and BMU (2009): Nationaler Biomasseaktionsplan für Deutschland - Beitrag der Biomasse für eine nachhaltige Energieversorgung. (National Biomass Action Plan for Germany - the Contribution of Biomass of a sustainable energy supply).
9. FNR (2013): Anbauflächen für nachwachsende Rohstoffe. (arable land for renewable raw materials). At: http://mediathek.fnr.de/grafiken/anbauflache-fur-nachwachsende-rohstoffe-2012-grafik.html
10. WBA (2007): Nutzung von Biomasse zur Energiegewinnung – Empfehlungen an die Politik (The use of biomass feedstock for energy generation - recommendations for policy makers). Conclusion: The subsidised lines of bioenergy feedstocks (biofuels and biogas based on maize) are inefficient not only from an energy, but also from a climate policy perspective. Only those bioenergy types should be subsidised that do not compete with food production, that help to avoid methane emissions from slurry, and/or are associated with very low CO2eq abatement costs or a very high CO2eq abatement potential.
11. WBA (2011): Förderung der Biogaserzeugung durch das EEG (Support of biogas production within the EEG). Statement on the planned amendment to the EEG. Conclusion: Subsidies for biogas production in their present form should be discontinued. They cannot be justified from a climate policy perspective, as they lead to high CO2 abatement costs, especially if indirect land use changes are taken into account. Their contribution to the overall energy supply is negligible, but results in problematic changes in the agricultural structure (nutrients, crop rotation), increasing prices for agricultural products and a new dependency of the agricultural sector on policy.
12. SRU (2007): Klimaschutz durch Biomasse. (Climate protection through biomass) Special report. Conclusion: The availability of arable land puts restrictions on the growth potential of biomass. Biomass cultivation competes with food and animal feed production and can only be supported where it is in compliance with the requirements of conservation and countryside management. The support for biomass production must take its lead from climate protection and a holistic energy concept must be developed. Recommendations: A freeze on the fuel quota, support for combined heat and power generation, in combination with national and international ecological standards.
13. WBGU (2008):Welt im Wandel (World in transition). Zukunftsfähige Bioenergie und nachhaltige Landnutzung. (Future-proof bioenergy and sustainable land use) Conclusion: The sustainable bioenergy potentials available worldwide should be exploited as long as sustainability is not put at risk, especially in terms of food security as well as conservation and climate protection objectives.
14. Leopoldina (2012): Bioenergie: Möglichkeiten und Grenzen (Bioenergy - opportunities and limitations). Conclusion: no further expansion of the bioenergy sector, support only for those feedstocks that do not compete with food supply, which, in turn, would lead to food scarcity and price increases. The types of bioenergy supported should have no major negative impact on ecosystems and biodiversity, while their carbon footprint must be significantly smaller than that of the fossil energy they are replacing.
15. LUC: Land use change: Land use changes due to the cultivation of biomass as energy feedstock, e.g. deforestation, cultivation of grassland, turning wetland into arable land. ILUC: Indirect land use change: indirect land use changes due to the cultivation of bioenergy crops on existing arable land, while food production is being displaced to other areas.
16. EWSA (2013): Opinion of the European Economic and Social Committee on the „Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC concerning the quality of petrol and diesel fuels and amending Directive 2009/28/EC concerning the promotion of the use of energy from renewable sources.
17. Purpose-grown biomass are defined as energy crops, i.e. biogenic energy carriers from agricultural production (plants grown on fields and grassland) that have not been previously used in any other way, but are combusted or converted into gas.
18. For biomass from waste, GHG emissions are attributed to the main product and not to the waste that is utilised to generate energy.
19. The EU Commission has published a topical proposal on how to deal with the ILUC issue - by flagging up ILUC emission factors for prevalent biofuel feedstocks. COM (2012) 595 – Opinion of the European Economic and Social Committee on the „Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC concerning the quality of petrol and diesel fuels and amending Directive 2009/28/EC concerning the promotion of the use of energy from renewable sources. The proposal is currently controversially debated between policy makers and experts.
20. Ordinance on requirements pertaining to sustainable production of bioliquids for electricity production (Biomass-electricity-sustainability ordinance – Biomassestrom-Nachhaltigkeitsverordnung (BioSt-NachV))
21. Ordinance on requirements pertaining to sustainable production of biofuels (Biomass-biofuel-sustainability ordinance – Biokraftstoff-Nachhaltigkeitsverordnung (Biokraft-NachV))
22. Jehring et al. (2012): (Sustainable use of global land and biomass resources).
23. The KLU would like to point out that material flows must be considered each in their own right. There are huge regional differences as well as technological and logistical limitations. Furthermore, protein-rich residual matter should be primarily used as animal feed in line with the protein strategy of the BMELV (Federal Ministry of Food and Agriculture),

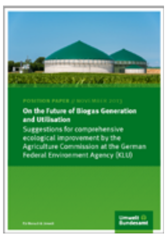
while composting should become more widespread and replace the use of peat in order to protect soils and wetland. As a general principle, the accumulation of residual and waste matter should be avoided.

24. Biomethane could only be a transition technology option, while the other options mentioned are gaining ground.
25. Lowest cost per tonne of CO2 equivalent saved.
26. Jering, A. et al. (2012): Sustainable use of global land and biomass resources. Position paper, published by the Federal Environmental Agency.
27. This does not mean we have to go back to square one, as it is possible to adopt criteria from the Biofuel Sustainability Ordinance and the Biomass-Electricity Sustainability Ordinance. These can be generalised, modified and amended so that they apply to solid and gaseous energy carriers, as required.
28. Power generation should be combined with the generation and reuse of renewable heat, which still happens far too rarely.
29. BMU (2012): Langfristszenarien und Strategien für den Ausbau der erneuerbaren Energien in Deutschland bei Berücksichtigung der Entwicklung in Europa und global. (Long-term scenarios and strategies for the deployment of renewable energies in Germany in view of European and global developments). P. 115.
30. Scenario 2011 A describes a middle-of-the-road scenario for the development of renewables in the electricity sector. By 2050, electric vehicles (vehicles powered exclusively by electricity and plug-in hybrids) will account for 50% percent of all vehicle kilometres. The remaining transport will rely on biofuels as well as vehicles powered by hydrogen. Vehicles overall will have become more efficient. Hydrogen will also be used as a chemical storage medium for renewables-based electricity in combined heat and power generation and for short-term reconversion into power. The scenario takes into account the nuclear exit decision of the Bundestag of June 30th 2011 (13th act amending legislation on nuclear power).
31. BMU (2013): Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland unter Verwendung von Daten der Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat). Time series on the development of renewables in Germany, using data provided by the working group on renewable energy-statistics (AGEE-Stat)). Last updated: February 2013: P. 38
32. There were also some small additional changes.
33. Fachverband Biogas (2013): Branchenzahlen 2012 und Prognose der Branchenentwicklung 2013.(Industry figures for 2012 and forecast of the development of the industry for 2013).
34. WBA (2011): Förderung der Biogaserzeugung durch das EEG (Support of biogas production within the EEG). P. 4.
35. DBFZ (2012): Monitoring zur Wirkung des Erneuerbare-Energien-Gesetz (EEG) auf die Entwicklung der Stromerzeugung aus Biomasse. (Monitoring the effect of the Renewable Energy Sources Act on the development of power generation from biomass. P. 85 Use of feedstock for energy production: 77% renewable raw materials, 14% excrement, 8% biowaste, 1% industrial and agricultural residues.
36. Existing plants are protected and thus not affected by the new rules (abolition of the NaWaRo bonus and a cap on maize feedstocks). Although new plants do not receive the NaWaRo bonus, their basic feed-in tariff (depending on installation capacity) was increased. The difference between renewable raw materials (feedstock tariff class I) and ecologically preferable raw materials (feedstock tariff class II) is no more than 2 Eurocents per kWh. It can therefore be assumed that the percentage of biocrop feedstock will remain at the existing high levels.
37. Plant operators who make up at least 30% of their overall biomass feedstock by slurry receive subsidies (NaWaRo bonus 7 Eurocent + slurry bonus 4 Eurocent) for the overall output of their plant. However, 30% slurry generate just about 7% of the electricity, while 93% are generated from energy crops.
38. DBFZ (2012): Monitoring zur Wirkung des Erneuerbare-Energien-Gesetz (EEG) auf die Entwicklung der Stromerzeugung aus Biomasse. (Monitoring the effect of the Renewable Energy Sources Act on the development of power generation from biomass. Final report on the EEG period 2009 to 2011. Last updated: March 2012. An installation's own demand for heat varies considerably, depending on the size of the installation and the feedstock used, in a range between 7% and >80% of the overall heat generated. Small installations in particular and those using a large proportion of slurry in their feedstock require large amounts of heat to keep up their fermentation temperature. The average own heat demand lies around 30%. Of the remaining heat available for external use, the DBFZ (German Biomass Research Centre) estimates that approximately 45% are actually utilised. In other words, approximately 31% [45% of 70%] of the overall heat generated is used externally
39. - a problem (heat wastage) not unknown, however, to conventional power stations.
40. Gelsenwasser AG et al. (2010): Kooperationsvorhaben „Nachhaltiges Biogas am Niederrhein" – Biogaseinspeisung als dezentrales, partnerschaftliches und nachhaltiges System. (Cooperation project Sustainable biogas at the Lower Rhine - a decentralised, cooperative and sustainable biogas feed-in system). IN: Energie- Wasserpraxis 11/2010. 56-62.
41. Deutsche Energie Agentur (German Energy Agency, dena) (2012):Branchenbarometer Biomethan. Daten, Fakten und Trends zur Biogaseinspeisung. (industry barometer for biomethane. Data, facts and trends on feeding in biogas).
42. FNR (2012): At: http://mediathek.fnr.de/grafiken/pressegrafiken/maisanbau-in-deutschland.html
43. Statistisches Bundesamt (Federal Statistical Office), BMELV (2012): 132. Livestock
44. BMU (2013): Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland unter Verwendung von Daten der Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat). Time series on the development of renewables in Germany, using data provided by the working group on renewable energy-statistics (AGEE-Stat)). Last updated: February 2013:
45. Feed-in tariffs for solar power are currently around 11-15 Eurocents per kWh, those for power from onshore windfarms around 5-9 Eurocents per kWh (and about 15 Eurocents per kWh for offshore windfarms). Feed-in tariffs for power from biomass depend on the size of the installation and the feedstock used. The range is between 11 and 25 Eurocents per kWh with an average of approximately 18 Eurocents per kWh ((Frauenhofer-ISE 2012: Studie Stromgestehungskosten erneuerbare Energien and BMU 2012: EEG-Vergütungssätze).
46. EuroNatur (2013): Bioenergie neu bewerten. Tonne/Trog/Tank/Teller/Tagfalter: Welchen Beitrag kann eine nachhaltige Bioenergie zur Energiewende leisten? (Bioenergy re-evaluated. Barrel/trough/tank/plate/moth - what contribution can sustainable bioenergy make to the energy turnaround?)
47. Soil Protection Commission at the Federal Environmental Agency (KBU, 2008): „Bodenschutz beim Anbau nachwachsender Rohstoffe." (Soil protection in the cultivation of renewable raw materials) http://www.umweltbundesamt.de/

uba-info-medien/3472.html
48. Reporting pursuant to the United Nations Framework Convention on Climate Change and the Kyoto Protocol in 2013. Nationaler Inventarbericht zum Deutschen Treibhausgasinventar 1990 – 2011, (national inventory report on the German greenhouse gas inventory 1990-2011) Umweltbundesamt, EU-Submission 15.01.2013
49. Poeplau C, Don A, Vesterdal L, Leifeld J, Wesemael B van, Schumacher J, Gensior A (2011) Temporal dynamics of soil organic carbon after land-use change in the temperate zone - carbon response functions as a model approach. Global Change Biol 17(7):2415-2427
50. Gensior A, Roth G, Well R (2012) Landwirtschaftliche Bodennutzung: eine Bestandsaufnahme aus Sicht der Klimaberichterstattung. (Agricultural land use – taking stock from a climate perspective) Bodenschutz 17(3):81-89
51. Höher (2012): Auswirkungen der Bioenergie auf die Landwirtschaft in Niedersachsen. (Effects of bioenergy on the agriculture of Lower Saxony). Talk given at the Biogas Forum 2.5.2012.
52. LWK Niedersachsen (2010): Maisanbau folgt Biogasanlagen. (maize cultivation follows biogas plants).
53. NLWKN (2010): Niedersächsisches Modell- und Pilotvorhaben - Energiepflanzenanbau, Betrieb von Biogasanlagen und Gärrestmanagement unter den Anforderungen des Gewässerschutzes. (Model and pilot project in Lower Saxony - cultivation of energy cultivation of energy crops, operation of biogas plants and digestate management in compliance with water protection requirements.)
54. Oldenburg-East Frisian Water Board.
55. OOWV (2013): Gülle, Gärreste und Klärschlamm – Konkurrenz auf knappen Flächen (Slurry, digestate and sewage sludge - competition on limited space). Talk by Egon Harms on the 8th DWA sewage sludge conference in Fulda, June 4th - 6th 2013.
56. The EEG 2012 stipulates the establisment of new closed-system storage for digestate. These must allow for a hydraulic retention time of at least 150 days for this type of feedstock in order to reduce methane, nitrous oxide and ammonia emissions. On the technology side, this requires gas-tight storage space for the digestate (see Article 6 (4) Sect. 1; EEG 2012). There are no comparable rules in previous versions of the EEG.
57. In other words, there are not enough C-backbones available to convert the available inorganic nitrogen into amino acids and finally proteins.
58. vTI (2008):Aspekte des Gewässerschutzes und der Gewässernutzung beim Anbau von Energiepflanzen - Ergebnisse eines Forschungsvorhabens im Auftrag des Umweltbundesamtes (Aspects of water protection and utilisation in the cultivation of energy crops - results of a research projects commissioned by the Federal Environmental Agency).
59. DWA (2010): Information sheet DWA-M 907: Erzeugung von Biomasse für die Biogasgewinnung unter Berücksichtigung des Boden- und Gewässerschutzes. (Biomass production for biogasification purposes with soil and water protection in mind). DWA Set of Rules. P. 20 et seq.
60. VDLUFA (2004): Standpunkt. Humusbilanzierung. Methode zur Beurteilung und Bemessung der Humusversorgung von Ackerland. (Point of view - nutrient balance of humus - evaluating and measuring the supply of organic matter in arable land). P. 8. Depending on the original organic content of the soil, crop-specific changes in humus content can be expected to vary between -560 to -800 kg of organic carbon per hectare.
61. „Empfehlungen zur Optimierung des Maisanbaus in Schleswig-Holstein“ (2011) (recommendations on the optimisation of maize cultivation), published by Bauernverband, Landwirtschaftsministerium, Landwirtschaftskammer, Gemeindetag, Fachgruppe Biogas, Landesverband Lohnunternehmer, Landesverband Maschinenringe, Christian-Albrechts- Universität Kiel, Deutsches Maiskomitee und Kompetenzzentrum Biomasse.
62. DWA (2010): information sheet DWA-M 907 Erzeugung von Biomasse für die Biogasgewinnung unter Berücksichtigung des Boden- und Gewässerschutzes. (Biomass production for biogasification purposes with soil and water protection in mind).
63. Philipp, W., Hölzle, L. (2013) Gärprodukte aus hygienischer Sicht (Digestates from a hygienic perspective). IN: Biogas-Journal 4/2013. P. 110-114.
64. Ratsak et al. (2013): Veterinärantibiotikarückstände in Gülle und Gärresten aus Nordrhein-Westfalen (residues from veterinary antibiotics in slurry and digestate in North Rhine-Westphalia.
65. Initiativen mit Weitblick. At: http://www.initiativen-mit-weitblick.de/16.html
66. BfN (2008): Where have all the flowers gone? Grünland im Umbruch. (turning the grassland upside down). P. 9.
67. The EEG 2012 introduced a tariff scheme for biomass-to-power conversion where the tariff paid depends on the feedstock used. The feedstocks are divided into three feedstock tariff classes which are listed in appendixes 1-3 of the Biomass Ordinance (Biomasse-Verordnung) together with their energy yield. The share of electricity generated by feedstock listed in Appendix 1 will only receive the basic feed-in tariff. The subsidy will increase proportionally for electricity generated from feedstock listed in Appendix 2 (feedstock tariff class I) or Appendix 3 (feedstock tariff class II).
68. Because small units incur very high specific costs.
69. In 2012, only 340 new installations were commissioned, which is a reduction by 74 percent compared to the previous year 2011 (1270 new installations).
70. BMU (2013): Memorandum - 2nd EEG Dialogue “The Potential and Utilisation of Biogas” on February 4th 2013 at the Federal Ministry for the Environment.
71. This follows the Biofuel Sustainability Ordinance and the Biomass-Electricity Sustainability Ordinance. Both stipulate that from 2017 a greenhouse gas abatement potential of 50% (Article 8) should apply under certain conditions and be increased to 60% from 2018.
72. Provisions for this have already been made in the draft version of the biogas plants ordinance.
73. DVGW-BGK (2013): Eignung von Gärprodukten aus Biogasanlagen für die landbauliche Verwertung in Trinkwasserschutzgebieten für Grundwasser. (The compatibility of digestate from biogas plants with agricultural use in drinking water protection areas and the protection of groundwater).
74. Verordnung über die Erzeugung von Strom aus Biomasse (Ordinance on Generation of Electricity from Biomass, Biomass Ordinance) (Biomasseverordnung - BiomasseV) (2012) : Appendix 2 and 3: Feedstocks in tariff classes I and II and their energy yields.
75. For BGPs up to 500 kWel. Over and above their tariff for feedstocks, plant operators receive a basic feed-in tariff. For installations up to 150kWel, this amounts to 14.3 Eurocents per kWh, for installations up to 500 kWel 12.3 Eurocents per kWh and less for larger installations. The basic feed-in tariff is degressive - decreasing by 2% per annum. The tariff quoted here applies to BGPs commissioned in 2012.
76. For the summer months when demand for heat is lower, the KLU suggests that BGPs be operated at reduced capacity, to

save feedstock for the winter months. Power demand over the summer would then primarily be met by solar and wind energy,

77. KLU (2011): Towards a Greening of Pillar 1 and an efficient Pillar 2 At: http://www.umweltbundesamt.de/publikationen/towards-a-greening-of-pillar-1-an-efficient-pillar
78. vTI (2012): Analyse der Vorschläge der EU-Kommission vom 12. Oktober 2011 zur künftigen Gestaltung der Direktzahlungen im Rahmen der GAP nach 2013 (Analysis of the suggestions by the EU Commission of October 12th 2011 on future direct subsidies within CAP beyond 2013).
79. How high these will be is currently being negotiated in Brussels. However, there seems to be agreement that if farmers do not take part in the Greening altogether, not only will 30% of the Greening component of their subsidies be cut, but also a proportion of their 70% basic subsidies. No definite decision has been taken yet.
80. Möller, D.; Anspach (2007): Biogasproduktion im ökologischen Landbau – Chancen und Herausforderungen aus betriebswirtschaftlicher Sicht. (Biogas production in organic farming - opportunities and challenges from a managerial perspective). Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Bd. 42, 2007: 485-486
81. NABU (Hrsg.) (2011): Grünlandpflege und Klimaschutz (Care of grassland and climate protection). Situation, Erfassung und Ansätze zu alternativer Nutzung von naturschutzfachlich wertvollem Grünland (A survey of the situation and solutions for the alternative use of valuable conservation grassland).
82. KLU (2011): “Towards a Greening of Pillar 1 and an efficient Pillar 2” - Opinion of the Agriculture Commission at the German Federal Environment Agency. (KLU) on the Reform of the Common Agricultural Policy.
    KLU (2012): The legislative proposals for the reform of the CAP - Good initiatives but not good enough for the environment. Opinion of the Agriculture Commission at the German Federal Environment Agency. (KLU) on the Reform of the Common Agricultural Policy.
    KLU (2013): Common Agricultural Policy reform must ensure mandatory and effective greening of Pillar 1
    Statement of the Agriculture Commission at the German Federal Environment Agency (KLU)
    KLU (2013): A Greener Common Agricultural Policy - A start has been made but many weak points remain.
    Opinion of the Agriculture Commission at the German Federal Environment Agency. (KLU) on the Reform of the Common Agricultural Policy.
    At: http://www.umweltbundesamt.de/landwirtschaft/klu/publikationen.htm



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