

Climate Change Mitigation by Biomass

Executive Summary of the
SRU Special Report

July 2007

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German Advisory Council on the Environment (SRU)

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This special report is the result of the combined and tireless efforts of the Secretariat staff and Council members.

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Acknowledgements

In preparing this special report, the entire Council, individual Council members and SRU staff held numerous discussions with representatives from government and industry. Our special thanks go to:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU): MinDir Dr. Rid AL KI; WA Kaiser UAL KI III; Wiss.Dir'in Dr. Freier RefL'in KI III 2; TA Dr. Dreher, WA Dr. Jochum (KI III 2); MinDir Dr. Lahl AL IG; MinDir Steinkemper UAL IG I; MinR Dr. Knobloch RefL IG I 6; RR'in Dr. Schwarze (IG II 4); MinDirig Dr. Holzwarth UAL WA I; MinDir Flasbarth AL N; MinR Dr. Delbrück RefL N II 5,

Federal Ministry of Transport, Building and Urban Affairs (BMVBS): ORR'in Parker, Ref. A 10

Federal Ministry of Food, Agriculture and Consumer Protection (BMELV): MinDir Neumann, AL L

Federal Environment Agency (UBA): DirProf. Dr. Friedrich AbtL I 3; WA Miehe, FG I 4.3, WissOR'in Jering, FG I 1.1

Federal Nature Conservation Agency (BfN): WissDir Krug AL II 2; AN'in Ammermann FGL'in II 3.3

European Commission, DG ENV: Joost van de Velde, Erik Tang

European Environment Agency: Dr. A. Barbu, Project Manager

Öko-Institut: Uwe Fritsche, Coordinator Energy and Climate Protection Unit

Scientific Council, Federal Ministry of Food, Agriculture and Consumer Protection: Prof. Dr. Isermeyer (Chairperson), Prof. Dr. Dr. h.c. Heißenhuber

Deutsche Shell: Kurt Döhmel, Vorsitzender der Geschäftsführung

Verband der Chemischen Industrie e. V.: Dr. Jörg Rothermel, Geschäftsführer der Fachvereinigung Organische Chemie

Bundesverband der Deutschen Industrie e. V.: Dr. Klaus Mittelbach, Head of the Environment and Technology Department

Concawe: Dr. Alain Heilbrunn, Secretary General, Dr. Kenneth Rose, Technical Coordinator Fuels Quality & Emissions

Europaia: Peter Tjan, Secretary General

WWF: Imke Lübekke, Bioenergy Officer

Naturschutzbund Deutschland e. V. (NABU): Mr. Krüger, Head of Nature Protection Department; Mr. Schöne

Bund für Umwelt und Naturschutz Deutschland e.V. (BUND/Friends of the Earth, Germany): Friedrich Wulf, Head of Unit for Nature Protection and Water Policy, Mr. Schümann

Wuppertal Institute: Dr. Stefan Bringezu, Director, Research Group 3: Material Flows and Resource Management, Dr. Stephan Ramesohl, Research Development Coordinator and Co-Director, Future Energy and Mobility Structures

Institut für Energetik und Umwelt: Dr. Achim Weiske

Technische Universität Wien: Dr. Gustav Resch, Energy Economics Group

FH Weihenstephan: Prof. Dr. Klaus Menrad

Technologie- und Förderzentrum (TFZ) im Kompetenzzentrum für Nachwachsende Rohstoffe Bayern: Dr. Bernhard Widmann, Leiter

ATZ Entwicklungszentrum: Dr. Mario Mocker, Dr. Peter Quicker, Uwe Eggenstein

Bavarian State Ministry of Agriculture and Forestry: MR Dr. Rupert Schäfer

Institut für Ländliche Räume Bundesforschungsanstalt für Landwirtschaft Braunschweig (FAL): Dipl.-Geoökol. Heike Nitsch

Technische Universität München: Prof. em. Dr. Dr. h. c. Haber

The Council also appreciated the opportunity to engage in numerous discussions and gather ideas at conferences, symposia and other events, sometimes putting forward initial propositions for debate:

Presentation by Prof. Dr. Faulstich at a conference at the *Evangelische Akademie Tutzing*, 16 – 18 February 2007 in Tutzing, Germany

Dialogue event *Energie vom Feld – Potenziale für Agrarwirtschaft und nachhaltige Mobilität econsense* (Energy from the Fields: Potential in Agriculture and Sustainable Transport – A Green Consensus), Forum Nachhaltige Entwicklung der Deutschen Wirtschaft, 8 March 2007 in Berlin

Talks with the Scientific Council of the Federal Ministry of Food, Agriculture and Consumer Protection, 9 March 2007 in Berlin

Biomasseproduktion – ein Segen für die Land(wirt)schaft (Biomass Production: A Gift in Land(scape) Use), 12 – 14 March 2007 at the BfN Academy on the Island of Vilm

Talks with the German Advisory Council on Global Change (WBGU), 15 March 2007 in Berlin

Presentation by Prof. Dr. Faulstich at a meeting of the Political and Scientific Council of the Bundesverband BioEnergie (Federal Association of BioEnergy Producers, or BBE), 9 May 2007 in Berlin

Presentation by Dr. Hey at the 7th *Netzwerk Bioenergie* Meeting, held on 23 May 2007 at Deutsche Umwelthilfe in Berlin

(This report went to press on 2 May 2007)

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Climate Change Mitigation by Biomass

1 Introduction

1*. The recent report by the Intergovernmental Panel on Climate Change (IPCC) ensured that climate change is one of the main focuses in environmental policy. To be effective, climate change policy must prescribe significant reductions in greenhouse gas (GHG) emissions. Besides improving energy efficiency, reductions can be achieved by using renewable energy sources in place of fossil fuels. The EU thus intends to increase the share of renewables in primary energy use to 20 percent by 2020. The German government confirmed its commitment to meeting this target in an announcement made in April 2007, stating that by 2020 some 14 percent of the energy used in heat production, 17 percent used for transportation fuel and 27 percent used in electricity generation will come from renewable energy sources. In meeting these ambitious targets, substantially greater use will be made of biomass, which at 70 percent already makes up the largest share of renewable energy in use.

Given the potential of biomass in reducing emissions of climate-damaging gases, we welcome the importance placed on increased biomass use by the European Commission and the German government. Nonetheless, any increase in the use of biomass for energy production must focus on the realistic contribution it can make to combating climate change. Biomass can only serve climate change mitigation if the framework, and not least the relevant funding policies and legal requirements, for cultivation and use of biomass crops take adequate account of environmental constraints.

2 Opportunities for Biomass Use

2*. From an environmental standpoint, cultivating and using biomass for energy production has vast potential in that as an energy source, it spares the increasingly limited supply of fossil fuels. Biomass use for energy is also climate-friendly because the carbon dioxide released during burning is equivalent only to that absorbed by the crops during their growth. However, one of the basic requirements in ensuring that using biomass to produce energy results in lower emissions of GHGs compared with fossil fuels is that renewable resources be cultivated and used in an environmentally compatible way and aimed at combating climate change.

Cultivating biomass crops can also have a positive impact on the environment. One option would be to plant former intensively farmed cropland with extensively farmed biomass crops.

The potential for using biomass is increased relative to how efficiently it is used and the size of the reduction in greenhouse gas emissions achieved through its use.

3*. Compared with other energy carriers, biomass has multiple advantages. For example, it can be made available as a solid, liquid or gaseous fuel. Hence, unlike other renewable energy sources, biomass can be utilised for all energy-related needs (heat, electricity and propulsion). One great advantage with biomass and the energy carriers produced from it is that their excellent storage properties allow for flexible energy supply, both in terms of time and distance.

The availability of new technologies provides further opportunities for biomass. Numerous new processes have been developed and optimised, allowing Germany to strengthen its position as a leading technology supplier.

3 Limitations in Biomass Use

4*. The advantages in using biomass as an energy carrier are, however, countered by limited land availability and consideration of environmental needs.

3.1 Limited Potential for Biomass Production in Germany

5*. Use of biomass, either as biogenic waste or as renewable raw materials, can meet only a portion of Germany's primary energy needs. The annual volume of waste from the forestry and timber sector, farming, disposal of animal carcasses, the food industry, and wastewater and waste management lies at around 100 million Mg. With existing technology and given environmental constraints, only 65 percent (70 million Mg) can be used in any meaningful way. This gives Germany a potential four or five percent biomass share in meeting primary energy demand. In the short term, the potential for using biogenic waste is higher than that for using renewable raw materials. Using biomass waste for energy is not yet fully established, however. It makes sense, therefore, to give priority to exploiting biomass waste potential while taking account of environmental restrictions (e.g. in use of straw and forestry waste) rather than growing more renewable raw materials.

The potential in renewable raw materials is limited first and foremost on account of the limited availability of agricultural land for their production. This puts cultivation of biomass crops in direct competition with food and feed production, and it may only be expanded in line with the needs of nature conservation and landscape management. Consequently, it can be assumed that by 2030, the area of arable land used for biomass crops can be increased from 1.6 million hectares to between three and four million hectares.

The potential energy yield will depend on the type of energy crops grown and the ways in which they are used. Use in the stationary energy sector in combined heat and power (CHP) promises significantly greater energy potential than transportation biofuels grown on the same area of land. Looking at the overall potential regarding biomass waste and renewable

raw materials, domestic biomass can meet at maximum only 10 percent of primary energy use by 2030.

Merely producing enough biomass for all petrol and diesel placed on the market to contain at least 6.75 percent biofuel by 2010 and even higher percentages further into the future – the targets set in the third sentence of Article 37a (3) of Germany's Immission Control Act (BImSchG) – would use up the entire potential available land. These ambitious targets thus promote the import of biomass and biogenic energy carriers.

3.2 Biomass Crops: Environmental Threats and Needs for Regulation

6*. The push to cultivate and use biomass hits an obstacle given the associated environmental risks at national and international level. Biomass produced using intensive farming methods poses a threat to the environment. These risks must be mitigated by changes to the legal framework.

7*. At national level, threats to the environment have less to do with any harmful aspects of new crop-growing practices. A greater risk is posed by increased use of crops that have strong adverse effects on the environment: rapeseed and maize are increasingly being cultivated in place of less environmentally harmful crops. Over-exploitation of vegetation types that capture and store CO₂, for example woodlands and forests, can affect their sink function. Changes in land use such as digging over permanent grassland and draining bogs and fens can have a similarly negative effect on the climate.

Looked at from a legal standpoint, the same standards should apply to cultivating renewable raw materials as for food and feed production. The changes in farming practices that can be expected in response to the targeted promotion of biomass crops are cause enough to step up efforts towards making farming environmentally compatible. The existing environmental standards contained in the best practice provisions of national legislation and in EU cross-compliance requirements must be implemented in a determined manner and advanced where appropriate. The following measures would seem appropriate to counter the impact of increased biomass farming:

- Introduce a fertiliser tax to penalise excessive use of nitrates
- As regards use of plant protection products, further define, legally enhance and forcefully implement the requirements for integrated plant protection
- Compliance with, at minimum, three-way crop rotation with no exceptions. At the same time, scope should be created to allow legally prescribed annual limits on the number of crops allowed and the maximum amount of land they may cover on a holding.
- A general ban on digging over permanent grassland

Also, conservation area charters should be reviewed as to whether they adequately exclude environmental threats arising from farming of renewable raw materials. They should be aligned as appropriate, particularly as regards crop-growing restrictions. An assessment should also be made as to whether protection of fringe and structural elements should be boosted with additional compensation rules.

Specific standards for biomass crops are needed when it comes to the extraction of residues which in excessive quantities can have adverse effects on the nutrient cycle. A need could also arise for regulatory provisions regarding farming of genetically modified crops. In the case of crop-specific and site-specific effects, prevention measures should be an integral part of spatial planning policy. Per-hectare premiums for growing renewable raw materials should only be made available when neither protected nor sensitive areas are affected by inappropriate crop-growing practices.

Research on the environmental impacts of intensified farming of renewable raw materials can hardly keep up with the rapid growth in energy crop production. For reasons of damage limitation and precautionary environmental protection, there is thus an urgent need to slow down the promotion of renewable raw materials. Without such action, there is a risk that to ensure attainment of (dynamically increasing) renewable energy targets, environment-related requirements will be formulated in such a way that they provide less than adequate protection.

8*. Given that the EU's and Germany's ambitious biomass policies will significantly increase biomass imports from non-EU countries (particularly emerging economies and developing countries), it must be ensured that the rise in imports does not lead to greater use of environmentally harmful production practices in the producing countries.

Intensified biomass production on an international scale goes hand in hand with a considerable risk of over-use of natural resources in the producing countries. This must be countered with binding standards. In this connection, although private certification systems are not an adequate substitute for binding standards on biomass crops they do provide a useful conceptual approach for their advancement.

There is thus a need for binding environmental standards and for making compliance with them a prerequisite for marketing biomass and biomass products in the EU and in Germany. The Council believes it would be preferable for such standards to be made an integral part of an international agreement to which key import and export countries are signatories. This consensual approach in which acceptance of the environmental standards is embodied in an international agreement would aid both implementation and enforcement of those standards. Further, restrictions on international trade enacted under international environmental treaties have not yet become a point of contention in the debate on global trade law.

Another option, secondary to the above but nonetheless available if attempts to negotiate an international agreement should fail, is that of imposing environmental standards unilaterally on producer states. WTO law would not be a barrier to this type of approach in principle. It can be expected that restrictions on international trade that are specifically designed to rule out environmentally harmful production methods would be incompatible with WTO non-discrimination rules, especially the National Treatment Clause. However, under GATT Article XX (b) and (g), such restrictions may be justified where they involve action to protect the lives, health and welfare of people, animals and plants, and to conserve non-renewable natural resources. Trade restricting standards are thus an option when it comes to protecting primary forests, bogs and fens, and other wetlands. In such circumstances, WTO law is not in opposition to the enactment of environmental standards, including internationally applicable ones, based on the powers to issue secondary legislation set out in Section 37d of Germany's Immission Control Act (BImSchG).

4 Solutions and Priorities

4.1 Prioritising Climate Change Mitigation and Devising an Integrated Energy Strategy

9*. In principle, promotion of biomass can contribute to varying degrees to achieving agricultural, energy and environmental policy targets. Account must however be taken of the inherent costs and of the conflicts between these targets. Due to insufficient analysis of the environmental impacts, especially regarding climate change impacts of land use changes, there is a tendency to over-estimate the greenhouse gas reductions that can be attained using biomass for energy production. Largely for this reason, the jury is still out on the issue of biomass use and its environmental effects. In case of doubt in instances where multiple objectives are pursued, climate change should be given priority to ensure environmentally compatible cultivation. Nonetheless, the findings arrived at so far lead to the conclusion that stationary use of biomass for electricity and heat production is more advantageous than its use as a transport fuel. Prioritising the use of biomass in the transport sector does not sufficiently exploit the potential of biomass in climate change mitigation. For this reason, efforts should only be made towards achieving moderate expansion in the use of biofuels in transportation. Stationary use harbours great potential for greenhouse gas savings, especially in heat supply and in combined heat and power generation. Promoting combined use of biomass in this way should thus be pursued further.

Looking at biomass use according to available forms, with the exception of waste substances for use in fermentation and of renewable raw materials, minimum use should be made of biomass in transport fuel production. Solid biomass, particularly wood, should ideally be used to produce heat. Its use for high-temperature process heat in industry would appear to make

sense because no other renewable energy source can serve as a substitute. With regard to power generation and room-temperature heating, wind, solar and geothermal energy are available as alternative renewable substitutes in the long term. Another important aspect is increased use of district heating networks in place of individual heating systems. Thus, with regard to its climate change mitigation potential, biomass use should not be assessed in isolation from other renewable energy sources. The aim should be to develop an integrated approach to allow optimal use of all energy carriers in efforts to combat climate change.

4.2 Integrated Biomass Strategy to Avoid Segmented Funding

10*. Funding for bioenergy is segmented. Promotion focuses on the one hand on greater use of biofuels through minimum fuel mix requirements, tax concessions and farming subsidies, and on the other on use of biomass in electricity and heat production – primarily through special feed-in tariffs under the German Renewable Energy Sources Act (EEG) and investment grants for heating supply systems.

While this segmentation has its historical reasons, when looked at from an economic and environmental standpoint it hinders overall optimisation of biomass use. In particular, it obstructs market processes in arriving at the most cost-effective ways of achieving greenhouse gas reductions. Rather than promoting market price-finding under a stringent climate policy framework, funding focuses on fine-tuning specific technologies and on quantity targets for selected uses. This approach does not fully exploit the role biomass can play in climate change mitigation. No realistic overall estimate has been made of the full costs and benefits of this kind of funding policy to tax payers, consumers and climate change efforts for the period up to 2020.

Instead, segmentation promotes a funding race between the various biomass uses. Extremely high biofuel quotas that must be achieved regardless of economic viability will push up the costs of biomass use in areas that can contribute most to climate change mitigation. There is thus a risk that significant public and private funds will be wasted due to a lack of coordination between the various available instruments.

Powers to issue secondary legislation contained in Section 37d of Germany's Immission Control Act (BImSchG) and the EU climate change target for motor fuels (10 percent reductions in GHG emissions by 2020) set out the first practical steps to be taken in the coming years to lay down minimum environmental standards for the use of bioenergy. Their scope is, however, already limited because they focus solely on specific funding instruments and give no indication of an integrated approach to providing an environment policy pillar in biomass promotion. A conflict thus exists between environmental criteria set out in Section 37d of the BImSchG and the over-ambitious nature of the fuel quotas. Resolving this conflict will prove extremely difficult.

Against this background, the key task of any potential biomass action plan is to set out and prioritise the main points of a strategy on biomass potential and its optimal use in climate change mitigation, for a workable funding policy, and for a framework to allow environmentally sound cultivation of biomass crops.

This sustainable biomass promotion strategy must meet two fundamental requirements:

- It must optimise biomass use to avoid GHG emissions
- It must produce a legislative framework at national, EU and international level to allow environmentally sound cultivation of energy crops. This framework cannot be developed without taking account of general instruments for environmentally sound agriculture.

Advancing biomass promotion should take a two-phase approach:

- An interim funding phase to assist market entry of a broad range of technologies
- A subsequent phase to promote effective climate change mitigation activities based on further fundamental reform of the EU Emissions Trading Scheme for greenhouse gases.

4.3 Existing Funding Instruments

11*. The market entry phase should build on existing instruments for biomass promotion, although the funding amounts and expansion targets should be reviewed to allow optimal transition to the climate change mitigation phase. The funding instruments should take greater account of the energy-related advantages in using biomass in heat and electricity generation. Neither the effectiveness of the Renewable Energy Sources Act (EEG), which sets out fixed rates of payment for renewables-generated electricity fed into the public grid, nor that of promoting heat generation should be diminished by the price-hiking effects of biofuel quotas.

When granting funding to assist market entry, measures should be taken to avoid promoting technologies whose medium and long-term contribution to climate change mitigation bears no meaningful relation to the cost-effectiveness of the overall climate change measures. With realistic estimates of learning curve effects, promising technologies can be identified as regards their economic potential and, using life-cycle analysis, assessed for environmental soundness.

The various funding instruments should be subject to systematic review based on the above criteria. This means:

- Where funding under the Renewable Energy Sources Act is concerned, the restriction on providing funding only to small-scale facilities and those that only convert biomass should be reviewed. With regard to technical efficiency and climate change mitigation, the use of biomass is also desirable in larger-scale power plants. Also, funding amounts and the decreasing scale used to allocate funding should be reconsidered. Paradoxical effects

such as further promotion of less than viable micro-scale biogas facilities sparked by allocating funding on a decreasing scale should be avoided. Bonus payments for use of renewable raw materials (*NaWaRo-Bonus*) should also be reviewed as regards their negative effect on the use of waste in biogas facilities.

- When funding heat use, the provision of funding as a market incentive should be further advanced. It appears particularly important in this regard to strictly link the availability of funding to the use of available exhaust gas cleaning technology and, in the interests of climate change mitigation, to priority substitution of coal and heating oil. It is also important to review the funding instruments as regards greater use of biomass in district heating and for industrial process heat. When redesigning funding-based incentives, greater weight should be given to climate change mitigation potential over purely quantity-based targets. To finance a programme of this type, consideration should be given to putting special levies on fossil fuels used in heating.
- The enactment of legislation, as currently under debate in Germany, to promote renewables-generated heat supply (*EE-Wärmeenergiegesetz*) by means of different payment rates according to the technology used will not achieve its intended goals because promoting the use of energy to generate heat could lead to efforts towards energy efficiency being neglected. Also, energy source-dependent funding would make it difficult to implement the installation and modernisation of biomass-fuelled heating systems so necessary in abating air pollution.
- Direct, unconditional promotion of biomass cultivation and the implicit preference for energy crops in Community measures to encourage set-aside in agriculture should be reversed, as should the payment of premiums for energy crop cultivation. Promotion of bioenergy should occur solely on the user side as this is the only way to ensure optimisation of biomass use. In rural development programmes, which are to be stepped up, special consideration should be given to cultivation methods and crops that give rise to synergies in the attainment of nature conservation goals.
- The ambitious national and EU growth and expansion targets for biofuels in transportation should be subjected to critical assessment. The national biofuel quota should – taking account of the sphere of trust regarding the investments already made in conversion plant in response to the rising quota – be frozen as close as possible to the present level. The target set by the EU Council of a 10 percent quota by 2020 is in need of downward correction. As long as the conditions the EU Council has linked to this target (sustainable production, availability of second generation technology, and commercial viability) are not in place, the EU fuel-mix quota cannot be made a binding legal requirement.
- Taxation-based promotion of second generation biofuels (biomass-to-liquid and lignocellulose bioethanol) should be re-focused without delay to concentrate on their contribution to climate change mitigation. It would make sense for possible tax exemptions

to be based on a set amount relative to the reductions in GHG emissions achieved per fuel unit in specific production processes.

4.4 The Long-Term Perspective: Emissions Trading

12* In the second phase of the climate change policies called for in this report, efforts should focus on avoiding GHG emissions wherever it is most cost effective to do so. For the various funding areas, this means a medium-term withdrawal from quantity-based funding and the broadest possible integration into a cross-sectoral emissions trading scheme. In the longer term, the aim should be towards fundamental reform of the existing emissions trading system at primary trade level. In contrast to the sectoralised trading system that is currently evolving, this would be far easier to implement, the transaction costs would be lower and there would be fewer drop-outs. What should not be fully excluded, however, is the second-best solution – that of a pricing policy which simulates emissions trading at primary trade level.

For models of this type to be integrated into emissions trading, a near-reality picture of the greenhouse gas balance is needed for the use of biomass for a range of different energy needs. It is thus necessary to expand the scope of the balance to take in CO₂ equivalents to allow at minimum the inclusion of bioenergy-related emissions of methane and nitrous oxide in production processes. The entire biomass production chain, especially that for biofuels used in transportation, should be assessed for possible changes in land use, crop cultivation, biomass processing and fuel economy in the types of engines involved.

Annex
Publications

Publications

Environmental Reports, Special Reports, Research Materials and Statements

The Council's environmental reports and special reports published **from 2007** onwards are available both from book shops and directly from the publisher: Erich-Schmidt-Verlag GmbH und Co., Genthiner Str. 30 G, 10785 Berlin, Germany.

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