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A new assessment of the material use of renewable raw materials

A new study from the nova-Institut shows higher resource efficiency, climate protection, improved security of raw material supplies and employment benefits through the increased material use of agricultural and forest products. Realignment of the policy framework supporting renewable resources is required.

The nova-Institut in Hürth (Rheinland) has provided the first comprehensive study of all industrial material uses of renewable raw materials in Germany – domestically produced agricultural materials, wood and imported materials. Data from all sectors has been systematically collected and analysed to identify the characteristics of these materials from a public policy perspective. This analysis was used to frame proposals for the most appropriate ways of providing public support for these uses.

If criteria such as resource use efficiency, climate protection, security of raw material supplies and employment are taken seriously, the policy framework used to support energy and material uses of renewable materials needs to be rebalanced so that the current bias in favour of bioenergy is overcome.

The aim of the study
The theme and overall goal of the study was to conduct a comprehensive study and analysis of the characteristics of the material use of renewable raw materials and to propose policy instruments for their promotion. The volume, sector structure, substitution potential and the competitive situation of the material use were studied in detail.

The result is the first comprehensive presentation of the flow of all material uses of renewable raw materials in Germany. Flow diagrams show how both domestically-produced and imported renewable raw materials are used in Germany. The data that made this possible are not available for other EU countries or for the European Union as a whole. Conducting the study has shown that there is a lack of data relating to material uses compared to the data available for the bioenergy area.

Definition – the material use of renewable raw materials
Renewable raw materials comprise the totality of plant, animal and microbial biomass, including biomass delivered through food chains, whose primary production is based on photosynthesis and which are provided for material and energy uses of all kinds outside food and feed. With material use, the biomass serves as raw material for the (industrial) production of all types of goods.

Germany 2007: 90.6 million tonnes of renewable raw materials
The study shows that a total of 47.9 million tonnes of renewable raw materials were used for their material properties by German manufacturing industry in 2007. Of this, 3.6 million tonnes were provided by agricultural crops (excluding straw) while wood accounted for 44.3 million tonnes. In addition, 6 million tonnes of cereal straw were used, particularly in

agriculture. In contrast, a total of 10.1 million tonnes of agricultural materials and 32.6 million tonnes of wood, that is a total of 42.7 million tonnes, were used for energy purposes.

Overall, a total of 90.6 million tonnes of renewable raw materials were used for non-food purposes in Germany in 2007 of which 53% were used for industrial materials and 47% were used for energy. When only the agricultural sector is considered, 26% of non-food output is used for industrial materials and 74% is for energy. The proportion used for energy has risen continuously over the last 10 years.

Major industrial users of agricultural raw materials include the chemical industry (various feedstock chemicals, structural chemicals, pharmaceuticals, bio-based plastics) (47%), the oleochemical industry (surfactants, paints and inks, lubricants, polymers, etc.) (28%), the paper and pulp industry (paper starch) (18%), the textile industry (textiles, insulation materials, non-wovens and composites) (4%) and the pharmaceuticals and cosmetics industry (2%). Wood is used for the sawn timber and other wood-based industries (construction, furniture, packaging) and for the pulp and paper industry. Smaller quantities of cellulose derivatives and regenerated celluloses are produced for a variety of applications (textiles, thickeners, adhesive paste, cigarette filters and processed polymers).

Of the 3.6 million tonnes of agricultural raw materials used in industry, 2.3 million tonnes (64%) are imported and 1.3 million tonnes (36%) are grown in Germany on a total area of 280,000 ha. Imports are dominated by vegetable oils (palm, coconut, soy), natural rubber, chemical cellulose, natural fibres (mainly cotton), corn starch and medicinal plants. Until 2008, there were little or no imports of proteins or sugar based raw materials.

In the wood sector, the proportion of imports is about 10% and this level of imports is evenly distributed through the processing chain. When wood and agricultural raw materials are considered together, the net import is only 14% of total supplies of renewable industrial raw materials. Germany is thus 86% self-sufficient in renewable raw materials used for non-food purposes in industrial manufacturing.

Unbalanced policy: High levels of support for bioenergy while material uses are neglected

The rediscovered production and non-food use of renewable raw materials from agricultural crops developed in the 1980s. The driver then was the need to address surplus food production in Europe. Policies sought to divert agricultural commodities away from food to other uses to stop the downward spiral in agricultural commodity prices. These policies first began to make a significant impact in the late 1990s with the emergence of energy security and climate change as major concerns for policy-makers. The extreme dependence on oil in the transport sector motivated the development of simple technologies such as first-generation biofuels. The central question then was how to ensure future mobility. The subsequent policy emphasis on using agricultural crops for energy successfully addressed political objectives of the day. A small number of simple policy instruments, focused on few intervention points, developed against a background of a broad political consensus, were used to great effect. They mobilised a large quantity of biomass for transport fuels. This showed that highly regulated markets such as the market for transport fuels provide more opportunities for policy intervention compared with the more diverse and less regulated markets relevant to the material use of renewable resources. The more diverse markets for material uses not only offer fewer points where policy levers can be applied to significant effect, they are also global markets subject to intense global competition. In these circumstances, it was inevitable that the material use of non-food crop materials would become less prominent and fall behind.

Since about 2000, the German Renewable Energy Resources Act (EEG), The Energy Tax Act, the Biofuel Quota Act, reduced VAT for firewood and wood pellets, a market stimulation programme for wood pellet heating, and many other measures have provided a comprehensive

set of incentives that support the use of biomass for energy. Energy uses of non-food crops have triumphed over all other options. While the agricultural area used in Germany for energy production has increased 10 fold to 1.8 million ha, the area under crops for material uses, which have had no corresponding support, stagnated at around 300,000 hectares.

Economic analyses have shown that the various support measures account for 50 % to 80 % of revenues of many bioenergy products and options. On a production area basis, these equate to 300 to 3,600 €/ha with biodiesel and other vegetable oil fuels (by now) at the lower end of this scale and small-scale biogas, bioethanol and BTL at the upper end.

No corresponding policy instruments have been developed for material uses. Measures available comprise mostly temporary support available to the material use of renewable resources in a few individual supply chains. These amount to only very limited financial support.

Market distortions and the misallocation of resources

The need for policies to address over-production of food is now a feature of the past. Global agricultural markets are now characterised more by risks of food shortages than surplus. Bioenergy has become a significant source of demand regionally and globally and has influenced agricultural markets. It has raised commodity prices, not just stabilised them.

The high returns that these support instruments have made possible from energy uses have led to an increase in commodity prices and land rents. These have been pushing out other land use options that generate lower gross margins. This has led and is leading to a significant shift in land use, crop production, and commodity flows. The possibility that the support instruments could thwart the realisation of the original purpose of the policies that drive them in relation to climate protection and resource efficiency has not been assessed. Critics speak of a misallocation in the use of resources in relation to the public policy objectives (climate protection and resource use efficiency) when for example strongly subsidised biogas plants out-compete other uses of biomass and land or when wood becomes too expensive for the wood products and paper industries because subsidised energy uses yield higher returns.

Potential for material uses

According to the analysis conducted by the nova-Institut, there are 2 – 3 million ha available for non-food crop production purposes in Germany. This estimate takes into consideration the reduced availability of land for non-food crop production in times of high prices for food crops (with production of wheat for export).

Under favourable conditions (e.g. adequate public support, high oil prices) it is predicted that material uses could account over 1.8 million ha of arable land by 2020 in Germany, which is equivalent to the area now used for energy. The main sources would be rapeseed (905,000 ha), wheat (670,000 ha) and sugar beet (175,000 hectares). The most important sectors would include the chemical industry in general, bio-based materials and products as well as the oleochemical industry (surfactants, lubricants) in particular. In addition, niche crops such as hemp, miscanthus, short rotation coppice (e.g. willow) and medicinal plants could amount to up to 90,000 ha. They would be mainly used as bio-based materials and products (wood-based materials, natural fibre reinforced plastics, insulation materials, textiles) and in pharmaceuticals.

Under a suitable policy framework, the support for energy and material uses can be rebalanced so that 2 – 3 million ha are very effectively and sustainably used.

Significance and characteristics of the material use of renewable raw materials

Securing supplies of raw materials
While there are numerous options for the provision of renewable energy such as solar and wind energy, hydropower, and geothermal energy, the situation with the supply of the raw materials for industry is precarious. Sun, wind and nuclear power supply energy, but not materials. A comprehensive resource management and commodity diversification programme that includes the material uses of agricultural raw materials is essential to secure the raw materials of German industry. Here, the use of agricultural biomass for material uses is as essential as their use in food and animal feed. The material use of renewable resources is a key technology to secure the supply of industrial raw materials. Renewable raw materials are the only renewable source of carbon for industry and their role will increase continuously.

Macro-economic effects – advantages in terms of employment and added value
The analysis of recent macro-economic studies and surveys have shown that the material use of renewable raw materials supports significantly more employment and results in more value-added compared with the use of the same resource for bioenergy. When considered on the basis of the quantity of biomass used or the area used for production, material uses result in 5 to 10 times more people directly employed and 4 to 9 times more value added. The reason for this is the more complex and longer supply chains that material uses support.

Life-cycle assessments are favourable –sequestration of carbon
The study involved reviewing a total of 160 life-cycle assessments. Most show clear advantages for renewable materials compared with materials based on fossil oil. The material use of biomass generally delivers area related climate protection benefit at least equal to that of first generation biofuels (each based on the same area). Most deliver higher benefits and the best are significantly higher than the benefits of the second-generation biofuels. On average across all product lines, material uses can be expected to deliver a saving of 5 to 10 t CO_2-eq./ha per year. When cascade use is considered which involves repeated material uses followed by recovery of energy, the saving can be increased significantly. There is a lack of robust data on these additional benefits of cascading.

The fixation of carbon over the life of the product, which can extend from weeks to many decades, is a unique feature of material uses. Material uses can result in the fixing of substantial amounts of carbon which contributes particularly to greenhouse gas reduction over the critical period of the next 20 years.

Recommendations for policy development
The study proposes two over-arching support instruments to address the current market distortions and misallocation of resources caused by the preferential support of energy uses and to support resource and climate protection: a basic support of primary production through a refund of production costs on the basis of avoided greenhouse gas emissions per hectare (CO_2-eq.) combined with the development of regulatory taxes applied to all non-renewable resources. The basic area related support would only apply to the agricultural sector. There is consensus amongst forestry and wood industry representatives that the forestry sector needs no area support. They emphasise instead the need to bring an end to subsidies for the use of wood for energy combined with a strengthening of cascade utilization.

Companies using renewable raw materials should receive a refund of production costs on the basis of per hectare CO_2-eq. emissions avoided. Moreover, new regulatory taxes aimed at

putting a price on fossil carbon carriers in material uses (e.g. in the chemical industry) could pave the way for fairer competition between fossil and renewable inputs. Obviously, the use of renewable raw materials would become more attractive.

An intelligent and balanced combination of both instruments would provide comprehensive support. It would lead to a transparent and predictable market intervention thereby overcoming market- and policy-generated distortions in resource and climate protection. Apart from that, these new instruments would not interfere with fair competition, and they would rely on the market forces work without favoring certain uses or technologies.

Outlook

Considering the criteria of resource efficiency, climate protection, secure supply of raw materials and employment, the study has shown that a greater proportion of the renewable non-food resources coming from arable land and forests should be used in industrial material applications. It also shows that the demand for these applications exists. Through the support instruments proposed and the catalogue of measures presented, the route to achieving this is set out.

The development of these support instruments should lead to a reduction in existing market distortions. Current distortions are the result of a sectoral-based support policy pursued over the last 20 years. Fairer competition between the various uses of renewable materials should prevail – on the basis of clear criteria such as climate and resource protection, security of supply, and employment. To achieve a more optimal allocation of resources and a more effective use of land, support can be oriented on the carbon savings per hectare. Under such a new support framework that treats all options equally, products, processes and technologies that best deliver environmental and economic sustainability will prevail in the market. This market success will be based on their effective substitution of fossil carbon based materials.

In practice this will mean that the hitherto neglected material use will receive increasing support until the same level of support as that for energy uses is reached. The adjustment of support instruments to provide this level playing field based on greenhouse gas mitigation potential per hectare requires at least ten years to allow operators sufficient time for necessary adjustments to the new, but clearly predictable, policy environment.

If resource efficiency is taken seriously, it is impossible to overlook cascading utilization whereby renewable resources are first used for material purposes (possibly several times through recycling) and then used for energy. The proposed public support should take account of this and should favour the use of agricultural and forestry resources from cascades, by-products and residues for energy instead of virgin biomass.

Title of the study

The development of instruments to support the material use of renewable raw materials in Germany – Market volumes, structure, substitution potential, competition situation and characteristics of material uses and the development of support instruments

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The summary of the study (in English/German) comprising 70 pages of text, 25 figures and tables, can be downloaded free of charge from the website of the nova-Institut at www.nova-institut.de/nr from May 19th 2010 on. The full report (ca. 450 pages) is provided on request.

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