

Accelerating the Development of the Market for Bio-based Products in Europe

**REPORT OF THE TASKFORCE ON BIO-BASED PRODUCTS
Composed in preparation of the Communication
“A Lead Market Initiative for Europe”
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Bio-based Products: A Vision for Sustainable Growth

1. Introduction

The Aho Report on "*Creating an Innovative Europe*"¹ recommended the development of innovation-friendly markets in a more targeted and prospective way by creating conditions to facilitate the translation of technological and non-technological innovations into commercial products. In September 2006 the European Commission adopted a Communication on "*Putting Knowledge into Practice: A broad-based innovation strategy for the EU*", in which it proposed a more strategic and integrated approach to policy-making so as to set the right conditions for innovation-driven lead markets to emerge and develop in Europe.

The Competitiveness Council in December 2006 agreed to launch an initiative as a new policy approach aiming at supporting the development of markets with high economic and social value, in which European companies could develop a globally leading role, by addressing systemic failures in policy and lack of policy coordination and legislative coherence which might hamper this potential.

In May 2007 the Competitiveness Council invited the Commission to propose further steps for the creation of lead markets and other measures to enhance market demand for eco-efficient **bio-based products**, in order to exploit the positive environmental impact of bio-based products.

This report, prepared by the Lead Market Task Force on Bio-Based products², provides:

- a broad analysis of the existing and emerging markets for bio-based products,
- recommendations concerning policy coordination aimed at developing a coherent set of demand side measures driving the development of bio-based product markets, with a particular focus on standardisation, labelling, public procurement, regulatory initiatives and communication,
- elements of validation by external stakeholders,
- a roadmap of proposed actions and deliverables.

2. Bio-based products

Definition: In this report, bio-based products³ refer to non-food products derived from biomass (plants, algae, crops, trees, marine organisms and biological waste from households, animals and food production). Bio-based products may range from high-value added fine chemicals such as pharmaceuticals, cosmetics, food additives, etc., to high volume materials such as general bio-polymers or chemical feedstocks. The concept excludes traditional bio-

¹ Esko Aho, *Creating an Innovative Europe: Report of the Independent Expert Group on R+D and Innovation Appointed Following the Hampton Court Summit*, available at: http://ec.europa.eu/invest-in-research/pdf/download_en/aho_report.pdf

² The inter-service Task Force has included participants from DG ENV, DG ENTR, DG AGRI, DG RTD, DG MARKT and DG COMP.

³ "Bio" refers to "Renewable biological resources" and not "biotechnology". While advances in life sciences and biotechnology are a major driver for optimising biomass production and for bio-product innovations, there are other technology drivers, such as chemistry, nanotechnologies, etc.

based products, such as pulp and paper, and wood products, and bio-mass as an energy source.

With respect to policy recommendations (section 5), we have excluded bio-fuels, since issues related to the markets for bio-fuels are dealt with in another task force. However we consider as absolutely essential the link between the production of bio-fuels and bio-based products. This could occur in so called “bio-refineries”. The technologies to produce bio-fuels and bio-based products, or their intermediate chemical building blocks, follow the same principles. Bio-based products have the potential of reinforcing the economics and rapid introduction of bio-fuels and *vice versa*.

In general we have excluded conventional paper and wood products even though these products are based on bio-mass, the reason being that for these products we do not see the same kind of market failures that might be at hand for new bio-based products. However wood based production is affected by the development of the bio-fuels demand and pulp and paper production plants have in principle the technical potential of becoming bio-refineries. The current forest-based industries can therefore be affected by the developments in lead markets for bio-based products.

3. Analysis of markets for bio-based products

There is a wide range of **bio-based products** which could eventually acquire a substantial market acceptance:

- Fibre based materials (i.e. for construction sector or car industry);
- Bio-plastics and other bio-polymers;
- Surfactants;
- Bio-solvents;
- Bio-lubricants;
- Ethanol and other chemicals and chemical building blocks;
- Pharmaceutical products incl. vaccines;
- Enzymes;
- Cosmetics.

3.1 Current and potential markets

The total markets for bio-based products globally and within EU are difficult to estimate. Generally there is a strong tendency to focus on markets where bio-based products can substitute products based on other raw materials while the possibilities to estimate markets for new bio-based products are limited⁴. Additional data regarding current and potential markets for these products are presented in annex I.

In 2005 bio-based products accounted for 7 percent of global sales and \$ 77 billion in value within the chemical sector, with the EU industry accounting for approximately 30% of this value. McKinsey & Company predicts that by 2010 bio-based products⁵ will account for 10 percent of sales within the global chemical industry, accounting for \$ 125 billion in value.

⁴ See also the recent IPTS “Bio4EU” study published by JRC. <http://bio4eu.jrc.es>

⁵ The definition of bio-based products in this study refers to industrial products made from biological feedstock and/or biotechnological products and does not fully overlap with the definition used in this report.

However the share could rise to as much as 20 percent depending on the development of technologies, feedstock prices and policy framework.

	2005	2010	2020
Volume of the new bio-based product markets	\$77 billion (global) \$23b (EU)	\$125billion (global)	\$250 billion (global)*
Jobs dependent on new products**	120.000	190.000	380.000

* conservative estimate assuming that best case scenario predicted by McKinsey for 2010, i.e. that 20% of chemical industry output is bio-based, is achieved latest in 2020.

** Estimate by assuming that relative sales figures of 7%, 10% and 20 % also apply to employment levels (current EU chemical industry employment at is at 1.9 million (CEFIC data); these jobs include those generated in the bio-fuels area).

Table: Examples of current production and market development for bio-based products

<ul style="list-style-type: none"> • The total European market (EEA) for soap, detergents and similar products amounts to about € 30 billion. 30-50% of the products include enzymes which are bio-based. Enzymes make it possible to reduce water and energy consumption in washing. EU is a leading producer of enzymes. There is a potential of increasing the use of enzymes in food, pulp and paper and textiles production. • At EU level, 50,000 tons of bio-plastics were produced in 2005 which represent a limited market share (0.1%). Although bio-plastics are at present "niche markets" a dynamic market growth is forecast. Market shares in the order of 1-2% by 2010 and 2-4% by 2020 are projected⁶. As regards specifically packaging plastics, it is estimated that in 2010 there is a potential market share of 5% of the total use of packaging plastics. Large supermarket corporations are currently giving increasing attention to the use of bio-based packaging materials. • The current market share of bio-solvents in the EU is about 1.5 %. However, bio-solvents produced from vegetable oils and from starch progressively replace petrochemical solvents. One of the principal factors for their increased consumption is the Community legislation concerning the reduction of volatile organic compound (VOCs) emissions in the context of the air quality policy. Some estimations point at a potential share of approximately 12-40% of the solvents market. • Packaging, health and care sector disposables, detergents, hygiene products, cosmetics and paints represent areas in which bio-based products could potentially reach a substantial market share. These are sectors which are strongly influenced by health and environmental concerns. The sales in the EU in these areas were roughly about € 250 billion in 2005 and in particular the health and care sector is expected to grow due to the ageing of the population.
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⁶ Estimations made by the report JRC-IPTS, 2005 - "Techno-economic Feasibility of Large-scale Production of Bio-based Polymers in Europe".

3.2 Factors driving the future demand for bio-based products

Some of the major factors driving the future markets and demand for bio-based products in the EU are:

- Limited availability and increased cost of fossil resources vs. renewable bio-based resources;
- Policy development, in particular climate change mitigation, sustainable production and consumption, Lisbon agenda, industrial policy and employment growth;
- A changing consumer demand based on the awareness of the need to ensure sustainable production and consumption.

Resources

In the long-term one can expect, in relevant areas, a shift from petroleum- and gas-based raw materials to bio-based. The major reasons are the limited availability of fossil resources and the continuously increasing costs for fossil-based raw material as well as the climate change impact of increased consumption of fossil resources, and political and security factors. At what point in time this switch from one raw material base to another will occur is generally difficult to determine and would differ between products areas.

Bio-based materials can in certain applications also substitute metals and mineral-based materials. Metals and minerals are not renewable but products based on these materials are generally recyclable.

It should be noted that bio-based products would not only compete with and potentially substitute petroleum-based products but could also offer new functionalities and higher product qualities.

Possibly the greatest advantage of bio-based products is that they are manufactured out of renewable raw materials and the life cycles of production, use and disposal are generally greenhouse gases (GHG) neutral. The time span for renewal can be annual, like for many plants, or stretched over several years like for trees. Excluding bio-fuels, the biomass volume required for production of bio-products is modest and the biological raw material base is expandable within the EU and in general also globally.

The CO₂ emissions released in the manufacturing and consumption of bio-based products are largely balanced by the CO₂ captured in the growth of the biomass used for their production. The extent to which such a closed eco-cycle of CO₂ can be achieved might vary between products.

The main growth potentials for bio-based products are therefore their capacity:

- in the longer term, to substitute, at lower costs, fossil-based products;
- to create GHG neutral eco-cycles thereby contributing to a low carbon economy;
- to be manufactured with lower ecological footprint, i.e. lower energy and water use and lower waste generation.

In general, these are product characteristics that have societal benefits which should be acclaimed. Obstacles that hinder the realisation of these benefits should be eliminated.

Policy development

The Community climate change and energy policy objectives will set important framework conditions for the development of markets for bio-based products, alongside those for renewable energies⁷:

- Reduction of GHG emissions of 20% by 2020 and 30% within a wide international agreement;
- Increasing of the share of renewable energy sources to 20%;
- Increasing the levels of bio-fuels in transport fuels to 10% by 2020;
- Improving energy efficiency with 20% by 2020.

In addition, the EU Sustainable Development Strategy and environmental policies and legislation (with respect to packaging, waste, landfill, pollution control, etc.) will likely have a considerable impact on the development of markets for specific bio-based products.

The Common Agricultural Policy (CAP) will impact on industrial non-food production by strengthening the sustainable production of agricultural raw materials and their supply to industry. The Forest Action Plan and measures suggested in the forthcoming Commission Communication on forest-based industries are also important for increasing the use of EU forest resources. Bio-based products would be produced in an agriculture/forestry-manufacturing industry system which among others calls for an integrated approach involving agricultural, forestry and industrial policies. The Rural Development Policy contributes in this industry system through its support for innovative SMEs.

Consumer behaviour and the need to ensure sustainable development

Advanced biomass production and new bio-chemical conversion technologies have shown to lower resource use (energy, water and other inputs) in the production of existing and new industrial (bio-based) products, thereby contributing to the development of more sustainable industrial production and greener industries. Most bio-based products can also be recovered and recycled. In addition, bio-based products have the potential of saving on limited fossil resources, reduce greenhouse gas emissions, and offer a high bio-degradability and full compostability. European consumer behaviour is increasingly affected by these "green" product qualities and recent research shows consumers' willingness to pay a premium for more sustainable products.

3.3 Factors limiting the demand for bio-based products

As stated above, currently bio-based products in general make up only a small portion of the total markets compared to their petroleum-based counterparts. A number of factors limit the demand for bio-based products:

- *Higher costs for and more complex value and production chains of bio-based products*

Demand for bio-based products has not been sufficient to realise economies of scale in the manufacturing of these products. In most cases bio-based products have to compete against fossil-based products, which are being manufactured and distributed in well established value chains. In contrast, new and highly complex value chains need to be

⁷ see Communication from the Commission on Limiting Global Climate Change to 2 degrees Celsius, The way ahead for 2020 and beyond (COM(2007)2)

established for bio-based products, linking raw material producers in agriculture or forestry to manufacturers (chemical and other industries), retailers and end users. In some cases, reliability of supply and quality of bio-based raw materials can cause producers and users to choose a less risky alternative.

- *Lack of LCA data and product quality standards for bio-based products*

While bio-based products promise to offer economic, environmental and societal benefits this cannot be taken for granted for all bio-based products. Bio-based products, from raw materials to intermediate and final products, need to be subjected to detailed Life-Cycle–Analysis (LCA), taking into account use and disposal or re-use in order to fully evaluate their benefits. Product quality standards and certification, industry voluntary approaches, labelling and communication schemes are important to encourage and aggregate demand, and may help public procurers. Actual or perceived quality differences between incumbent and bio-based products and a lack of information on bio-based products among consumers and down-stream producers may cause them to choose established products instead.

Financing of large scale demonstrators that allow up-scaling of bio-based production and of new bio-based product innovations, in particular through high-tech SMEs, as well as stronger efforts in communicating the benefits of bio-based products are also considered to be important factors for creating dynamic markets for bio-based products.

4. Societal, economic and strategic interests

Bio-based products are of high societal and economic interest due to the potential impacts on sustainability and the protection of the environment, human health, rural development and industrial competitiveness.

- **Sustainability and protection of the environment**

Bio-based products are based on renewable and expandable resources, thereby decreasing dependency on increasingly expensive and limited (finite) fossil and mineral resources, and having the potential of saving energy and reduce GHG emissions. In the long term, they thus offer the potential for a more sustainable industrial production.

Many bio-based products have advantages for the environment:

- Low emissions of components that negatively affect the environment, such as organic volatile compounds (e.g. hydraulic fluids, solvents used for adhesives and paintings, products used for dry cleaning).
- Generally high biodegradability (e.g. plastic materials waste, land-filling aspects).

However, it is certainly necessary to investigate further via cradle-to-grave life-cycle assessments the effects of establishing value-chains based on bio-based raw materials, not least the net effect on CO₂ emissions. Efforts to identify solutions to current problems should be broad in scope to avoid shifting problems from one place to another or from one impact category to another. It has been demonstrated that increased bio-based production will require careful management to avoid detrimental agricultural repercussions and that

the growth of bio-based production will involve many nations, both developed and developing.

- **Improved population health**

Bio-based products in general have low toxicity. Novel bio-based products, such as pharmaceuticals, food and feed additives, plant-based vaccines etc. offer the potential for increased functionality and quality at lower production costs.

- **Support to rural development**

Bio-based products can contribute to rural development by providing additional market outlets for farmers and decentralised production facilities (i.e. bio-refineries) can provide new income and employment opportunities in rural areas. Due to the fact that the raw materials grow over large areas, bio-based production favours a decentralized structure.

- **Increased industrial competitiveness through innovative eco-efficient bio-based products**

Bio-based products can make a substantial contribution towards a more sustainable and competitive industry, capable of generating growth.

Strategic EU advantages

Europe is currently well placed to develop lead markets for innovative bio-based products, building on its established strengths:

- Europe has a solid chemical, pulp and paper, woodworking and industrial biotechnology industry infrastructure, agriculture and forest sector and knowledge base.
- Europe has a competitive forest-based industry. Forestry and sustainable forest management have been based on and developed in Europe. Europe is leading in paper recycling in the world, constantly developing new applications for paper residues and by-products.
- Europe is the world leader in key industrial biotechnologies such as enzyme technologies, and both small- and large-scale fermentation. Key enzyme-business players are located in Europe. However, US and Japan competitors are constantly improving their products and the market structure might therefore change in the near future.
- Europe is very strong in the development and production of bio-based speciality products such as food ingredients, several pharmaceuticals, and fine chemicals.
- Underused renewable raw materials are still available in Europe, but competition is increasing.
- Europe has an essentially high performance education system which provides a highly skilled workforce.

5. Policy measures

Targeted policy measures could have a stimulating impact on the uptake and demand for bio-based products, some of them similar to those already in place to support the uptake of renewable energies. Considering the dynamic interaction between demand and supply in efficient markets demand-side measures have to some extent to be complemented by supply-side measures that are aimed at further decreasing production costs of certain bio-based products, thereby lowering prices which further increase market demand, and facilitating product innovations.

Demand side measures:

- Economic and market measures such as the establishment of common EU or international standards for bio-based products, development of a harmonized and approved EU or international labelling system.
- Raise awareness and better communicate the benefits of bio-based products to the various customers and services, the general public and the consumer.
- Public procurement of bio-based products as well as the use of standards and labels depends on the communication of the benefits of bio-based products. The information should be based on harmonized LCA or comparable methods that measure the benefits and improved qualities of bio-based products. The characteristics of bio-based products and best-practice in public procurement should be communicated widely. Member States could set milestones and draw up road maps for bio-based procurement.
- Overall, coherent and comprehensive legislative action building upon, further streamlining and better targeting the existing ones, in particular, in the areas of agriculture, environmental, health, transport, energy, and industrial (sustainable development) policy. Regulatory actions, such as the setting of targets or provision of subsidies for specific high-volume bio-based products (such as biofuels) can affect raw material supply and costs, thereby impacting on the competitive position and market up-take of other bio-based products.

Supply side measures:

- Supply side measures would include actions to improve the availability of agricultural and forest resources. These measures can contribute to lowering the raw material and processing costs and consequently reduce product prices, thereby facilitating market demand and further reducing product prices through economics of scale.
- Facilitating public-private-partnerships for setting-up bio-refinery demonstration and pilot plants, in particular those based on 2nd generation technologies. Integrated production of various bio-based products in 2nd generation, integrated bio-refineries will provide economies of scale and cost reductions not currently achievable, but this necessitates bringing together various public and private actors, and along new and highly complex value chains.
- Increase access to finance for companies, in particular SMEs, developing new innovative products for new or existing markets.

The above policy measures strongly depend on each other and are interlinked. Only the combination and proper timing of these measures would facilitate lead markets for bio-based products to emerge in Europe. Policy makers, industry and other relevant actors and stakeholders at EU, national and regional level will need to be involved and cooperate to fully realize the economic, societal and environmental potentials and benefits of these products.

Recommendation

We therefore propose, as an action of high priority to ensure a coordinated and coherent approach, to establish a Commission inter-service task force (ISTF) complemented by a high-level advisory group involved in the development of bio-based product markets. Both groups should have a time limited mandate, i.e. up to 4 years. While the advisory

group should give more general recommendations, the objective of the inter-service task force would be, in consultation and cooperation with Member States, and stakeholders, to further develop and coordinate Commission initiatives. The work of the ISTF should relate to and be coordinated with the work of existing inter-service groups and external working groups like the "Member States Competitiveness Group in Biotechnology" (DG ENTR), the KBBE-NET (DG RTD) and other relevant forums.

The rationale and objectives for demand-side measures and complementary measures which would need to be further developed and implemented through this strategic approach are outlined below.

5.1 Standards

Standardisation is a voluntary process based on consensus amongst different economic actors (industry, SMEs, consumers, employees, environmental NGOs, public authorities, etc). It is carried out by independent standardisation bodies, acting at national, European and international level. Standardisation supports a number of EU policies (competitiveness, environment, energy, trade, etc.) and has contributed significantly to the development of the Internal Market. Standards are seen as essential elements in aggregating initial demand, in particular for new bio-based products.

In the area of bio-based products, an industry self-commitment concerning biodegradable and compostable polymer products exists since 2004. This was facilitated by the Commission through a working group on renewable raw materials (RRMs) for industry and consists of a voluntary certification and labelling scheme⁸. The commitment is seen as the starting point towards a harmonised internal market for bio-based products. It is essential to further build upon the biodegradability standards, e.g. stronger standards for lubricants in forest and agricultural machines to boost the use of bio-lubricants for this application (see example in text box below).

Recommendation

Sustainability standards and labels (eco-efficiency) will to a large extent rely on harmonised and in-depth life cycle assessments and would need to cover the whole spectrum of bio-based products, from biomass raw material to intermediate products and final end products. There are also links to be made with standards that are being developed for recycled materials and products. Eco-efficiency standards would also need to take into account that final end-products might be made up of a mix of bio-based and non bio-based components. They should hence build on a sound scientific knowledge base, the achievements of the JRC-IES "European Platform on Life Cycle Assessment" and on the standardisation achievements at

⁸ The notification costs of this voluntary scheme are ~7000€ per product linked to the execution of standardised tests (i.e. EN13432), while the additional certification costs are ~1400€ per product for the first year and ~1200€ per product for each of the following years. Companies include: BASF AG (DE), Cargill Dow (USA), Novamont (IT), Rodenburg Biopolymers (NL). It is supported by EU federations: IBAW, Plastics Europe, and ERRMA. More information on www.errma.org. Some bio-lubricants would also qualify for an ECO-Label (see Commission Decision N°2005/360/EC of the 26 April 2005 establishing the ecological criteria for the award of the Community eco-label to lubricants – OJ L 118/26, 5.5.2005).

international level.⁹ In this respect, it is also essential to develop bio-mass raw material quality standards and bio-degradability standards to also boost the sustainable development in third countries¹⁰. The potential use of EU sustainability standards in international trade needs to be considered.

Considering the length of time often required for standardisation it is essential that these activities, building on current work, are accelerated.

To intensify the standardisation process it is suggested that a bio-based products standardisation working group is established with representatives of the concerned industries, distributors, consumers and standardisation organisations. This working group should develop, in close cooperation with the proposed inter-service task force, a coherent concept for bio-based product standardisation in the first half of 2008, taking into account existing Commission policy on standardisation, as outlined in the Commission Communication on the role of European standardisation in the framework of European policies and legislation (COM(2004) 674 final). Within its framework contract with the standardisation organisations, the Commission could launch a mandate to explore the potential of EU wide bio-based product standards.

This activity is seen to be short-term to medium-term.

Example: Standards for lubricants in forest and agricultural machines to boost bio-lubricants.

For the use of bio-lubricants ISO-Standard/Norm DIN ISO 15380 requires for the change from mineral lubricant to bio-lubricants or bio-hydraulic oils that the residues of mineral oils should be $\leq 2\%$. The value should be at $\leq 1\%$ for HPLD-Mineral oils or motor oils. This is important to avoid excessive fuming production and filter load which leads to damages of machines. Hence, the use of bio-lubricants could be boosted if these thresholds would be replaced by a sensitivity factor that limits mineral oil residues and will avoid the technical problems (e.g. fuming) described above. Such a sensitivity factor could be introduced in the normal testing regime for bio-lubricants. Moreover, the introduction of a maximum zinc or calcium content would facilitate the controlling of the required residue level of mineral oils as this could be based on standardised laboratory sample. Furthermore, the introduction of quantitative ultimate biodegradability performance criteria of such as 90% in standards for the use of bio-lubricants in forest and agricultural machines would also encourage their application. It is estimated that these activities together with awareness rising would stimulate the bio-lubricants consumption.

5.2 Labelling

The EU Eco-label scheme is laid down in Regulation (EC) No 1980/2000, which is also part of a wider approach on Integrated Product Policy (IPP). The scheme is currently under review to increase its uptake by industry as well as to integrate it fully into the forthcoming Sustainable Consumption and Production Action Plan (SCP Action Plan). While a study has shown that the EU Eco-label has delivered some positive results, it also has noticed that there

⁹ This project was started in 2005 to provide the methodological and data basis for integration of Life Cycle Thinking into a range of EU policies, such as Integrated Product Policy, the two Thematic Strategies on Natural Resources and on Waste, and the upcoming Sustainable Consumption and Production Action Plan.

¹⁰ The Roundtable for Sustainable Palm Oil (RSPO), established 3 years ago, has brought together hundreds of companies with the objective of establishing a world-wide certification scheme (www.rspo.org)

is a low awareness of the label, procedures are perceived as cumbersome, fees and costs of getting the label are perceived as barriers and there is a lack of public purchasing benefits.

As part of the SCP Action Plan the Commission is considering streamlining and reinforcing European product labelling rules in general with the objective to improve the synergies and coherence between labelling schemes. This analysis will look at the existing labelling schemes such as energy labelling and eco-labels as well as possible new labelling such as carbon labelling and sustainability labelling for key raw materials (fish, biofuels). The outcome of the ongoing revision of the Energy Labelling Directive 92/75/EEC could be considered in this context. The objective should be to inform consumers of the best performing products, thereby rewarding producers of the best performing products in the marketplace.

Generally, it is not possible to develop a “generic” standard and label for all bio-based products. Labelling and definition of product quality criteria (including that of eco-efficiency) would need to take into consideration possible mixtures in products (bio/non-bio) and the manufacturing processes, etc. Labels and quality standards may need to be developed at different levels of the bio-based production process, from the initial raw biomass, over bio-based intermediary products, like ethanol, plastic pellets, etc. (which could serve as a B2B communication tool) and in a last step a final products labelling. The latter would be closer to an eco-label approach, based on LCA and also taking into account waste management issues. Labels and standards could be developed for specific bio-based products, such as lubricants, bio-plastics, bio-packaging etc. for which there is a demonstrable benefit in terms of lower ecological footprint in production or use, lower toxicity, etc.

Recommendation

It is recommended that bio-based products become a new product group category within a revised EU eco-label scheme and that the specific product requirements are developed with a strong commitment from industries at an early stage and fully embedded into the sustainable development policy. This strategy would increase the uptake of labels in this field. Measures should include actions to raise awareness, the development of standards, assessment criteria and procedures that are cost-effective.

This activity is seen to be short-to medium-term taking into account the current revision activities of the EU eco-labelling regulation.

5.3 Public procurement

Public Procurement has a strategic role in stimulating bio-based product markets based on technical standards for "bio-based" and "sustainable" products. Green Public Procurement Policies have to be based on full Life Cycle Analysis of the product, production process and its application, including waste management.

The Review of the EU Sustainable Development Strategy as adopted by European Council in June 2006 sets the objective of aiming to achieve by 2010 an EU average level of Green Public Procurement equal to that currently achieved by the best performing Member States.

Member States have or are currently submitting Action Plans on Green Procurement. A Communication on Green Procurement is likely at the end of 2007. This will specify in more

detail the kinds of processes that will be put into place for voluntary target setting and exchange of best practice.

Examples of currently existing/planned policy measures at Member States or international level:

- The French Agency for Environment and Energy Management, the ADEME, has published a guidebook “**Bio-products Guidebook for Greener Procurements**”¹¹, which gives buyers useful information and concrete data about bio-based products in the 10 main bio-product applications areas: bio fuels, wood heating, packaging, inks for printing, lubricating oils, building materials, agricultural films, cleaning agents, phytosanitary products and road-surfacing. Each section includes an overview of the existing market in France and Europe, and of the legal context. The advantages of the vegetal alternatives are summarised, along with the existing commercial offer (suppliers, manufacturers, distributors) and some important showcases are highlighted (see http://www.ademe.fr/htdocs/publications/publipdf/bioprod_collectivite.pdf)
- The US “**Federal Bio-based Products Preferred Procurement Program**”¹² (FB4P) launched by the Farm Security and Rural Investment Act of 2002 (FSRIA) is a policy supporting the preferred purchase of bio-based products by the US government as long as the product has similar (or superior) pricing, performance, and availability to a conventional product. A first list of bio-based products issued in March 2006 contain: Mobile equipment hydraulic fluid; diesel fuel additives; penetrating lubricants; roof coatings.

Recommendation

- The Commission could study, collect information and identify and disseminate good practice of the Member States activities and also third country programmes regarding the procurement of bio-based products, notably for the integration of measurable technical specifications concerning bio-mass content into the tendering document. These can help in describing the products so that public authorities can decide whether they are of interest to them and the specifications would also constitute minimum compliance criteria at the same time. They would then provide measurable requirements against which tenders can be evaluated. If they are not clear and correct, they will inevitably lead to unsuitable offers. Offers not complying with such technical specifications have to be rejected.¹³
- The characteristics of bio-based products and best-practice in public procurement should be communicated widely, i.e. via specific guidelines or handbooks.
- The National Action Plans on Green Public Procurement could be developed further and include milestones and roadmaps for increasing the use of bio-based products.
- A forum concerning procurement of bio-based products to the public and private health and care sector could be established.

These activities are seen to be short-term actions.

¹¹ ec.europa.eu/environment/etap/pdfs/bioproducsguidebook.pdf and *Guide de l'achat public éco-responsable. ADEME - Agence de l'Environnement et de la Maîtrise de l'Energie, 2004*

¹² <http://www.biobased.oce.usda.gov/public/index.cfm>

¹³ See “Buying Green! - Handbook on green public procurement” http://ec.europa.eu/environment/gpp/guideline_en.htm.

5.4 Ensuring policy coordination and coherency

Markets for bio-based products are affected by policy development and legislation from a number of different policy areas, in particular agriculture, environment, transport, energy, health, industry and research.

The Common Agricultural Policy (CAP) could have a strong impact on the supply of agricultural raw materials. Although the CAP has not a specific "non-food" aim, it does contain instruments for promoting cultivation of crops for non-food industrial uses, which offer a high added-value outlet to agricultural biomass.

The recent modification of the cereal intervention system (the dismantling of maize intervention) is an excellent example. The reform would significantly increase the competitiveness of maize for biofuels and bio-products, and help the building up of those EU industries under more competitive conditions in the short term.

Examples from environment policy include "The Integrated Pollution Prevention and Control legislation (IPPC)" (directive 96/91/EC) as well as the legislation concerning Packaging Waste (directive 2005/20/EC, 94/62/EC) and Landfills (Directive 1999/31/EC). These could be used as instruments to further facilitate the use of bio-based products and encourage the use of new technologies to produce such products thereby also stimulating competence-building concerning bio-based products.

Bio-based products could also be promoted through forthcoming Commission initiatives to improve the environmental performance of products. In particular, the Commission is considering proposing a system of "advanced performance benchmarks" (describing the best performing products in the market) coupled with minimum requirements already foreseen in Community legislation (notably in the Eco-design of energy using products Directive) and market incentives so as to reward front runners and drive performance upwards.

Recommendation

A strategic approach towards supporting the development of a lead market for bio-based products will need to be based on coherent, comprehensive and coordinated legislative actions, further streamlining and better targeting the existing ones, in particular, in the areas of agriculture, environmental, health, transport, energy and industrial policy. This coordinated approach will need to cover the full product value chain, starting from the renewable raw material up to the final bio-based end-product, taking into account and satisfying the required product capabilities for customers, ensuring sustainable growth and supporting job creation.

It is proposed that the inter-service task-force mentioned above be charged with ensuring a coordinated and coherent policy approach, thereby supporting the development of markets for bio-based products. It can do so by analysing and providing input to on-going policy strategies and legislative actions that can impact the development of bio-based product markets or by proposing new, coordinated policy actions.

- Examples of policy areas and legislative development relevant to bio-based products

In the context of the **IPPC**, an information exchange on Best Available Techniques (BAT) is organized with stakeholders by the Commission resulting in the BAT Reference Documents (BREFs). In the context of the review of the relevant existing BREFs, further information could be provided on innovative emerging techniques in the field of bio-based production technologies including those that potentially would be used in bio-refineries, and thereby promote the introduction of bio-based products. The IPPC Directive is also under review taking into consideration, amongst other aspects, the possibility to make quicker use of research information for determining BAT, to focus more on emerging techniques in the BREFs and to improve the information exchange amongst stakeholders which could lead to the determination of lead markets.

Reduction of different types of waste will lead to the development of new uses for different **waste** types, including specifically the conversion of biological waste to various chemical feed-stocks and subsequently into new bio-based products. Potentials for conversion of specific waste into bio-based products should be analysed and taken into account when developing new waste reduction policies.

Future revisions of the **CAP** will provide opportunities to examine the various elements of non-food policy in order to give positive incentives to the cultivation of crops for industrial uses, in line with the ongoing CAP reform path, alongside the provision of biomass for energy production. In the recent years the demand of biomass for transport and non-food purposes has been increasing significantly, thus any change in the current set of available tools may enhance the intrinsic capacity of the sector to respond to such demand.

An obligatory set-aside requirement with possibility of producing non-food crops was introduced at the 1992 CAP reform and has been in place until now. Nevertheless, a withdrawal of this set-aside obligation would expand the production potential of EU agriculture allowing matching the surging biofuels and bio-products demand. Moreover, the reform of the sugar regime of 2006 enhances the competitiveness of sugar sector and encourages the non-food uses of sugar as sugar for the chemical and pharmaceutical industries and for the production of bio-ethanol will be excluded from production quotas. Additional incentives are also set out for the use of sugar for producing bioethanol.

The rural development policy also offers support for developing non-food markets for agricultural and forestry products, such as support to training in the field of non-food production, and to cooperation between farmers and companies for the development of new products, methods and technologies.

5.5 Communication

It is important to communicate the benefits of bio-based products to users and the public at large, in order to get a buy-in from all relevant societal groups and market actors. The bio-based product markets are strongly diversified and involve many actors: consumers, SMEs, larger companies, retailers, the financial sector, in particular the risk-capital markets, public authorities, etc.

European consumers are increasingly making purchasing decisions based on ethical or environmental considerations. Such buying patterns also give signals to retailers and manufacturers that factors other than quality and price are important. As environmental awareness grows, the demand for products from clean, green manufacturing processes, including bio-based products, will likely grow.

It is necessary to create a function to coordinate communication efforts concerning the introduction of bio-based products. It is also important to create a forum for collecting user feed-back on the use of bio-based products and further more to follow-up the development of new products in particular those coming from small companies.

Establishment of a communication function has been given the highest priority by stakeholders in our consultations.

Recommendation

Communication efforts should have a “lighthouse” function steering actors towards the aim of establishing lead markets for bio-based products. This function could be facilitated by the high-level advisory group mentioned above. Communication activities could be financed by the Competitiveness and Innovation Program (CIP).

An "eco-efficiency" approach for the labelling of bio-based products that is firmly embedded into the sustainability policy is seen as an important element of communicating the benefits of bio-based products, and should therefore be seen as one of the priority actions.

A Eurobarometer public opinion survey will be held during 2008. It is planned to include some questions directly related to the use of bio-based products that might be helpful in understanding the likely consumer response to, as well as the broader European public's understanding of bio-based products and their introduction.

5.6 Complementary actions: Access to finance for innovation and R&D

In the US, China and elsewhere markets for bio-based products are expected to increase rapidly. These countries are increasing investments into research, technology development and innovation and are supporting large scale demonstrators:

- China is setting up a pilot factory for second-generation bio-fuel production and has entered a three year research agreement with Danish enzyme producer Novozymes, who will develop the cellulose-ethanol bio-conversion process.
- BP in early 2007 announced to invest \$500m over the next 10 years in an Energy Biosciences Institute linked to part of the University of California.
- US Dept. of Energy is co-financing commercial demonstration of an integrated bio-refinery system for production of liquid transportation bio-fuels, bio-based chemicals, substitutes for petroleum-based feed-stocks and products, and biomass-based heat/power generation with up to \$160m.

The research and development activities regarding renewable raw material production for non-food applications have been an important objective for several Community research programmes¹⁴.

Enabling the production of bio-fuels and bio-energy, together with bio-based products, within "integrated bio-refineries", using second generation technologies for the conversion of ligno-

¹⁴ During the last ten years, the EU has financed more than 200 individual research projects and networks in the field of the agricultural raw materials (excluding bio-energy). Research in the agro-industrial field has absorbed a research budget of approximately EUR 400 million, of which 50% from the EU budget.

cellulosic material (from agricultural and forest origin) and waste into chemical feed-stocks, is of particular interest, since it does not compete with agricultural production for food uses, offers higher environmental benefits than first generation bio-products and may contribute to rural development. The full economic and environmental benefits of high-volume production of certain bio-based products and bio-based chemical feedstocks, can only be realised through such large-scale integrated and diversified bio-refineries. Pilot infrastructures to demonstrate the technologies and to test new feed-stocks and pre-treatment processes already exist to some extent but need to be complemented by larger scale demonstrators to verify scale-up of processes.

The initial construction of bio-refinery pilot and demonstration plants is, however, is not only a costly undertaking but it also involves bringing together market actors along a new and highly complex value chain. This ranges from the diverse suppliers of biomass raw materials (farmers, forest owners, wood and paper producers, biological waste suppliers, etc.) with industries providing the technologies and industrial plants to convert the raw materials and the various end users of intermediate or final products.

Recommendation as to possible supply-side actions that could impact on the market development for bio-based products:

- The "Knowledge-based Bio-Economy" (KBBE) network of Member States research ministries coordinated by the Research Directorate General, together with relevant European Technology Platforms and the Member States Competitiveness Group in Biotechnology (coordinated by the Enterprise and Industry Directorate General) could play an important role in supporting the development of a strategic European research agenda for bio-based products and help in establishing a number of strategically important bio-refinery pilot plants and demonstrators before 2010, bringing together actors and investments at EU, national and regional level.
- Co-ordinated calls of FP7 programmes to develop knowledge and the technology base to speed up development of 2nd generation bio-refineries (by 2009).

6. Evaluation

If the suggested measures concerning lead markets for bio-based products are implemented it is important to evaluate the effects and to consider how to proceed. This evaluation should be carried out within 3-4 years.

7. Elements of validation

Stakeholders consulted:

- EU-RRM meeting 18 April 2007
- Presentation and discussion of the Bio-Based task force recommendations at the Conference of the Forestry Technology Platform (Hannover – 14-15 May 2007)
- Meeting with relevant ETPs, industry associations and other stakeholders (22 May 2007)
- KBBE-NET meeting of Member States research ministries (30 May 2007; Cologne)
- Member States network for Competitiveness in Biotechnology (31 May 2007; Cologne)
- Presentations at various conferences, including the 3rd International conference on Renewable Resources and Biorefineries (RRB), (4-6 June 2007, Gent)

Summary of consultation with stakeholders:

Stakeholder consultations included relevant European Technology Platforms and industry associations (meeting in Brussels on 22 May), and representatives from research ministries responsible for biotechnology/bio-based research as well as technology/industry ministries (meetings in Cologne). The lead market concept and the policy recommendations of the bio-based task force were also represented at various conferences and stakeholders meetings.

Major response of stakeholders to proposed recommendations:

- Overall, there was a **very strong support** from the stakeholders, including those that today largely produce "conventional" (fossil-based) products, both as concerns the lead market initiative as well as the specific policy recommendations. Stakeholders stressed the need for policy coherence and a prospective, coordinated and strategic approach to the bio-based lead market. This would need to be translated into a clear process supported by a high-level group of stakeholders and the relevant Commission policy areas.
- It was pointed out that the **labelling** and definition of product quality criteria (including that of eco-efficiency) for final/consumer products would be complex because one has to take into consideration possible mixtures in products (bio/non-bio) and the manufacturing processes etc. There was consensus on the fact that it would be impossible to develop a "generic" standard and label for bio-based products, but that these should be developed first for specific bio-based products, such as lubricants, bio-plastics, bio-packaging etc. for which there is a demonstrable benefit in terms of lower ecological footprint in production or use, lower toxicity, etc. International harmonisation of quality standards was seen as very important, in particular for ensuring that exported biomass raw materials were produced in a sustainable manner. The "enforcement" of standards, in particular in exported goods, was also raised as an important issue.
- Most stakeholders were of the opinion that **communication aspects** should receive a much higher priority within the mix of policy recommendations. The benefits of bio-based products and its use for public procurers would need to be strengthened (similar to the "buy-bio" initiative in the US). Labelling, build on sound and harmonized LCA, as well as well defined and not overcomplicated standards, was again seen as a pre-requisite for these activities.
- As to the setting of **targets** for specific bio-based products, there was general consensus that they should be voluntary as far as possible, but that in specific cases, for which there was strong policy interest, target setting could be a powerful and acceptable instrument.
- **Bio-refinery**. The need for financing integrated bio-refineries and setting up demonstrators for bio-refineries producing different outputs from a variety of bio-mass input was stressed. In the medium to long term, up-scaling of production processes was seen as the only way to realize cost-reductions. In advancing the bio-refinery concept, it was argued not only to focus on bio-fuel production but also on other larger volume bio-products. These could also be realized in conjunction with food, feed, paper, etc; production, i.e. by processing by-products or wastes. However, since there are still technological risks and as yet under developed markets, co-financing of such demonstrators within public-private partnerships was seen as the preferred option, also in trans-national and trans-regional partnerships and in particular in those areas where a large supply of biomass would fall together with the need for economic development of this region.

8. Roadmap for implementing policy recommendations

Policy Instruments	Objectives	Actions	Timetable	Actors
Legislation	Ensure the coherent, comprehensive and coordinated development of policies and regulations that impact the development of bio-based product markets	Establish a high-level advisory group, including Member States and industry, to assist the thematic inter-service task force on bio-based products in the follow-up of the present action plan and including in the analysis of the impact of legislative proposals in relevant policy domains on the development of markets for bio-based products.	2008	EC Stakeholders
Public procurement	Encourage Green Public Procurement for bio-based products.	<p>Establish a network between public purchasers of bio-based products to apply the Commission guide on public procurement for innovation, to identify good practices in the field of bio-based products and promote their application across the EU.</p> <p>The network would inter alia:</p> <ul style="list-style-type: none"> Provide an overview of standards or technical features of bio-based products Collate a best practice catalogue and put it on the Web, Initiate training programmes <p>Member States to consider developing milestones and roadmaps for increasing the use of bio-based products within National Action Plans on Green Public Procurement.</p>	<p>2008-2010</p> <p>2008-2009</p>	<p>EC Member States Industry</p> <p>Member States</p>

Policy Instruments	Objectives	Actions	Timetable	Actors
Standardisation, Labelling, Certification	Aggregate demand for bio-based products through a coordinated approach for standard setting and labelling.	Establish standards/labels for specific bio-based products involving all relevant actors by:		EC
		analysing potential for bio-based products standards/labels,	2008	CEN Industry
		launching a mandate to CEN, in co-operation with Commission services	2008	Other stakeholders
		developing standards/labels, including cost-effective assessment criteria and procedures, building upon the current work of the European Platform on Life-Cycle-Assessment	2008-2011	
		proposing a first set of standard.	by 2010	
Complementary Actions	Communication of policies regarding bio-based products as well as the benefits of bio-based products.	Conduct an information campaign via different media with focus on SMEs.	2008-2012	EC
		Eurobarometer survey	2008	EC
	Support access to finance for R&D&I.	Promote the establishment of strategically important bio-refinery pilot plants and demonstrators involving all actors and investments at EU, national and regional level.	2008-2010	EC Member States Stakeholders

Annex I: Markets and societal interest in bio-based products

1.1 Construction materials; composite materials

Market description	Market analysis	Strategic and societal interest
<p>Products for construction. Products made from natural fibres (flax, hemp, jute, wood) that have found application in production of building materials such as cement-based composites (hemp concretes) that can be used for walls, roofs.</p> <p>Composite materials for the automotive industry. These are made from a mix of natural fibres and polymers (biopolymers or petrochemical) in replacement of fibre glass for the automotive industry. To improve their mechanical properties, fibres of different origins are added to thermoplastic or duroplastic in the production process.</p>	<p><u>Current:</u> 50,000 t of fibres in the automobile industry and 3,500 t in the construction industry</p> <p><u>Growth:</u> 100,000 tons in the motor industry (2010); market share of bio-based out of total could be between 5 and 30% maximum (2020)</p> <p>Cost of natural fibres is 3-4 times higher than that of mineral wools <u>but</u> natural fibres have good mechanical properties (impact resistance, acoustic qualities, strongly reduced weight- lightweight concretes.). Benefits in cars are related to lightweight advantages over conventional glass fibre compounds and partly to cost advantages over PUR foam based products. Better waste management: materials containing vegetable fibres are easier to recycle or burn than the materials containing fiberglass fibres..</p>	<p><u>Sustainability/environmental factors of major interest</u> because of better waste recycling, high environmental quality of products and potential reduction of CO₂ and other emissions in manufacturing</p>

1.2 Total biochemical products (bioplastics, polymers, lubricants, surfactants, etc.)

Market description	Market analysis	Strategic and societal interest
<p>All "green" bio-based chemicals that replace fossil-fuel based chemicals, such as bioplastics and -polymers, lubricants, solvents, surfactants.</p> <p>Second generation chemicals applying cellulose-based ethanol-production know-how to produce other chemicals (adipic acid etc.) under R&D development, to enter the market in follow-up of related ethanol production and may replace this due to potentially much higher profits.</p>	<p><u>Current:</u></p> <p>6.4 million tones of renewable raw materials used for EU-25 chemical industry in 2005 (8% of al RRM)</p>	<p>Sustainable chemical production; lower GHG and other emissions in production (in some cases lower resource use in terms of energy, water and less waste compared to fossil-based production); typically better biodegradability; potentially less toxic</p>

Estimated EU potential of major RRM-based products (source: ECCP report¹⁵)

Market Sector	Total Consumption Market (1998) ('000 tonnes)	Renewable Consumption (1998) ('000 tonnes)	Potential in 2010 ('000 tonnes)	Potential Share in 2010 (%)
Polymers	33000	25	500	1.5
Lubricants	4240	100	200	5
Solvents	4000	60	235	12.5
Surfactants	2260	1180	1450	52

The figures on the potential, columns 4 and 5, take into account the future development of the total market without specific additional policies and measures. With such policies and measures, significant increases are possible.

1.2.1 Bioplastics

Market description	Market analysis	Strategic and societal interest
Biopolymers, such as polysaccharides (carbohydrates – starch from maize, wheat, and potatoes). Polylactic Acid (PLA), a plastic material derived by fermentation (producing lactic acid) from starches or glucose. Used for food packaging, bags, hygiene products, packaging for biological waste, plant pots, etc. Also composite materials with new qualities; textiles, etc.	Total EU plastics market about 73 Mtoe, 3-5% growth rates p.a. Current: 0.1% (50,000 t) of total EU plastic production; but 30% production increase in recent years. World capacity in 2008 is 0.5 MToe. Future: Production: 0.5-1 Mtoe (by 2010) and maximum 3-5 Mtoe (by 2020) - Market share: 1-2% (by 2010) and 1-4% (by 2020) of total plastics (would require an estimated 2.5 million acres of land) 5% market share for packaging plastics by 2010	Bioplastics usually have better biodegradability (starch-based). May provide savings in terms of GHG emission (0.8-3 tons of CO2 less per ton of plastic compared with conventional plastic). Total GHG savings in EU in 2020 would be 9-27 million tons of CO2. Contribute to economic activity and employment opportunities in the agricultural sector and rural areas PLA: fully biodegradable

¹⁵ European Climate Change Programme; Long Report. June 2001. Available since 23/07/2007 at: http://ec.europa.eu/environment/climat/pdf/eccp_longreport_0106.pdf

1.2.2 Surfactants

Market description	Market analysis	Strategic and societal interest
Surfactants lower surface tension of liquids and are used in soaps, detergents, pharmaceuticals, food additives, etc. and for the production of emulsions and foams. They are produced largely from oils. Next generation "biosurfactants" can be produced from algae or bacteria.	World market 10 Mtoe in 2002 (EU 2.5Mtoe) of which 30% (700 000 t of vegetable matters, mainly oils) New emerging markets: <ul style="list-style-type: none"> ▪ plant health products (currently 100.000 tons p.a.) detergents (60-65% could be of vegetal origin)	Low eco-toxicity, biodegradability and compostability; (enzyme based detergents have hugely reduced energy used by household washing machines and replaced phosphorus)

1.2.3 Biosolvents

Market description	Market analysis	Strategic and societal interest
Solvents mainly part of paintings, inks, varnishes, adhesives etc. Majority of solvents currently petrochemical solvents.	Currently 1.5% of total (60.000 tons out of 4 Mtoe) Could grow to 12%-40% encouraged by environmental regulation.	Bio-based solvents do not emit VOC (volatile organic compounds) which are harmful to human health (and ozone layer). 23% of VOCs emitted into air are from petrochemical solvents.

1.2.4 Biolubricants

Market description	Market analysis	Strategic and societal interest
Biodegradable lubricants made from vegetable oils (and their chemical derivatives) that are non toxic for soil or water. Used as hydraulic oils in areas where high risk of pollution.	<u>Current:</u> 2 % of total (100.000 tons out of 5 Mtoe); mainly in hydraulic sector 50% of total market is automotive, but biolubricant use low. Biolubricants 1.5 to 5 times more expensive (higher development/delivery costs) <u>but</u> prices are decreasing <u>Future:</u> 30% market share by 2010; Total market potential could be up to 90%.	Biodegradability; reduce pollution of petrochemical lubricants in automotive sector.

1.3 Pharmaceutical products, incl. vaccines

Market description	Market analysis	Strategic and societal interest
Biological resources used as feedstock for fermentative production of antibiotics, amino acids, organic acids, vitamins, enzymes, etc.	High value, but low volume niche markets. World market for plant derived pharmaceuticals is €30billion, 10-25% of prescription medicines sales; 60% of anti-cancer drugs and 50% of cardiovascular drugs).	Some new product markets (plant based vaccines) could provide an interesting opportunity for lead markets.

1.4 Enzymes

Market description	Market analysis	Strategic and societal interest
Technical enzymes; food enzymes; animal feed enzymes Only 20% produced on truly industrial scale (75% of world production is generated by 4 EU companies in DK, NL and DE)	Current: 53Ktoe in 2001 (3/4 in EU); Growth:5% annual growth rate	Contributes to lower water and energy consumption.