

Realising the economic potential of sustainable resources – bioproducts from non-food crops

Editorial

Welcome to the sixth EPOBIO Newsletter. In this Newsletter we review our 2007 Workshop in Athens which reported the outputs delivered by our Flagship and Support Themes since priority actions and targets were defined during the 2006 EPOBIO Workshop in Wageningen. Our 2007 Workshop set the findings of the EPOBIO desk researchers in the context of the strategic development of the bioeconomy, international perspectives, policy issues and sustainable industrial development. We were delighted to have representatives from various parts of the world – for example, from the US, Canada, China, New Zealand and Japan. This very clearly illustrated the range and strength of current activities addressing the economic potential and future development of the bioeconomy globally.

Algae Report

This Newsletter also introduces the latest EPOBIO report on the potential of micro- and macro-algae. We have examined the huge potential of aquatic biomass and considered future development scenarios. As the summary below shows, the report highlights the need to consider carefully the economics of using organisms from the aquatic environment for industrial production.

FP7 Progress in selection of bio-projects

We are delighted to be able to record here that all of the EPOBIO Flagship themes (biopolymers, plant cell walls and plant oils), in which we were tasked with identifying both research needs and future industrial potential, were included within the first call for proposals from the first round of Framework Programme 7. We understand that the projects submitted in response to the specific calls (KBBE-2007-3-1-01: PLANT CELL WALLS, KBBE-2007-3-1-03: GREEN OIL and KBBE-2007-3-1-06: BIOPOLYMERS) have been evaluated and the next stage (contract negotiation) is in hand. This is excellent news and we wish the successful Consortia well in their future work. For further details of the calls see:
<http://www.biomatnet.org/secure/FP7/F2080.htm#bio>

Dissemination through BioMatNet

As is normal in these Newsletters, we provide our regular update on BioMatNet, a unique resource that makes available the results from RTD projects supported by the European Commission in the area of

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biological materials for non-food products. This includes results of activities, both in the EU and in the US, relevant to the production of renewable bioproducts and biofuels continue to be disseminated through BioMatNet. Details of recently added ITEMS can be found in ITEM Update No 5 – see:

<http://www.biomatnet.org/news/news.html>

Partner Search

A partner search facility has now been added to the BioMatNet site. If you wish to attract interest in your proposals for the 2008 call, you can add details of your interests and requirements using the Partner Search facility:

<http://www.biomatnet.org/secure/Partners/S2139.htm>

Contact Us

We trust you find this a useful indication of the continuing activities within the project and welcome comments or other inputs.

If you have questions about the work or activities of EPOBIO please contact us at info@epobio.net; comments about the website should be sent to web@epobio.net.

If you are not already registered with EPOBIO or BioMatNet and would like to receive periodic emails summarising activities, events and additions to the website then please register with EPOBIO:

<http://www.epobio.net/register.htm>

You are reminded that we published the seventh edition of the BioMatNet CD-ROM just prior to the workshop. Copies are still available to registrants.

The EPOBIO Management Team

2007 Workshop

The 2007 EPOBIO Workshop was held in Greece in May and was attended by a wide range of international experts from the scientific community, academia, industry and policy development. The Workshop focussed on the potential of green plants to use solar energy and manufacture raw material feedstocks, which offers a major way to address issues of paramount importance and to deliver the future needs of society in a sustainable way. The EPOBIO team reported on our work undertaken since the 2006 Workshop, examining the future potential of the bioeconomy in the context of relevant regulatory and policy issues, global developments and industrial perspectives on sustainability. The results showed how the EPOBIO process had been used to provide a framework for validation of research priorities and a thorough evidence base to inform decision-making.



Participants at the 2007 EPOBIO Workshop

The EPOBIO presentations at the Workshop were accompanied by the publication of five reports as detailed below. All of these publications, the full report of the Workshop and the various presentations made during the event, as well as the posters, can be found in the workshop area of the EPOBIO website.

- 2007 Workshop: <http://www.epobio.net/workshop0705.htm>
- Full Report: http://www.epobio.net/workshop0705/0705final_report.pdf
- Presentations: <http://www.epobio.net/workshop0705.htm#presentations>
- Posters: <http://www.epobio.net/workshop0705/0705posters.htm>
- Crop platforms for cell wall biorefining – lignocellulose feedstocks: <http://www.epobio.net/pdfs/0704LignocelluloseFeedstocksReport.pdf>
- Industrial crop platforms for the production of chemicals and biopolymers: <http://www.epobio.net/pdfs/0704ChemicalsAndBiopolymersReport.pdf>
- Oil crop platforms for industrial uses: <http://www.epobio.net/pdfs/0704OilCropsReport.pdf>
- Public attitudes towards the industrial uses of plants: the EPOBIO survey: <http://www.epobio.net/pdfs/0704AttitudesReport.pdf>
- Science communication and the potential of sustainable resources: <http://www.epobio.net/pdfs/0704CommunicationReport.pdf>

Some of these reports have recently been re-printed. Numbers are limited, but if you wish to receive a printed copy please email us and you will be informed of availability: info@epobio.net

Micro- and macro-algae: Utility for industrial applications

This report has been prepared by Anders S Carlsson, Jan van Beilen, Ralf Möller and David Clayton

This, the final report from EPOBIO, addresses emerging opportunities presented by phototrophic organisms of the aquatic environment. It can be downloaded from the website (click on the link below) and hard copies will soon be available from the EPOBIO office but, for ease, we summarise the introduction and the conclusions of the report in the following paragraphs.

Download the report: Micro- and Macro-algae: Utility for Industrial Applications (2056 Kb PDF)

<http://www.epobio.net/pdfs/0709AquaticReport.pdf>

The purpose of EPOBIO, a Science to Support Policy Consortium funded by the European Commission, is to realise the economic potential of sustainable resources – non-food bioproducts from agricultural and forestry feedstocks. To date, our desk studies have produced eight reports addressing a range of bioproducts and feedstocks and assessing their potential for developing biorenewables with high value and utility to society. The

assessment has involved a holistic analysis of the science-based projects within a wider context of environmental impact, socio economics, regulatory frameworks and attitudes of public and policy makers. This EPOBIO process has allowed costs and benefits of each application, product and process to be defined, thereby providing a robust evidence base for strategic decisions, policies and funding.

The opportunities offered by land-based agriculture, forestry and their many applications for non-food industrial products are well recognised. Most recently, the use of lignocellulose biomass for generation of transport fuels is a much debated topic in the design of future energy production systems, again illustrating the versatility of plant raw materials for both energy and non-energy products. It is in this context that the potential of marine biomass is increasingly discussed, given the size of the resource and that more than three quarters of the surface of planet earth is covered by water. These aquatic resources, comprising both marine and fresh water habitats have immense biodiversity and immense potential for providing sustainable benefits to all nations of the world. Some 80% of the world's living organisms are found in aquatic ecosystems.

Of net primary production of biomass, it is generally accepted that 50% is terrestrial and 50% aquatic. Policies of Governments have focussed almost exclusively on the use of land plants, with little consideration so far of the non-food applications and utility of macro- and micro-algae and their products. The limitations of agricultural land and the impacts of global climate change on agricultural productivity are factors of increasing relevance in the decisions that must be taken on land use for food, feed, chemicals and energy. Clearly, this increasing competition for land is driving the current consideration of the potential of the aquatic environment for the production of biofuels and industrial feedstocks.



Figure 1 from the report shows some commercially exploited seaweeds - *Macrocystis pyrifera* (left); *Laminaria digitata* (right). © <http://www.algaebase.org>. Reproduced with permission from Michael Guiry and Dirk Schories.

The technical potential of micro-algae for greenhouse gas abatement has been recognised for many years, given their ability to use carbon dioxide and the possibility of their achieving higher productivities than land-based crops. Biofuel

production from these marine resources, whether use of biomass or the potential of some species to produce high levels of oil, is now an increasing discussion topic. There are multiple claims in this sector but the use of micro-algae as an energy production system is likely to have to be combined with waste water treatment and co-production of high value products for an economic process to be achieved. These current biofuel discussions illustrate two issues. First, the potential broad utility of these organisms that are capable of multiple products, ranging from energy, chemicals and materials to applications in carbon sequestration and wastewater remediation. Second, the need for a robust evidence base of factual information to validate decisions for the strategic development of algae and to counter those claims made on a solely speculative basis to support commercial investment.

The current regulatory framework under development in Europe notes that an all embracing maritime policy should aim at growth and more and better jobs, helping to develop a strong, growing, competitive and sustainable maritime economy in harmony with the marine environment. An aim is to integrate existing and future EU, regional and national policies affecting marine issues. The emphasis of the proposed framework is on use of the marine environment at a level that is sustainable where marine species and habitats are protected, human induced decline of biodiversity is prevented and diverse biological components function in balance. Whilst it is recognised that innovation may help to find solutions to issues such as energy and climate change, there is little in policy proposals that addresses the utilisation of available marine biomass.

The report explores opportunities for energy and non-energy products, encompassing both marine and fresh water macro- and micro-algae. Salt water agriculture and the use of tidal flats is not discussed nor is the harvesting of aquatic plants other than algae. The first chapters briefly introduce the range of organisms and their habitats, together with the production systems that are already in development and use for their large-scale cultivation. The later chapters summarise the diverse range of products that have arisen or could be developed in this sector, including the utility of genes.

The report concludes that the macro- and micro-algal populations of the aquatic environments provide a vast genetic resource and biodiversity. This feature alone suggests that these organisms have considerable potential for offering new chemicals, materials and bioactive compounds. The completion of the genome sequencing programmes of two micro-algae also opens up major opportunities for new applications, either using the algae themselves or through using the genes in other production systems, whether fermenter-based or fields.

The culture of micro-algae has been studied widely through their potential for greenhouse gas abatement and this information is detailed in many reviews cited in this report. There are many conflicting statements on the potential of micro-algae for high biomass production, but there is a general agreement that the current production systems are not economically viable for biomass production alone. The difficulties include high capital infrastructure costs, problems of contamination through open pond systems and costs associated with harvesting and drying. These costs adversely affect the competitiveness of aquatic biomass production systems, compared to land-based agriculture and forestry.

Thus these negative cost considerations currently preclude the widespread use of micro-algae for biofuel production or production of other forms of bioenergy. Similarly, the macro-algal seaweeds, whilst used for some specialised applications, are also expensive to farm and harvest offshore. There are few clear drivers for using these species as biomass for bioenergy, except in specific circumstances such as maritime

communities with no access to productive agricultural land or alternative energy sources.

The increasing concerns of global climate change and rising levels of atmospheric carbon dioxide have led to the recognition that carbon sequestration alone can have a tangible economic value. The value placed on a tonne of carbon within current trading schemes will determine decisions on how best to cost effectively 'manufacture' this product. There may be conditions in the future that would support the use of aquatic and particularly marine organisms for carbon capture and income generated through this route.

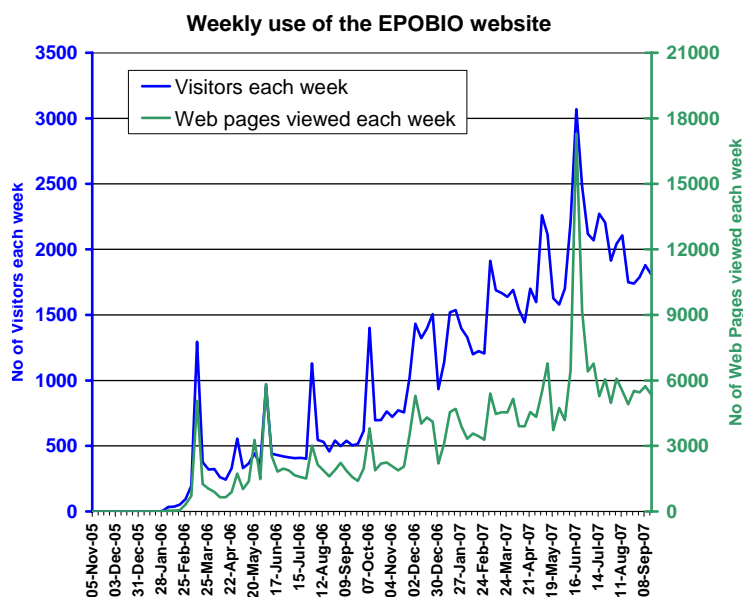
Additional value products from the micro-algae, such as chemicals, can increase the cost competitiveness. Often these are manufactured by the cells following a stress shock and under low nutrient conditions. For example, there has been a study in which the production of astaxanthin has been shown to be commercially viable using a micro-algal inoculum established in photobioreactors and transferred to open ponds for three day cultivation of biomass prior to harvest of product. This system successfully avoided the problems of contamination found in open pond cultivation systems since the cycle was extremely short.

Using micro-algae for waste water treatment is not a new idea. However, combining the ability of the cells to remediate water with their use for carbon sequestration or energy production may offer an economically viable way forward for the development of multiple products.

This report does highlight the need to consider carefully the economics of using organisms of the aquatic environment for industrial production.

EPOBIO – a growing audience

Statistics on the use of the EPOBIO website collected each week continue to show a satisfactory trend with a steady rise in the number of users recorded. As illustrated by the following graph, the number of visitors to the site each week is now in excess of 2000 individuals who, on average, view around 4 pages per visit. These statistics clearly show the interest generated when the second set of EPOBIO reports were added to the website, with visitors rising to 3000 with an average of 6 downloads by each visitor. The series of previous peaks coincide with emails sent out to registrants concerning the workshop and other EPOBIO news. The drop in July and August is not unexpected and is seen in many technical websites, reflecting the holiday period.



In the month following the addition of the second reports over 11,000 copies were downloaded. To date the number of times each of the EPOBIO reports has been viewed/downloaded (hits) is as follows:

Hits	Title	File Size	Publication Date
5327	Biopolymers flagship report: Alternative Sources of Natural Rubber	1279 Kb PDF	November 06
5098	Plant Cell Walls flagship report: Cell Wall Saccharification	532 Kb PDF	November 06
4468	Crop Platforms for Cell Wall Biorefining: Lignocellulosic Feedstocks	3282 Kb PDF	April 2007
3801	Plant Oils flagship report: Production of Wax Esters in Crambe	492 Kb PDF	November 06
3667	Industrial Crop Platforms for the Production of Chemicals and Biopolymers	1454 Kb PDF	April 2007
3442	Oil Crop Platforms for Industrial Uses	647 Kb PDF	April 2007
1318	Public Attitudes towards the Industrial Uses of Plants: The EPOBIO Survey	566 Kb PDF	April 2007
365	Economic and other data used in preparation of Industrial Crop Platform Reports	211 Kb PDF	April 2007
299	Science Communication and the Potential of Sustainable Resources	231 Kb PDF	April 2007

The reports can be downloaded from the publications section of the EPOBIO website:

<http://www.epobio.net/publications.htm>

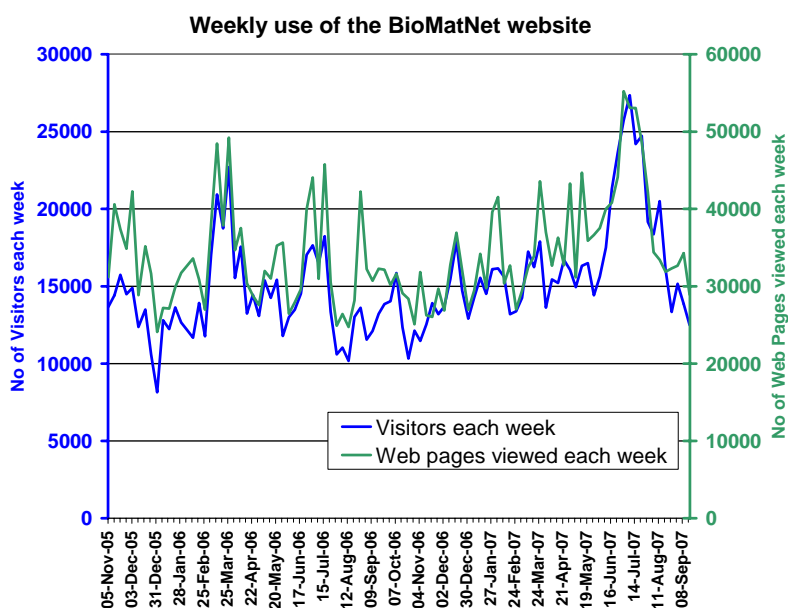
Dissemination through BioMatNet

Information concerning renewable bioproducts and biofuels continues to be added to the BioMatNet website: <http://www.biomatnet.org> on a regular basis. The more recent additions are listed in the recent ITEM Update No 5: <http://www.biomatnet.org/news/news.html>. However, the rate of addition of such information has slowed over the last few months since most of the new FP6 and IEE (Intelligent Energy - Europe) project descriptions have been added and reported on in previous editions of ITEM Update.

The re-organisation of the website has continued, with most of the commercial organisations now transferred to the database of websites with the contact list updated. This means that many of the individual contact names have been removed from older projects funded under programmes such as ECLAIR, JOULE, AIR and Thermie. The project descriptions and 'further information' have been retained, since in some cases revision of the official EU sites means that this is the only widely available source of information on the earlier Framework Programmes.

As shown in the graph (right), the use of the BioMatNet site remains fairly constant attracting around 15,000 users each week, superimposed on which is a large peak which probably also reflects the interest generated by the email notification sent out in June.

Dissemination of information concerning EC-funded RTD activities under the various Framework Programmes through BioMatNet and its predecessors (NF-AIRID, NF-2000) has been supported by the issue of a series of CD-ROMs. This tradition has now been continued by the issue of number 7 in the series. Copies can be ordered through the website by filling in the request form. For further information about the CD-ROM see: http://www.biomatnet.org/the_cd.html#nf



Partner Search Facility

A Partner Search Request section was added to the BioMatNet website in July 2007:

<http://www.biomatnet.org/secure/Partners/S2139.htm>

Partner Search Requests are removed from the website when the Calls they relate to close, hence during periods when there are few open calls, there will also be few Partner Search Requests listed. Both the first and second calls for 2007 are now closed. Hence, requests should relate to future activities. In common with all themes of the "Cooperation" programme, work-programmes for the theme "Food, Agriculture and Fisheries, and Biotechnology" will be published annually. The call identifiers for the majority of the topics take the form: FP7-KBBE-year-number. The reference to the "KBBE" is to emphasise the objective of the theme to build the Knowledge-Based Bio-Economy. The "year" is the year of the work programme and the "number" is the number of the call.

The second work-programme, in 2008, will contain the finalised topics for 2008 (FP7-KBBE-2008-2B one-stage

evaluation), any ERA-net topics (FP7-ERANET-2008-RTD); and indicative topics for 2009. The third work-programme, in 2009, will contain the finalised topics for 2009 (FP7-KBBE- 2009-2A two-stage evaluation and FP7-KBBE-2009-2B one-stage evaluation), any ERA-net topics (FP7- ERANET-2009-RTD); and indicative topics for 2010. Although KBBE is the most relevant area of FP7 for funding of research on bioproducts and biofuels, possibilities for support may also be found in other sections of "Cooperation" such as energy and environment. This section supports all types of research activities carried out by different research bodies in transnational cooperation and aims to gain or consolidate leadership in key scientific and technology areas. Funding is also available in other parts of the programme, which include IDEAS covering basic and innovative research, the PEOPLE programme for training and developing scientists and CAPACITIES that includes opportunities for development of SMEs (Small and Medium Enterprises). Further information on all these activities appear on the CORDIS website:

http://cordis.europa.eu/fp7/home_en.html