



Clean, sustainable and white....

Executive summary

White biotechnology has tremendous potential to transform energy production and lead to more sustainable industrial processes. It can play a significant role in reducing greenhouse gases, the use of fossil fuels and raw materials, leading to cleaner and greener industries. In sourcing raw materials from agriculture, white biotech can additionally contribute to a more competitive European agriculture, compliant with world trade rules, which is environmentally sustainable.

White biotechnology has been in industrial use now for two decades as laundry detergent enzymes; it has also been used to make penicillin and an alternative to animal-derived insulin as well as to produce many vaccines and medicines.

The technology seems to enjoy public acceptance. Certain non-governmental organisations (NGOs) even accept these applications because of their unobtrusive and environmentally friendly nature.

This potential is especially valid for Europe, with its ambitious environmental targets and highly critical public opinion.

Most of the world's white biotech industry is European, and Europe's sizable chemical industry (29% of the world market) – a key beneficiary of biotech derived processes - is on a par with the US.

Yet the potential of white biotechnology is almost unknown to European policymakers and remains largely untapped. In the US however, a substantial set of stimulating measures have already been in place for several years.

In this paper, a small group of highly innovative companies, all members of EuropaBio wish to focus the attention of European Institutions on this little known but very interesting technology. Our stated purpose is to share our expertise and work closely with the Commission to aim for a more sustainable and competitive industrial development of Europe.

Introduction

We are now familiar with the application of modern biotechnology in medicine and agriculture: so-called red and green biotechnology. There is less general awareness of the white variety: the use of biotechnology for industrial applications.

In the past, eco industries have mainly been associated with end of pipe technologies focussing on waste treatment rather than waste prevention. Modern industrial white biotechnologies are preventative, focussing on cleaner manufacturing processes to minimise waste in the first place.

White biotech uses the same tools as nature namely micro-organisms like moulds, yeasts or bacteria and enzymes as cell factories to make goods and services like antibiotics, vitamins, detergents and bio-fuels. White biotech can also use cell cultures, derived from animal cells, to yield new pharmaceuticals and vaccines. Future large scale applications of the technology will enormously contribute to the objectives of sustainable consumption and production on the one hand and wealth generation on the other.

The sustainable and targeted nature of white biotechnology

The various industrial applications of biotechnology have a number of things in common, both in terms of improved output and reduced environmental footprint. They can deliver some or all of the following benefits:

- Reduce water use and traditional chemicals
- Reduce use of energy, and thus lower levels of CO₂ emissions. Conversion of many existing chemical processes will make a significant contribution towards meeting the targets set by the Kyoto treaty.
- Increase the use of renewable resources, whether as chemical feed stocks or fuels. Growing rather than extracting will reduce the use of fossil fuels and be carbon-neutral.
- Biotechnological processes, because they are precisely targeted, can be used to make new materials and higher quality materials more cost effectively, with less waste.
- Cell cultures are unique in their capacity to make new pharmaceuticals and vaccines which could not otherwise be made
- Bio-based industries can also give a major boost to European agriculture by for example sourcing high-value raw materials from farmers, providing new alternatives for agricultural land use and using agricultural waste to build value: a clear contribution towards a sustainable rural economy.

White biotechnology is highly selective. For example, Vitamin B2 can be made using a one step bioprocess rather than by a chemical synthesis that makes mixtures which then have to be separated using precious water and energy resources. In doing so waste by-products are produced which then need to be treated. This is why introducing bioprocesses into production can help companies produce cheaper, cleaner and often superior products.

Creating value across industry sectors

Although a small number of biotechnology industries are involved in white biotechnology today, its contribution will be most keenly felt in the EU's heavy industries that will depend on it to remain competitive. Chemicals, textiles and leather, food, animal feed, paper and pulp, energy, metals and minerals and waste processing are industries already using biotechnology processes today.

White biotech has the capacity to change industrial processes as much as red biotech has transformed pharma. Biotech is a tool for pharma which often turns out to be the best one. In some areas there is simply no alternative. For example, 75% of pharma active compounds are chiral compounds and the best way to make these efficiently is through biotech processes. A cheap source of compounds for the pharma industry is vital to its competitiveness.

Bioprocesses already account for 15 million tons a year of chemical products including organic and amino acids, antibiotics, industrial and food enzymes, fine chemicals as well as active ingredients for crop protection, pharmaceutical products and fuel ethanol. Three out of four of the large volume chemical reactions employed in today's industry are so called oxidation processes, used for example in the production of plastics. These are the least sustainable of all chemical reactions. If bioprocesses could replace oxidation, then white biotech would profoundly change the industry and deliver real sustainability gains. Similar stories will be played out in other sectors: textiles, pulp and paper and energy.

Developing countries

Challenged with the difficult task to balance economic growth with more sustainable processes, many developing countries face heavy environmental problems, having neither the technology nor the resources to tackle the burning issues. White biotechnology both in the long term and in the short term can contribute to sustainable development in the lesser developed countries. In the short run, considerable progress can be achieved if white biotechnology is used to upgrade existing technologies in for example the textile, leather and food/feed industries but also in providing newer and safer vaccines.

The potential and the stumbling blocks

To date, white biotech applications are still being applied on a small scale. The big sustainability gains are still to come with large scale applications of the technology.

However, there are problems blocking white biotechnology's development. The raw materials or feeding stocks like vegetable oils and glucose needed for bioprocesses are expensive and the enzymes used to convert the material require a high investment in research and long development times. An increased level of research and investment in developing cheap feeding stocks and powerful enzymes is crucial.

Currently, researchers are investigating whether the large amounts of unused plant material (biomass) in the world could become the main feeding stocks for industry. Biomass can also be used to replace petroleum with bio-fuels. If this can be achieved, "biorefineries" may one day take their place alongside oil refineries. This change in raw-material base will open new markets for bio-mass and change the future perspective of agriculture in Europe dramatically. We have only to look at the importance our major competitor countries are placing on some of these areas to realise how crucial it is that European industry is not left behind. For example, in the area of biomass, the USA is spending nearly ten times as much as the EU on research

programmes. The Japanese government is to more than double their research and development budget for biotechnology in the next five years to 2007.

Europe is a leader in the development of white biotechnologies today and is investing resources to improve industrial processes. Advances in genomics and technology delivery devices and services for biotech applications have helped develop lots of enzymes and fresh synthesis pathways to create new materials. This will only continue into the future with the right level of investment in research and support for white biotechnology.

As the heavy industries of the twentieth century progressively give way to the more knowledge-intensive production technologies of today, there is a need to continue progress down this path if Europe is not to become a service economy, importing its physical goods from more efficient overseas competitors. Biotechnology is one of the keys to this. An increasing proportion of our manufactured output will come from efficient bio-processing but only if we take action to build on it.

What needs to be done?

The economic and environmental benefits of white biotechnology will not be realised without some positive actions. EuropaBio calls on the European Institutions to:

1. Consider white biotechnology as one of the preferred tools to achieving sustainable development
2. Promote investment in more effective manufacturing systems
3. Stimulate the demand for sustainable products from white biotechnology
4. Provide incentives for a broad range of chemical industries (especially small and medium enterprises) and the energy sector to switch to more efficient processes which white biotechnology offers
5. Promote a dialogue with all stakeholders, and in particular the industry itself and the OECD, in how to further the applications of white biotechnology and alleviate the current existing blockages.
6. Support the development of standardized tools or guidelines to measure the impact of white biotechnology
7. Encourage sustainable policies
8. Help developing countries to leverage white biotechnologies in the short and longer term

The political landscape

At the Lisbon European Council meeting in March 2000 the Union set itself the objective of becoming “*the most competitive and dynamic knowledge-based economy*”

in the world, capable of sustained economic growth with more and better jobs and greater social cohesion”.

The World Summit for Sustainable Development concluded that countries should encourage and promote the development of a 10-year framework of programmes to accelerate the shift towards sustainable consumption and production. And called on countries to diversify the energy supply and substantially increase the global share of renewable energy sources in order to increase its contribution to total energy supply.

Growth and employment potential

In the general environmental industry sector, in which white biotechnology plays its part, it is estimated that there are already 2 million jobs in the EU. A quarter of these have been created in the last five years, and there is every reason to believe that significant employment growth will continue – but only if the environmental industry is supported and investors are encouraged to invest in it.

If Europe does not seize the opportunity to build enthusiastically on its existing strengths, other countries will become leaders in the area.

Conclusion

Applying our knowledge of biological processes and biochemistry – collectively, biotechnology – will enable sustainable, environmentally benign global development to be achieved and the development of the bio-based economy, where intelligent applications of biology become the main driving factor behind growth and wealth creation.

Sources of further information

1. OECD report “The Application of Biotechnology to Industrial Sustainability” (May 2001) Short summary available <http://www.oecd.org/pdf/M00033000/M00033279.pdf>
2. Commission Communication COM (2002) 27 “Life science and biotechnology - A Strategy for Europe”
3. Commission Report COM (2002) 122 “Environmental technology for sustainable development”
4. US Presidential Executive Order 13134: “Developing and Promoting Biobased Products and Bioenergy” (a plan to triple the sector by 2010)
5. World Summit for Sustainable Development conclusions <http://www.johannesburgsummit.org>
6. Biotech impact in industrial chemistry - Mc Kinsey presentation at the European Chemicals Forum
7. The McKinsey Quarterly 2000 Number 2 -Using plants as plants
8. Plant/crop-based renewable resources 2020 - a vision to enhance U.S. economic security through renewable plant/crop-based resource use (DOE/GO-10097-385 January 1998)