

KBBE conference 2010



The Knowledge Based Bio-Economy towards 2020 Turning Challenges into Opportunities

*Report of a conference held on 14th September 2010 in Brussels
Organised by the Belgian Presidency in collaboration
with the European Commission*



This report sums up the main discussions and findings of the Knowledge Based Bio-Economy (KBBE) towards 2020 conference held in September 2010 during the Belgian Presidency and organized in collaboration with DG Research. The report complements the study on “KBBE in Europe: Achievements and Challenges” which was written as a background document for the conference and which formed the basis for the debate. Both documents can be downloaded from the conference website www.kbbe2010.be or ordered via info@ewi.vlaanderen.be.

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DISCLAIMER

The views expressed in this publication do not necessarily reflect the position of the Belgian Presidency or the European Commission.



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“The bio-economy includes all industries and economic sectors that produce, manage, and otherwise exploit biological resources (and related services, supply or consumer industries) such as agriculture, food, fisheries, forestry etc.”

Bio-economy conference, 2005

“Worth nearly €2 trillion, the European bio-economy provides around 22 million jobs in Europe across sectors as diverse as agriculture, forestry, fisheries, food, chemicals and bio-fuels. This is the impressive reality of the European bio-economy. It is an indispensable part of all of our lives and plays a major role in making our lives better.”

Máire Geoghegan-Quinn, 2010

“A bio-based economy is based on production paradigms that rely on biological processes and, as with natural ecosystems, use natural inputs, expend minimum amounts of energy and do not produce waste as all materials discarded by one process are inputs for another process and are reused in the ecosystem.”

Franz Fischler, 2010 (from WWF, Denmark)

FOREWORD

It was my pleasure to welcome the participants to this important conference on behalf of the Belgian Presidency. More than 500 delegates from over 40 countries representing all continents gathered in Brussels to hear a range of experts discuss key issues relating to the future role of biological processing and biomass in a sustainable economy.

The 'KBBE towards 2020' conference built on what was achieved at a similar conference held five years ago. While discussions were then primarily held on the potential of the technology, this time we focussed on realisation of that potential and how that process can be encouraged and speeded up. There has been plenty of progress in the last five years, but we still have a long way to go if the enormous potential is to be fulfilled.



In Belgium the academic research base is particularly strong in Life Sciences, providing the knowledge on which future development will be based. Unfortunately, like the rest of Europe, we do not have the same strength in translating excellent science into strong economic growth. This innovation gap must be bridged, so fortunately policymakers are responding with a holistic and integrated programme as part of the ambitious 2020 agenda.

“But in the end the building blocks of the KBBE will be made in the Member States and regions and it is to them that we will look for progress.” Ingrid Lieten

Moreover: the Life Sciences sector is crucial for economy at large and employment in particular. In Belgium it employed almost 92.000 people in 2009 and provided for another 150.000 indirect jobs. This represents 17.4% of the total manufacturing sector and its main subsectors are basic chemicals, pharmaceuticals and plastics products. Despite a difficult year, its turnover was around €45 billion.

Initiatives of the 2020 strategy include strengthening of the European Research Area (ERA), setting up R&D for a Sustainable Society programme and increasing ties with the global community of researchers and policymakers in the industrial biotechnology sector. But in the end the building blocks of the KBBE will be made in the Member States and regions and it is to them that we will look for progress. The planned launch of the EU Innovation Partnership scheme will provide further help for the national and regional authorities to undertake the necessary action.

We believe Flanders provides a good example for other regions. Our R&D expenditure is above the EU average of 2%, although below the EU goal of 3%. We have some important clusters of biotechnology-based industries, for example in Ghent which was deservedly visited by a number of delegates before the conference started. The Flemish government is continuing to focus on a few key areas to



maintain steady progress and build on existing strengths. Similar success stories are found in other Member States including Germany, the Netherlands and the UK.

The first Industrial Revolution was built on coal and steam power, the second on the power of electronics to create an ICT economy. The growing importance of the Knowledge Based Bio-Economy truly represents a third Industrial Revolution. Not only will this contribute to future prosperity, but it will also help meet the major challenges set by a number of important issues, particularly climate change, and an increasing and ageing European population.

However, it does not stop there: our mastery of biological processes will be important in providing food security and employment in developing countries. Building the KBBE is vitally important for all humankind. The outcome of this conference will now underpin the continuing efforts of the Belgian and Hungarian Presidencies and their successors.

On behalf of the Belgian Presidency,

*Ingrid Lieten
Minister of Economy, Science and Innovation
Flemish Government*

INTRODUCTION

As the first Commissioner responsible for both Research and Innovation, I was pleased to be able to speak to such a diverse international audience about the Commission's ambitious plans for the Knowledge Based Bio-Economy. An 'official' definition of the Bio-Economy was presented at the first conference in 2005, but I prefer a description that illustrates the reality very clearly: "Worth nearly €2 trillion, the European bio-economy provides around 22 million jobs in Europe across sectors as diverse as agriculture, forestry, fisheries, food, chemicals and bio-fuels." This is the impressive reality of the European bio-economy. It is an indispensable part of all of our lives and plays a major role in making our lives better.



The Europe 2020 strategy aims to build long term, sustainable growth via innovation, and innovation in the bio-economy will be an essential part of its success. The Innovation Union Flagship will help Europe to regain its global competitiveness using all available policy instruments. We need to take this approach to meet the major challenges of our age – particularly climate change, limited resources and a growing and ageing population – but there is also scope for social innovation, to make our lives healthier and better. Not only this, but our approach will encourage the multi-disciplinary working which is so productive, avoid duplication of work and tackle fragmentation of effort.

"The bio-economy strategy will reinforce Europe's leading position in the biological sciences, support education and improve the translation of excellent science into commercial success." Máire Geoghegan-Quinn

Many Member States are already setting up their own innovation programmes, but in a globalised world we also have to be part of the larger global picture. There are already strong ties with India, China, Russia and the USA, and the week of the conference also saw the establishment of the International Bio-economy Forum, comprising Australia, New Zealand, Canada and the EU. Sharing and pooling our efforts in this way will maximise our impact and benefit the lives of future generations around the world.

The upcoming "European Strategy and Action plan towards a sustainable bio-based economy by 2020" will reinforce Europe's leading position in the biological sciences, support education and improve the translation of excellent science into commercial success. A public consultation will be launched this year and we plan to adopt the final Communication in the autumn of 2011. The Commission is providing the high-level enabling strategy, but it will be up to Member State governments, researchers and private industry to make the Bio-Economy a reality. This conference has been an important step on the road to achieve this goal.

Máire Geoghegan-Quinn
EU Research and Innovation Commissioner



KEY OUTCOMES OF THE CONFERENCE

This conference covered a lot of ground, with the active participation of many of the delegates both in the plenary and parallel sessions. A number of important points emerged, often several times. The presentations and discussions are covered in more detail further on in this report, but it is important first to record the key outcomes, which will serve as a basis for the next phase of Europe's transition from a reliance on fossil fuels to biomass as a renewable raw material:

- The EU has a core strength in research in the biological sciences and it is important to maintain and build on this.
- On the other hand, we are relatively poor at turning knowledge into commercial products, so this strength does not yet fully translate into economic growth.
- There is a commitment from all EU institutions to build the Bio-Economy, but the high level policy now needs to be carried through in terms of practical, concrete actions which will make a difference to businesses and the way we lead our lives.
- The positive involvement of national and regional governments is also integral to the success of the future Bio-Economy.
- Important new and emerging technologies, in particular biotechnology (including genetic modification) and nanotechnology, must be harnessed to help meet the challenges which remain, and a rational, science-based approach used to regulate them.
- Communication has a key role to play in ensuring that European citizens are properly aware of the importance of agriculture to the future Bio-Economy and that romanticisation of farming is avoided.
- Development of the Bio-Economy is vital to properly address the challenges we face, but products cannot be forced on an unwilling public. Messages must be clear, product quality good and prices affordable.
- Europe has only 10% of the world's population, but represents 25% of global GDP. However, both figures will decline as China, India and other emerging economies grow rapidly. Our challenge is to develop economic sectors which produce sustainable employment in activities which cannot simply be exported.

Equally important are some specific guidelines to be used when formulating policy:

1. There is a need for a coherent and integrated policy framework covering the entire value chain from basic R&D, through innovation, agriculture and the consumer economy. Education, the economy and the environment must also come within this framework.
2. Not only must the policy framework be integrated and enabling, but it must also provide appropriate incentives, such as of tax credits or green procurement, to encourage take-up.
3. Good policy is necessary but not sufficient. To be successful, there must be a market demand for bio-products and the products themselves must be of high enough quality, and at a competitive price to take the place of existing ones.
4. Overall, measures to help the Bio-Economy grow should be as simple as possible. In most cases, innovative companies are SMEs which do not have large resources. It should be clear what requirements they need to fulfil and how they can access tax credits and other incentives.

To summarise, successfully developing the Knowledge Based Bio-Economy is the way forward for a prosperous, sustainable future for Europe. There will be continuing challenges but by working to our existing strengths and coordinating our efforts, we can turn this ambitious vision into a reality.



WHAT IS THE KNOWLEDGE BASED BIO-ECONOMY?

The KBBE is a broad concept which can be defined in a number of ways. In essence, the vision is of a Europe of the future in which fossil fuel feedstocks have been replaced by renewable plant raw materials, chemical processes replaced by biological ones and waste virtually eliminated by working in closed-loop systems. Above all, it will build on a strong European knowledge base of enabling science and technology and will generate sustainable employment for European citizens.

Three different definitions were offered at this conference:

“The bio-economy includes all industries and economic sectors that produce, manage, and otherwise exploit biological resources (and related services, supply or consumer industries) such as agriculture, food, fisheries, forestry etc.”

Bio-economy conference, 2005

“Worth nearly €2 trillion, the European bio-economy provides around 22 million jobs in Europe across sectors as diverse as agriculture, forestry, fisheries, food, chemicals and bio-fuels. This is the impressive reality of the European bio-economy. It is an indispensable part of all of our lives and plays a major role in making our lives better.”

Maire Geoghegan-Quinn, 2010

“A bio-based economy is based on production paradigms that rely on biological processes and, as with natural ecosystems, use natural inputs, expend minimum amounts of energy and do not produce waste as all materials discarded by one process are inputs for another process and are reused in the ecosystem.”

Franz Fischler, 2010 (quote from WWF Denmark)

The first is a clear and concise factual summary of the scope of the KBBE, used for a similar conference held in 2005. The second, however, gives a much better sense of the contribution already made by bio-processing and the exciting future it heralds. The third and final one emphasises the intrinsic efficiency and sustainability of closed-loop systems. All are valid statements, but each encapsulates a different aspect of the concept.

While removing our dependence on fossil fuels, avoiding waste and creating a sustainable, prosperous European economy are essential goals. However, we must not lose sight of the fact that the primary role of farming is to feed the human population. Not only does this need to continue, but harvests have to increase substantially to provide food security for a global growing population.

That the emerging bio-economy is already a reality and making a contribution to the overall European economy is not in doubt and was highlighted by the exhibition of bio-based products. Twenty companies of varying sizes showed that there are significant developments reaching the market. These companies will continue with their own market expansion and new product launches and will be joined by others as the KBBE gathers momentum. For more details see the exhibition catalogue on www.kbbe2010.be

THE CHALLENGES DRIVING THE BIO-ECONOMY

In the first plenary session, the speakers considered the various challenges and drivers which define the need for, and are helping to shape the reality of the Bio-Economy.

The role of Agriculture

Marion Guillou, CEO of INRA, spoke about the contribution agriculture can make to sustainable growth. Food and nutrition security remains a major global challenge, which is intensified by a growing population and compounded by increasing urbanisation, greater consumption of animal products, limited natural resources and the projected impacts of climate change.

Increased consumption of animal protein in the diet as prosperity increases has a major impact on future food production needs. If the current total consumption of animal products was to remain stable, then by 2050 the world would need a 28% increase in crop production to keep pace with population growth. However, if the current trend for increasing consumption of animal products continues, then harvests would have to grow by 83% over the next 40 years. This, of course, is likely to have a significant impact on land use and soil health, water availability, biodiversity and other environmental factors. At the same time, the actual yield of many major crops in Europe has remained almost static for the last two decades, following steady increases for many years prior to that.



“...agriculture-based actions – including using biomass to make fuels and a range of chemical products – could produce very significant emissions reductions at modest costs per tonne of carbon dioxide.” Marion Guillou

Climate change alone will give rise to significant problems, without the pressure from these social trends. Rising harvests in higher latitudes will be offset by falling yields in warmer regions, regional water scarcities may worsen and unpredictable, extreme weather events may cause severe localised crop losses. Dealing with these challenges consequences is justification enough for taking action. Using biomass to make fuels and a range of chemical products – may produce very significant emissions reductions at modest costs per tonne of carbon dioxide.

To fulfil the potential of agriculture to underpin the bio-economy, continued investment in research is needed. Application of increasingly sophisticated genomic knowledge, coupled with high throughput phenotyping and computational science, can significantly speed the rate of crop improvement. Development of new crop varieties which tolerate environmental stresses such as drought and salinity would prove particularly valuable.



Taking an eco-systems approach to farming (what we might term 'agro-ecology', a new agronomy) would also help to produce high crop yields in a sustainable way. Specific crop plant characteristics such as canopy size and root architecture themselves influence ecosystem functions such as water cycle regulation and soil fertility and structure. Crops and rotations could be chosen not just for their primary end uses, but also to promote healthy ecosystems, which in turn support good harvests. This ecological approach should also take into account micro-organisms and associated meta-genomic analysis, since micro-organisms are of fundamental importance to the understanding of the complex mechanisms affecting soil, the environment above ground and human health.

But none of this can be achieved without a framework for cooperative agricultural research, in which knowledge is pooled to achieve better and faster results, as highlighted by EURAGRI. Large, multidisciplinary programmes in which centres of excellence share their skills and facilities rather than competing will advance the frontiers of science more effectively and increase Europe's competitiveness. The Joint Programming Initiative 'Agriculture, Food Security and Climate Change' (FACCE) which today has 20 participants, has already produced a vision paper with five core thematic priorities. Continued cooperation will help agriculture to meet the demands not just of food security but also of raw material supply for the bio-economy.

Setting the perspective

The main challenges facing society today – not just in the EU but globally – can quite easily be identified. **Prof Patrick Cunningham, Chief Scientific Adviser to the Irish government**, reviewed the key issues to set the context for later parallel sessions on specific topics. Briefly, they are:

- Climate change, with average temperatures likely to increase by 2°C or more later this century.
- Finite reserves of fossil fuels.
- A world facing continued population growth, from 6.8 billion to an expected plateau of around 9 billion by mid-century.
- In parallel, in industrialised countries, a net decline of an ageing population is leading to fewer people of working age.
- A transition among developing world populations towards a greater consumption of meat.
- As a result of these trends, an expected 70% increase in food demand and doubling of energy needs by 2050.



“The challenge is to provide food security for all from limited land...while at the same time moving towards an increasing use of biomass as raw material to replace fossil fuels.” Patrick Cunningham

Sustainable solutions to these challenges require the use of renewable raw materials or direct use of solar energy. Use of biomass instead of fossil fuels provides, in principle, an inexhaustible supply of

raw material, but this cannot be at the expense of food production. Developing a successful, sustainable bio-economy while increasing food security for a larger population will require persistent and coordinated effort.

World agriculture has made enormous strides in the last half century, producing enough food for a rapidly growing population and confounding the catastrophic predictions of Paul Ehrlich and the Club of Rome. But, despite this, a significant minority of the population remains chronically malnourished. Although relatively steady in absolute numbers, the malnourished population has declined in percentage terms over the last 40 years, with again a recent, be it relatively little, rise to 17% of the developing world population.

Increasingly, the world's population will be buying rather than growing their own food: by 2050, 86% of people in the developing world are projected to live in cities (up from 44% in 2007). The challenge is to provide food security for all from limited land - arable land and pasture account for only 12% of the Earth's surface area, or 40% of the land area – while at the same time moving towards an increasing use of biomass as raw material to replace fossil fuels. To accomplish this, agricultural production will need to increase significantly without use of additional land.

But there is an economic challenge to move in this direction. First generation bioethanol and biodiesel are – depending on their source – economically viable at oil prices in the current range, but they also compete with food uses of the same crop. Cellulosic biofuels, on the other hand, use the vast amount of biomass (for example, cereal straw) which is currently wasted, but need significantly higher oil prices to break even, given current technology.

The policy perspective

Franz Fischler, former commissioner for Agriculture, presented his views of the challenges and opportunities facing agriculture and the bio-economy. Like Commissioner Geoghegan-Quinn, he put forward another alternative definition, this time from WWF Denmark: “A bio-based economy is based on production paradigms that rely on biological processes and, as with natural ecosystems, use natural inputs, expend minimum amounts of energy and do not produce waste, as all materials discarded by one process are inputs for another process and are reused in the ecosystem.”



“An intensive public debate is needed, not least to improve people’s understanding of the realities of agriculture and counteract the rosy and romanticised view of farming by the urban majority.” Franz Fischler

This view of the bio-economy has certain consequences for policies. To fulfil the aspirations, an increased efficiency of resource and energy use should be encouraged, while the longer term goal should be to move towards large-scale use of biomass in closed loop systems, with actual production of biomass being managed for long term sustainability. This is a lengthy process that requires continuous monitoring to realize the transition.



Currently, three quarters of all renewable raw materials (excluding wood, used in large amounts for paper-making and a wide range of other products) is used in either the chemical or oil industries. In Germany, the area of land used to produce renewable feedstocks rather than food grew from 400,000 hectares in 1997 to nearly 2 million ha in 2009, with by far the greatest part going to energy use. According to a study from the nova-Institut this is expected to change: over 1.8 million ha will be cropped for raw materials for non-energy uses in 2020, largely wheat, sugar beet, rapeseed, hemp and other fibre-producing plants. This move from energy crops to renewable raw materials is expected to create more value and jobs and to be economically sustainable.

Significant changes are also to be expected in crop production methods as the bio-economy develops. These include the adaptation of wild plants to present arable farming, development of new plant varieties for specific non-food uses and the use of the powerful tool of genetic modification. We can expect continued development of better management methods such as precision farming, no- and low-tilling agriculture and integrated crop management, while on the other hand the existing vast tonnage of biomass, such as straw, which is currently wasted, may be more efficiently integrated.

The expected boost for the economy is not without its risks and concerns. The most common critics include the perceived risks of use of genetic modification, the risk of reduced food security and higher prices because of competition between food and non-food crops for land, greater agricultural intensification (to the disadvantage of small farmers) and environmental degradation. None of these concerns should necessarily stand in the way of progress towards the bio-economy, but neither can they be ignored. An intensive public debate is needed to improve the understanding of the realities of agriculture and its challenges and counteract the rosy and romanticised view of farming by the urban majority.

Besides communication such developments need a good supporting policy framework. Although some of this is already present, particularly via payments for carbon dioxide emissions reduction, the upcoming reform of the Common Agricultural Policy (CAP) gives even more scope both to target appropriate investment and encourage the uptake of good farming practices. The KBBE will continue to develop in any case, but continued support of the EU will speed up the process.

A view from industry

For a view of the bio-economy from one of the leading companies in the sector, the conference turned to **Steen Riisgaard, President and CEO of Novozymes**. His message was clear: fossil fuels are running out and the bio-based economy is taking off, with a focus today on next generation biofuels. Although the technology is ready, adoption of the bio-based economy in Europe is slow as and we are still only at the pilot plant stage due to an uncertain policy environment and the lack of clear incentives. Commercial plants to make cellulosic ethanol are expected to be on-stream in Europe in 2013, but that is a year behind the USA and only slightly ahead of China and Brazil.





Next generation biofuels will use a range of renewable feedstocks: agricultural and forestry residues, cultivated energy crops and municipal waste. The challenge is to break down the cellulose or hemicellulose backbones to produce fermentable sugars. For suppliers of industrial enzymes like Novozymes, this opens large commercial opportunities. But the sector will not become established without an enabling policy framework.

“But the main barrier is that investment is seen as a risk while the policy environment remains uncertain and no clear incentives are provided.”

Steen Riisgaard

The potential is revealed in a new study by Bloomberg New Energy Finance: “Next generation ethanol and biochemicals: What’s in it for Europe?”, which covers the outlook for the sector over the next decade. The authors conclude that, even without changing patterns of land use or compromising food security, 62% of Europe’s petrol consumption could be replaced by cellulosic biofuel, up to 1 million jobs created (largely in rural areas), over €30 billion contributed to the economy (while reducing oil imports by €49 billion), and greenhouse gas emissions from gasoline-related road transport reduced by 50%. The reduction in emissions would be the equivalent of taking 30 million cars off the roads.

Simply following the business-as-usual path will not allow this vision to be fulfilled. Large-scale investment is needed, made possible by appropriate short term economic incentives. The outlook study envisages a cumulative investment of up to €88 billion between 2014 and 2020, while the breakeven point should be reached by 2018. By 2020 cumulative revenues would be more than €120 billion. A positive return on the investment is thus to be expected at the mid-term of the transition.

Despite the obvious benefits, barriers still exist as with any fledgling sector. Conversion costs are currently high and large investments are perceived as a risk, but this is to be expected for a new process and would fall with further development and optimisation. Feedstock blending and setting up a handling infrastructure for large volumes of bulky raw material require considerable work and technical standards for car engines would need to be changed to allow high levels of ethanol to be used.

To enable the necessary investment – including the building of nearly 1,000 rural biorefineries across the EU – demand for next generation biofuels will need to be secured via mandatory blending targets. At the same time, the supply side will need to be stimulated via the use of loan guarantees and production subsidies (for the early stages only) and comprehensive support for biomass development and collection. The technology is now available to make a large, profitable, biomass-based fuel and biochemicals sector a reality over the next decade. Biofuels are the biggest growth sector at present, but biological processing has a much wider range of applications and the potential in fields such as fine chemicals, cosmetics, pharmaceuticals and food ingredients is enormous.



ADDRESSING THE NEEDS

Having reviewed the challenges and supported by an expert study on **The Knowledge Based Bio-economy (KBBE) in Europe: Achievements and Challenges** (see www.kbbe2010.be), the conference turned to the practical needs of a transition to the Bio-Economy. Three parallel sessions focused in more detail on three key areas:

1. **Production of feedstocks:** This group was briefed to discuss the availability of biological resources for the bio-economy and sustainable agricultural and fisheries production through efficient soil and water management, while respecting biodiversity and labour conditions and stimulating rural and coastal development.
2. **Innovative bio-based products:** This group discussed the role of innovative bio-based products in greening the industry by largely replacing conventional fossil fuels and finite supplies of raw materials.
3. **Innovative food products:** The topic for this group was food production and eco-innovation in the food industry, including sustainability aspects such as packaging, waste, energy and water management. The development of novel food products and processes meeting requirements for safety, health and quality were also covered.

MAKING THE BIO-ECONOMY A REALITY: PRODUCTION OF FEEDSTOCKS

The bio-based economy is more complex than the fossil fuel-based one and needs to be integrated and continuous, with no breaks in the chain. The whole point of using renewable raw materials is not to create different sorts of waste but to utilise all components as efficiently as possible in closed loop systems. Over time, this new paradigm will become the norm but it will require some serious effort to reach the ultimate goal.

A clear message which emerged from the discussion was that projects needed to be properly assessed on the basis of a benefit/cost analysis. Although incentives to stimulate the transition towards a bio-based economy are felt to be necessary at this early stage, and first introductions of new technologies will not be immediately profitable, the established bio-economy must be fully sustainable and not be based on a need for long term subsidy.

A point which came up a number of times at this conference was that the Common Agricultural Policy has an important role to play in facilitating and encouraging the development of the KBBE. With discussions currently under way about the structure of the CAP from 2013, this presents the perfect opportunity to reshape it according to the needs of the bio-economy in mind. To achieve success and improve competitiveness according to the 2020 vision, a coherent policy framework supported by a range of DGs with responsibility for different competencies will be needed.

Global competitiveness is vital for the future prosperity of Europe. An important way to encourage this is to benchmark the EU and Member States against the best of what is happening in North America, South America and the Asia/Pacific region. Although we have a strong scientific base, innovation knows no boundaries and we must always be prepared to learn from the success of others.

Innovation must also be fostered within the different member states if the EU is to be truly competitive. One facet of this is an openness towards new technologies but unfortunately the European agriculture and plant science sectors currently suffer from problems caused by the ongoing GM crop acceptance issue. A negative impression is given to competitors and the rest of the world because decision-making in this area has been allowed to become politicised rather than be based purely on the best scientific advice. In the meantime, European livestock farmers are dependent on imports of GM feed to provide affordable animal products for consumers, while arable farmers are denied the choice of using the same technology which might allow them to compete for export business and therefore have a disadvantaged competitiveness position.

A final point, which is related to this, is the need to harness all available technologies to achieve ambitious targets. The best solutions will often come from synergies between technologies which some people might see as competitive or incompatible. There is no reason why, for example, GM seeds should not be used alongside biological pest control while field margins are managed as wildlife habitats. Crop biotechnology could even help organic farmers to better achieve their goals of soil health and reduced environmental impact.



Water availability is potentially a big problem, and farming is a major user of water around the world. However, if we manage this vital resource efficiently there should be no problem in achieving sustainable use. Doing so is vital if the bio-economy is to become a viable reality.

A sustainable raw material supply underpins the entire KBBE, and it is clear that real effort must be put in to ensure that sufficient biomass of the right quality is available without compromising either food security or ecosystem integrity. Close collaboration has already been established between the nine European Technology Platforms relevant to the KBBE area. Biomass yields are continuing to increase, crop biotechnology R&D continues to provide new opportunities for crops tailored for particular end uses and growth of the bio-energy sector is supported by a strong policy framework.

PRODUCTS OF THE BIO-ECONOMY: INDUSTRIAL MATERIALS AND FOOD

1. Innovative bio-based products

The first point for discussion was financial support for the bio-economy, and general agreement was reached that there was insufficient funding at the crucial early stage of scale up from pilot- to demonstration- to commercial-scale. There is also no dedicated policy to stimulate such investments. Many companies appear to be risk-averse or to favour investment outside the EU given more encouraging policies elsewhere.

Moving on to the position of the European chemical industry, which still plays a leading role in the global market, it was agreed that the first priority for companies at present was to maintain their overall market position. The prospect of cost reductions and increased sustainability in the long run creates incentives for large companies to move towards bio-processing and away from established, traditional chemical processes. On the other hand, newer companies focussing only on enzymes or other bio-based products have already established a strong position, with EU-based companies at the forefront.

Setting targets and incentives for bio-based products (as is already the case for biofuels) was considered as a way to encourage growth. Overall, the panel felt that it was better to direct efforts towards developing better products and properly communicating their benefits to customers. Demonstration plants can show how bio-based products are manufactured and recycled. While there is a role for incentives for innovation in bio-based production, particularly at an early stage of development, these should be simple and reassure investors. In the long run, the bio-economy must be sustainable without any subsidy.

Another key factor in successful innovation is the proper management and exploitation of intellectual property, particularly patents, given Europe's strong scientific base. The problem with translating strong science into economic growth seems to lie in the lack of an innovation culture and risk aversion for investments, both of which are more the norm in the USA.

Patenting in Europe costs about 5 - 10 times more than in the US or Japan, seriously hampering innovation in Europe, particularly from SME's. The lack of a European 'low cost' community patent creates further disadvantages through more bureaucracy and time requirements for patenting, thereby reducing the willingness of companies to explore the synergies which might come from sharing emerging technologies. This also compounds the already long time to market for bio-based products and makes them less attractive to investors.

There are two further controversies which hamper the development of more bio-based products. The first of these is the debate about the conflict between food and industrial feedstock in the case of first generation biofuels. This problem has been recognised and will become much less of an issue as technologies to convert straw and other biomass to fermentable feedstock come to commercial fruition.



The second controversy – relating to GMOs – could still cause problems. The problem to date has been the vocal opposition from some quarters which has led to a politicised decision-making process for new dossiers. Nevertheless, the expectation is that as genetic modification begins to make a positive impact on the development of the bio-economy, the evident benefits will greatly reduce concerns. The cornerstone of the bio-economy is in any case contained use of GMOs for fermentation and bio-conversion, but a failure to capitalise on the potential of agricultural biotechnology could still hamper the development of the sector in Europe by restricting development of tailored feedstocks, while in the rest of the world the full capacity of modern biotechnologies is exploited.

There was some discussion of the issue of sustainability. This is a prerequisite for the future success of the bio-economy, but not all bio-products do necessarily meet all sustainability criteria. However, a 'tick the box' approach to strict specific requirements which may need to be fulfilled would itself be a barrier to innovation. What is more important is the sustainability of the entire cycle of production of bio-products. It is the bio-economy as a whole which must be sustainable, rather than individual products, which means an appropriately holistic view is needed.

On the question of incentives for innovation, there was a consensus that these should be uniform and simple. Carbon taxes, as part of the mix, should be levied at a flat rate on all products and no distinction should be made between different types of bio-product. Equally, the use of different policies for different categories of product, which is currently the norm, would be counter-productive in the context of a holistic treatment of the entire bio-economy. Overall, the recommendations already made under the Lead Market Initiative on bio-based products should be implemented by national and regional governments to drive progress.

2. Innovative food production

Collaborative research efforts have already been productive in the food area. The 'Food for Life' Technology Platform and a wide range of national platforms have been set up and the sharing of a growing knowledge base has improved. In the bio-based products sector, the EU has become the leading region for enzyme development and production. There are now more than 300 European research projects dealing with bio-refineries and industrial biotechnology is included in the action plan on Key Enabling Technologies.

The global population is rising, with latest estimates suggesting it will plateau at around 9 billion by 2050. As well as the extra food needed for direct consumption, the trend towards higher consumption of animal products means that even more grain must be grown to feed livestock. In total, harvests will need to increase by about 70% over the next four decades. As plant material is also increasingly becoming used as a source of bio-fuel, agricultural productivity and food security is now one of the key challenges of our time.

As far as possible, the large increase in food production which is needed must come from essentially the same land area as is used for farming today. There is little additional good quality potential farmland available and water shortages, soil erosion and other problems have led to declining areas of arable land in many countries. Climate change is expected to cause further problems and disruption; any gains to be made in higher latitudes will be offset by losses in the tropics, sub-tropics and even the Mediterranean region. More drought- and stress-tolerant crop varieties will be called for if agricultural productivity is to be maintained and improved.

To meet this challenge, we need to take an integrated view of sustainable food production throughout the food chain. Sufficient safe, affordable and nutritious food must be produced while also avoiding environmental damage. Innovation is key, but must be done with the consent of consumers and stakeholders through the food chain while addressing a range of economic, societal and demographic issues. In this sector as in others, the many European SMEs which are sources of innovative technology must be helped to stay competitive.

To achieve this, the panel agreed that a holistic and integrated view of policy must be taken. In particular:

1. A clear enabling R&D strategy must be set and funding increased.
2. Research in Europe must be better coordinated to avoid duplication.
3. Specific programmes and networks are needed to promote participation of SMEs in the effort.
4. Acquisition, sharing and dissemination of knowledge between Member States and particularly with SMEs must be optimised as far as possible.
6. Focus, alignment and collaboration both within the EU and internationally need to be improved.
7. Multidisciplinary approaches, which are often very productive, need to be encouraged.
8. An enabling regulatory framework which encourages innovation is vital.

During the session, a number of specific points came up for discussion, firstly health and nutrition. The major health burden in Western societies is increasingly in the form of major chronic diseases such as cardiovascular disease, cancer and various forms of degeneration associated with ageing. Over the coming decades, the key challenge is to reduce the incidence of these diseases in a similar fashion to the way infectious diseases were tackled in the 20th Century.

A general increase in obesity, largely due to too little exercise in combination with poor diets, is leading to further increases in these chronic diseases: the WHO predicts that 2.3 billion adults will be overweight and 700 million obese by 2015. Already, half the global population have elevated blood cholesterol levels and 30% suffer from hypertension. Much of this disease burden could be prevented if healthy, nutritious diets were consumed as part of an overall healthy lifestyle.

There is a great need for more R&D on diet and health via a multi-disciplinary Collaborative Action. In particular, we need to understand the role of specific food components and how they can influence gene expression (nutrigenomics) and to identify useful bio-markers which are correlated with good health. All this will in turn allow the development of foods adapted to individual needs (nutrigenetics).

The other major factors important for good health are the development of new production systems to avoid the transfer of diseases from livestock production and an awareness of the human health implications of the use of antibiotics in livestock farming. None of this is meant to suggest that good health is simply a matter of eating the right food, but the clear link between diet and health nevertheless highlights the need to continue providing safe, affordable, nutritious food at a time when the demand for biomass for industrial processing is increasing.

Such R&D, which will have important human health benefits and also ease the pressure on public healthcare systems, will need to be funded primarily by the public sector. Most companies operating



in the food chain are SMEs and will only be able to benefit from such innovation if funding is also available for technology transfer.

As well as guaranteeing that people are able to afford healthy diets, sustainability has to be assured throughout product life cycles. Waste is a particular problem. It occurs along the whole food chain from the farm to the consumer's kitchen and can reach 30% or more in total. Storage life can be extended and optimised packaging can make further improvements, but there is also a need to deal with the waste which still inevitably occurs and to use this as a valuable resource. Appropriate regulation is also needed to help deal with the issue.

Another contentious aspect of sustainability is the consumption of animal protein. Meat production is regarded as having a large environmental footprint because of factors such as the relative inefficiency of animal protein production, high water use and methane production. Meat consumption increases in most societies as they become more prosperous and there is no easy answer to the sustainability issue. However, greater use of plant or aquatic protein is one obvious way forward and possibly in the longer term even insects could be seen as a significant source of protein.

Finally, there must be good communication programmes throughout society reaching everyone from schoolchildren to the elderly so that each person is able to understand the importance of a healthy diet and how they can optimise their own nutrition. Clear, consistent and effective labelling is obviously an important part of the overall picture.

SEIZING THE OPPORTUNITY: DEVELOPING THE MARKET

The final plenary brought the various strands of the conference together to share views and draw conclusions about the way ahead.

Franz Fischler, former Commissioner for Agriculture, talked about the role of the reformed CAP in helping to shape and encourage the development of the bio-economy. The first draft of the reformed policy can help to bring about a successful transition to the KBBE by linking research, development and evaluation of technologies, processes and supply chains, with rural development programmes giving scope for proper assessment. But although the CAP sets the overall enabling framework, Member States run the programmes and are responsible for delivery. National and regional governments therefore have an essential role to play.

There also needs to be more attention paid to the consequences of poor nutrition, as highlighted in the third of the parallel sessions. Just as good diets promote good health, so do poor diets contribute to obesity and chronic disease and place large burdens on healthcare systems and the general economy. Improving this situation would make an invaluable contribution to both the health of European citizens and the health of the European economy.

As new enabling technologies for the KBBE become available, they need to be exploited by SMEs to make the bio-economy a reality. Clustering, which has already been successful in similar sectors, can build up a critical mass of biotechnology businesses and create the right conditions for successful innovation. Although the bio-economy is based on industrial processing – the so-called white biotechnology sector – agricultural or green biotechnology could also play an important role, be it that the aversion for new technologies is hindering for transition and innovation. The controversy on the introduction of GM crops into Europe has raised the barriers for the introduction of new applications of this technology, although the potential contribution cannot be ignored and it would be appropriate to readdress these issues.



Ian Hudson, President of DuPont EMEA region, spoke of how climate change is the ultimate driver to create the bio-based economy. The move to replace fossil fuels will happen over time in any case, for purely economic reasons, but the need to reduce greenhouse gas emissions creates extra urgency for this to occur. Nevertheless, despite this imperative, it is also clear that bio-based products must meet consumer expectations. Bio-based products with properties which are at least as good as their conventional equivalents and which the consumer regards as good value will be successful, but substandard products will fail.

“It is also clear that bio-based products must meet consumer expectations. Bio-based products with properties which are at least as good as their conventional equivalents and which the consumer regards as good value will be successful, but substandard products will fail.” Ian Hudson



According to **Roel Bol, Director of the Biobased Economy programme** in the Netherlands, innovation is the key to creating a successful KBBE. But this will only work if there is cooperation across different policy areas: in Member States between different ministries, in the Commission between different DGs. Indeed, cooperation must go further than this. Business, government and the science community have to work together constructively, but only with the explicit consent of civil society.

“ (...) rather than look only at end products and how to make them, we need to take a holistic view of available biomass together with the full range of desired or possible end products to deliver the best results.” Roel Bol

Currently, there is no clarity about whether a transition to the bio-based economy will be driven by policy or demand. In Mr Bol's view a demand-driven approach is the right one, which is the approach supported also by other speakers. His last point was about integration: rather than look only at end products and how to make them, we need to take a holistic view of available biomass together with the full range of desired or possible end products to deliver the best results.

Giulia Del Brenna, Head of Unit at DG Enterprise, who has been responsible for organising the Lead Market initiative, has arranged a meeting at the European Forum for Industrial Biotechnology, to be held in Edinburgh in October.

Overall, clear agreement emerged on some key policy issues which will be important for the successful evolution of the Knowledge Based Bio-Economy in Europe:

- There is a need for a coherent and integrated policy framework covering the entire value chain from basic R&D, through innovation, agriculture and the consumer economy. Education, the economy and the environment must also come within this framework.
- Appropriate incentives, particularly in the form of tax credits, are required to encourage take-up.
- To be successful, there must be a market pull for bio-products and the products themselves must be of high enough quality to take the place of existing ones.
- Generally, measures to help the KBBE grow should be as simple as possible. In most cases, innovative companies are SMEs which do not have large resources. It should be clear what requirements they need to fulfil and how they can access tax credits and other incentives. .

Two final sets of remarks drew the conference to a close. **Maria Angeles Benitez Salas of DG Agriculture** emphasised the key role of farming in the bio-economy. Although much of the current development is driven by the need to mitigate climate change, in the longer run fossil fuels will not be available at an economic price and biomass will be the primary source of carbon for the global economy. This will inevitably create a move from large, coastal refineries where bulk oil supplies are handled, to decentralised production based on locally-sourced biomass, and perhaps also to more localised consumption. She ended on a note of caution: phosphate supplies, on which agriculture relies for fertilisation, are limited, which creates yet another challenge for farming.





“(...) in the longer run (...) biomass will be the primary source of carbon for the global economy. This will inevitably create a move from large, coastal refineries where bulk oil supplies are handled, to decentralised production based on locally-sourced biomass, and perhaps also to more localised consumption.” Maria Angeles Benitez Salas

Rudolf Strohmeier, deputy Director General of DG Research, also highlighted the need for holistic thinking and an integrated approach, already evident in joint calls involving several research directorates. He explained that a public consultation and an impact assessment will both be started this year. Given this and other preparatory work, the Commission hopes to adopt the Communication on the 'European Strategy towards a sustainable bio-based economy in 2020' in the autumn of 2011. In addition, the eighth EU Framework Programme for Research and Development is currently being prepared, against a background of the 2020 objectives and the Innovation Union.



DRAWING IT ALL TOGETHER: OUTCOMES AND THE WAY FORWARD

- **The EU has a core strength in research in the biological sciences and it is important to maintain and build on this.** Too often a leading position in basic science has been lost to competitors. Science education must remain a priority and universities supported to ensure Europe continues to develop generations of high class researchers who can make the scientific breakthroughs of the future which will underpin the continued development of the bio-economy.
- **On the other hand, we are relatively poor at turning knowledge into commercial products, so the scientific strength does not yet fully translate into economic growth.** Fostering a stronger innovation culture will be essential to the success not just of the KBBE but also the entire 2020 strategy on which the future prosperity and sustainability of the EU economy is based.
- **There is a commitment from all EU institutions to build the KBBE, but the high level policy now needs to be carried through in terms of practical, grassroots actions which will make a difference to businesses and the way we lead our lives.** Good policymaking is necessary but not sufficient. A sensible enabling framework can permit innovative industries to thrive, whereas a restrictive policy stifles growth. However, this must be translated into practical local action if goals are to be achieved.
- **The positive involvement of national and regional governments is also instrumental to the success of the future KBBE.** Ultimately the European institutions can only put these essential elements in place; national and regional governments must initiate the local programmes which make things happen.
- **Important new and emerging technologies, in particular biotechnology (including genetic modification) and nanotechnology, must be harnessed to help meet the challenges which remain, and a rational, science-based approach used to regulate them.** New technologies have much to offer in the nascent bio-economy. However, regulation needs to be not only stringent but applied rationally. Any politicisation of the regulatory process could be highly detrimental to innovation and economic competitiveness.
- **Communication has a role to play in ensuring that European citizens are properly aware of the importance of agriculture to the future KBBE and that romanticisation of farming is avoided.** Significant technological change can only be successfully introduced with the consent of civil society. It is essential to engage the public at an early stage and ensure that the realities of modern agriculture and the needs of the bio-economy are properly understood.
- **Development of the KBBE is vital to properly address the challenges we face, but products cannot be forced on an unwilling public. Messages must be clear, product quality good and prices affordable.** The technical arguments for the bio-economy are clear and convincing. However, the transition will not be successful if existing products are replaced by poor quality or expensive alternatives, whatever their environmental or economic benefits.
- **Europe has only 10% of the world's population, but represents 25% of global GDP. However, both figures will decline as China, India and other emerging economies grow rapidly. Our challenge is to develop economic sectors which produce sustainable employment in activities which cannot simply be exported.** In the face of rapid popu-

lation growth and economic development in emerging economies, some relative decline of the current dominant economic blocs – including the EU – is inevitable. However, the bio-economy is a vital new economic sector which can provide sustainable employment and keep the EU as a vibrant, prosperous and dynamic region.

These conclusions set some useful guidelines for future development of the KBBE. There are also a number of points which should form the basis of an enabling policy framework:

- **There is a need for a coherent and integrated policy framework covering the entire value chain from agriculture and basic R&D, through innovation and the consumer economy. Education, the economy and the environment must also come within this framework.**
- **Not only must the policy framework be integrated and enabling; it must also provide appropriate incentives, particularly in the form of tax credits, to encourage take-up.**
- **Good policy is necessary but not sufficient. To be successful, there must be a market pull for bio-products and the products themselves must be of high enough quality to take the place of existing ones.**
- **Overall, measures to help the KBBE grow should be as simple as possible. In most cases, innovative companies are SMEs which do not have large resources. It should be clear what requirements they need to fulfil and how they can access tax credits and other incentives.**



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PARALLEL SESSION PARTICIPANTS

1. Feedstocks for the KBBE

- Chairs: Wilhelm Gruissem (ETH Zurich)
- Members: Johan Cardoen (CropDesign BASF)
Timo Heikka (Stora Enso)
Michael Carus (nova Institut)
Ivan Ingelbrecht (UN Trustfund/IPBO)
Dianna Bowles (University of York)
- Rapporteur: Paul Temple (COPA-Cogeca)

2. Innovative bio-based products

- Chairs: Wim Soetaert (University of Gent)
Sirpa Pietikainen (EP, ENVI committee)
- Members: Gunter Festel (Festel Capital)
Iris Anderson (DECC, UK)
Luis Mora (PharmaMar)
Christophe Rupp-Dahlem (Roquette)
Steven Devlin (BioPreferred Program, USDA)
- Rapporteur: Christian Patermann (German BioEconomy Council)

3. Innovative food production

- Chairs: Diána Bánáti (Hungarian Food Research Institute)
Mairead McGuinness (EP, AGRI committee)
Judith Merkies (EP, AGRI committee)
- Members: Andrew Morgan (Danisco)
Daniele Rossi (CIAA)
Mella Frewen (CIAA)
Volker Heinz (DIL Germany)
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