SCIENCE|BUSINESS

The Energy Technology Roadmap

BIOFUELS: THE NEXT GENERATION

How innovation can brighten Europe's energy future

Report of a Science|Business symposium

Supported by

bp

At the second in a series of three high-level academic policy debates on the energy R&D challenge, The Energy Difference, key ideas and recommendations have emerged to better leverage Europe's opportunities and challenges for next-generation biofuels.

Words
David Pringle

Design
Peter Koekoek

Editorial production
Gail Edmondson

Photography
Bernard De Keyzer

www.sciencebusiness.net

Figure 1-4: **Technology Roadmap: Biofuels for Transport,** ***International Energy Agency, May 2011***

Supported by

bp

Hosted by

KWK Royal Flemish Academy of Belgium for Science and the Arts

BIOFUELS: THE NEXT GENERATION

Executive Summary

Solar panels, wind turbines and electric cars have become the most visible symbols of a global shift to renewable energies. But bioenergy holds significant potential to help speed the transition to a more sustainable and secure energy system. By 2050, a new generation of sustainable biofuels could provide over a quarter of the world's total transport fuel, according to a recent report by the International Energy Agency. And biomass-based fuels offer the only viable low-carbon alternative to high energy density liquid fuels, including diesel and jet fuel.

To achieve that scenario, researchers are developing fuels from wastes, residues and non-fuel crops that are environmentally and socially sustainable. But a number of scientific and policy hurdles remain. At a 28 June 2011 Science|Business symposium, researchers, industry experts and policymakers debated the challenges of bringing second-generation biofuels to market – a key requirement for meeting Europe's goals for cutting carbon emissions in transportation. The symposium was the second in a three-part series of high-level academic policy debates on energy R&D in Brussels, supported by BP.

The good news: new technologies and practices are leading to more-sustainable biofuels. Significant commercial rollout by 2020 is feasible, as long as public support to ensure their market deployment remains a priority. But these second-generation biofuels will require a complex systems-based approach to developing innovation policy. A biofuel that slashes carbon emissions, for example, is not sustainable if its production provokes regional water shortages or compromises biodiversity.

The criteria to measure the sustainability of any given biofuel must cover a wide range of environmental and social factors and include metrics on resource use efficiencies (such as total energy inputs versus outputs, crop yields versus inputs, etc) as well as direct and indirect environmental impacts. Researchers will have to tackle the development of sophisticated land and water management systems, plant productivity increases and land optimisation – challenges that extend far beyond the technology of engineering biofuels and encompass agricultural and forestry policy. At the same time, policymakers must ensure that the transport industry, energy suppliers and environmental groups contribute their expertise to the development of second-generation biofuels.

Certain types of second-generation biofuels are based on waste and residues that can be harvested without altering current agricultural land use patterns. Others will require the use of genetically modified organisms (GMOs). Policy makers may therefore need to launch an informed public debate on GMOs in specific relation to biofuels, including clarification of the different forms of genetically modified organisms, such as crops on open release, through to bacteria or fungi, which might only be used in contained systems, and the risks posed.

A new generation of biofuels "done well" can play an increasing role in sustainable mobility over the next decade, and reduce demand for oil – a strategic policy imperative. At the same time, innovations needed to produce sustainable biofuels could benefit the agricultural sector broadly, leading to more productive and environmentally sound land use.

But harmonised policies for biofuels deployment – including standards, regulation and sustainability criteria – will be vital to ensure their market success. Mandates must focus on truly sustainable biofuels, those with low carbon emissions and a low cost structure.

The timing for a renewed focus on bioenergy innovation and sustainable biofuels agenda is propitious. The European Commission's Strategic Energy Technology Plan has laid out an ambitious 10-year plan to invest in renewable energies, including a €9 billion in public-private partnerships for bioenergy technologies and demonstration plants. As the Commission and national governments decide in the coming years where to channel public funds, they have an important opportunity to speed progress towards Europe's renewable energy goals by encouraging biofuels done well, or those which are truly sustainable, based on a systems approach to energy innovation.

This report summarises the half-day of debate at the symposium and offers key ideas and recommendations to accelerate the deployment of sustainable biofuels. While we quote some of our 35 roundtable guests in this report, their opinions are personal and we do not wish to imply they endorse all or any of the individual suggestions for change presented here. Our list of recommendations emerged from the debate and the force of individual ideas. The symposium took place at the Royal Flemish Academy of Belgium for Science and the Arts.

RECOMMENDATIONS TO BREAK THE BIOFUELS LOGJAM

For policymakers

- Develop an integrated, long-term policy framework for biofuels that addresses health, energy, environment, agriculture and transport issues
- Set clear long-term targets for regulating CO2 emissions
- Harmonise biofuels standards, regulation and sustainability criteria across Europe to overcome fragmented markets
- Use the Common Agricultural Policy to incentivise farmers to collect their agricultural residues and to produce feedstocks for sustainable biofuels
- Integrate carbon offsets from biofuels into the Emissions Trading System
- Tap structural funds in key regions to support biofuel demonstration projects
- Commission independent research to establish the impact of biofuels on food prices
- Mandate the use of the most sustainable biofuels for transport. Fuels should be ranked on rigorous sustainability criteria which reflect total resource efficiency
- Target market incentives specifically at the import and production of sustainable biofuels with low carbon emissions and a low cost structure
- Educate the public on the use of GMOs

THE ENERGY TECHNOLOGY ROADMAP: HOW INNOV

For the private sector

- Forge a pro-biofuels alliance encompassing the energy sector, agriculture, the transport industry and the environmental movement
- Test biofuels made from genetically modified crops in regions where regulations and laws permit.
- Communicate the facts about second-generation biofuels to both consumers and policymakers
- Run trials specifically designed to address policymakers' concerns about the land-use implications of biofuels
- Develop new business models that reduce the financial risks for farmers venturing into growing crops for biofuels
- Create a greater diversity of sources of sustainable biofuel feedstock and a greater variety of uses for that feedstock.

VATION CAN BRIGHTEN EUROPE'S ENERGY FUTURE

SYMPOSIUM REPORT – THE PATH TO NEXT-GENERATION BIOFUELS

Here's a tough problem in innovation policy. You have an important alternative energy source in development and the technology is maturing. The challenge is getting it to market. Which production process should be used? How much will people pay for it? How should it be regulated? How should product standards be set? And who will fund demonstration? In short, how do you get this technology out of the lab and into the market?

That's the conundrum of second-generation biofuels today. Around the world, a first generation of biofuels derived from crops has been on the market for more than a decade, but a backlash against fuels that appear to compete with food or result in destruction of rainforests has weakened public support for biofuels in general and slowed investment. More sustainable solutions are in the offing, but everybody involved – regulators, industry, investors, researchers – is uncertain how to proceed. The result is a pressing need for an informed debate about second-generation fuels.

"The ethanol industry has effectively stalled around the world… there is very little new capacity being developed anywhere, be it from sugar cane in Brazil or grains in the US and Europe," said Oliver Mace, technology, strategy and regulatory affairs manager at BP Biofuels, speaking on 28 June 2011 at a Science|Business symposium, The Energy Technology Roadmap: The Case of Biofuels.

The challenge of bringing second-generation biofuels to market highlights the difficulties of developing new energy technologies, explored in a three-part series of symposia on energy R&D organised by Science|Business. The first symposium, The Energy Difference, took place in Brussels earlier in the year, on 11 March. At the second symposium in June, researchers, industry experts and policymakers debated how to best support innovation in second-generation biofuels – a key requirement for meeting Europe's goals for cutting carbon emissions from transport.

Top issues included the need for a clear, long-term policy framework and criteria for sustainable biofuels. Scientists have developed promising new biofuels in the lab, but an unclear policy outlook in the EU means industry is reluctant to take the expensive next step of funding capital-intensive demonstration plants. To break the deadlock, a consortium of energy suppliers, agriculture, vehicle manufacturers and environmental groups needs to address the cross-disciplinary issues raised by second-generation biofuels.

"The next 18 months is when the EU decides how to spend the money….I would urge industrial initiatives to become more outspoken, this is the moment."

- Rudolf Strohmeier, deputy director-general, DG Research and Innovation, the European Commission.

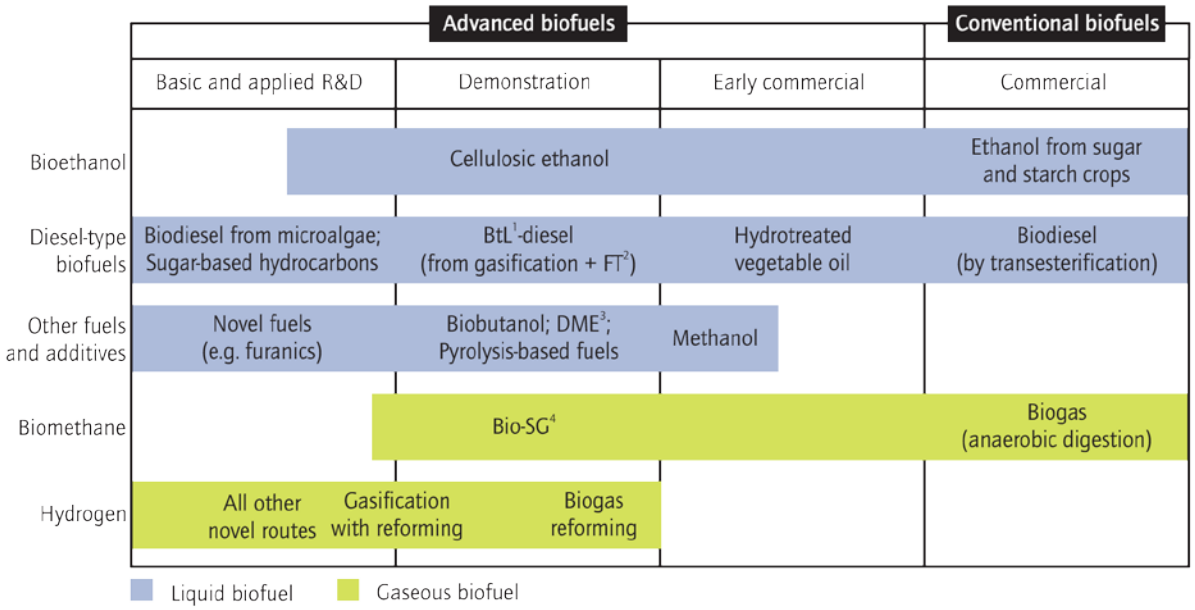
So-called first-generation biofuels are widely used in Brazil, the US and some other countries, but policymakers everywhere are concerned about their impact on food prices and biodiversity, and say they lack good information on second-generation fuels. Advanced biofuels based on lignocelluose address these concerns, but some solutions rely on genetically modified plants, generating further controversy.

The European Commission's Strategic Energy Technology (SET) Plan acknowledges the key role bioenergy will play in the transition to a more sustainable energy system. It envisions bioenergy will contribute 14 per cent of Europe's energy mix by 2020, including up to 10 per cent of transport energy, up from 4 per cent in 2009.

Biofuels are the main alternative for reducing carbon emissions from cars, trucks, tractors, planes and ships, which for now require liquid fuel. In May, the International Energy Agency published a roadmap projecting that biofuels can meet 27 per cent of global transport's fuel demands by 2050, up from 2 per cent today. The development of renewable energies has become even more urgent as support for nuclear power wanes following the recent crisis at the Fukushima Daiichi nuclear plant in Japan.

But to tap the potential of advanced biofuels, policymakers must tackle the ethical dilemma. "You are damned if you do and damned if you don't," said Jeremy Woods of Imperial College London, who is co-director of the interdisciplinary Porter Alliance and chair of the UK working group of the Scientific Committee on Problems of the Environment.

Figure 1: Commercialisation status of main biofuel technologies



1. Biomass-to-liquids; 2. Fischer-Tropsch; 3. Dimethylether; 4. Bio-synthetic gas.

Source: Modified from Bauen *et al.*, 2009.

Policy dilemma

Despite that conundrum, the US has moved more decisively to create incentives for advanced biofuels, including mandates for using lignocellulosic biofuels. To keep pace with next-generation biofuels research, Europe needs to bolster R&D efforts and channel support to demonstration plants. Above all, it needs a clearer policy framework and strong commitment to trigger investment by industry.

Citing the large capital costs, technology challenges and regulatory and market risks, experts at the symposium agreed the European Commission and Member States need to move quickly to set clear long-term guidelines, harmonise standards and regulations, and apply rules uniformly across all Member States to spur investment by industry.

"You will get much more investment if you have certain policy and uncertain technology. Right now, we have the opposite," said Jorgen Henningsen, senior energy and climate advisor at the European Policy Centre. "Unless the policy framework is improved, there won't be the research."

Specifically, European governments need to reward innovation that leads to carbon emission reductions through better-performing biofuels. Policies to bridge the last step to full commercialisation should be consistent across Europe. They could include higher premiums for second-generation biofuels with strong sustainability characteristics and the potential, when fully deployed, to be produced at lower costs. Sustainability criteria must also be sufficiently strict.

Lars Christian Hansen, regional president Europe of Novozymes and chair of the steering committee of the European Biofuels Technology Platform, agreed progress will depend on Europe's ability to develop a clear framework for investors to gauge risks and returns. "We need the long-term policy… then industry is going to figure it out."

Beyond food versus fuel

The conflict over using food crops for fuel, triggered by first-generation biofuels such as corn-based ethanol, has led scientists to search for "sustainable" second-generation biofuels based on grasses, plants, wood and residues that do not directly compete with food crops and can be grown on marginal lands.

Scientists working on second-generation biofuels are pioneering a whole-life-cycle approach to the research and development of new energy sources, analysing total energy inputs needed for their production and their direct and indirect impact on the environment. "We are starting to think much more holistically about land and the products of land," said Jeremy Woods. "We are embarking on a new transition in energy R&D. In that sense, energy R&D and biofuels link a whole set of issues that haven't been linked before."

One major problem is that while information about advances in second-generation biofuels is appearing in scientific journals, it is not feeding through into the public debate. The lack of clear public information exacerbates the policy impasse. "There is a scarcity of knowledge among the members of the European Parliament… The complexity of the renewable energies is a key issue," said Csaba Tabajdi, a member of the European Parliament's Committee on Agriculture and Rural Development.

"There is a scarcity of knowledge among the members of the European Parliament… The complexity of the renewable energies is a key issue"

- Csaba Tabajdi, a member of the European Parliament's Committee on Agriculture and Rural Development.

"Farmers just can't take the level of risk that may be required at that end of the value chain. The only way we have found to solve this so far is to participate in the whole value chain from the fields and the crops right through to the marketplace… We have actually done that in Brazil."

- David Eyton at BP.

Decision time for the EU

Energy-industry managers say the uncertain political climate – including fears over genetically modified crops for biofuels and the lack of criteria to define sustainable biofuels – creates a risky environment for investment. Policymakers meanwhile are waiting for industry to kick-start investments in demonstration plants and whole supply chains that show "biofuels can be done well", that is, can avoid the fuel-versus-food controversy.

Despite the impasse, the European Parliament and the Council of Ministers will decide between now and 2013 how much EU money will be allocated to the various elements of the European Commission's Strategic Energy Technology (SET) plan, which maps out a major policy shift to support innovation in renewable energies up to 2020.

"The next 18 months is when the EU decides how to spend the money," Rudolf Strohmeier, deputy director-general, DG Research and Innovation, the European Commission, told the symposium. "I would urge industrial initiatives to become more outspoken. This is the moment… Parliament will start to make up its mind… In the end, the money will be decided by Parliament and the Council. The Parliament has a significant say on spending."

The SET plan calls for €9 billion of public and private money to be invested in bioenergy R&D over the next 10 years, primarily to build up to 30 pilot and pre-commercial demonstration plants across Europe. But the majority of the funding must come from industry and Member States' R&D budgets.

Whether that €9 billion actually materialises may depend on the extent to which the Parliament and the Council of Ministers throw their weight behind biofuels. Experts say the biofuels sector needs clear and robust support from policymakers to give investors the confidence to stump up the large sums needed for demonstration plants and the commercialisation of second-generation biofuels which use the entire plant, can be grown on more marginal land and are cost-competitive with fossil fuels

But many policymakers are not yet up to speed on the different types of biofuels. Not all first-generation biofuels are unsustainable and not all next-generation biofuels will automatically be sustainable. Sustainability depends on the fulfilment of a series of criteria. "The European Union should clarify its new energy policy, its new energy vision and new energy concept… Predictability, long-term thinking, it is a really vital issue," said Tabajdi.

The facts on genetically modified organisms (GMOs)

Some of the most promising approaches to bringing the production cost down for advanced biofuels rely on genetic science which includes advanced breeding strategies and genetically engineered organisms.

Here are some facts:

- GMOs are plants, animal, bacteria or fungal species whose genetic structure (DNA) has been modified by scientists. Genetic modifications occur constantly in nature and drive evolution.
- A GMO is created by adding genes from another species to carry out a specific role or produce a chemical that is not produced by the organism. This modification may make plants more productive or more disease resistant.
- In the case of biofuels, researchers are working to modify some bacterial species to ferment five-carbon sugars as well as the six-carbon sugars they are able to ferment. The goal is to help bring costs down on sustainable biofuels.
- The release of GMOs into the environment remains highly controversial in Europe where concerns about the leakage of traits conferred by the genetic modification of one species into, for example, weeds, perhaps now outweighs the food safety concerns that originally dominated public debate.

What Are Second-Generation "Sustainable" Biofuels

There is no universal agreement on the definition of second-generation fuels, but the term generally encompasses fuels from wastes, residues and non-food crops (ie lignocellulose to fuel) that are environmentally and socially sustainable.

First-generation biofuels are those made from food crops. They are made from the fermentation of sugar cane, sugarbeet or cereals into ethanol and from the esterification of vegetable oils into biodiesel.

In the US, standards for "second-generation biofuels," are based on a minimum greenhouse gas savings threshold. Ethanol derived from Brazilian sugarcane qualifies under the US standard as an "advanced biofuel," but researchers tend to define advanced biofuels as liquid transport fuels derived from lignocellulosic biomass (which can include the residues).

The principles defining a sustainable biofuel should include the following metrics:

- Carbon conservation
- Preservation of biodiversity
- Soil conservation
- Sustainable water use
- Air quality
- Compliance with applicable laws
- Contracts and subcontractors
- Fair labour practices
- Social issues including health and safety
- Land rights

Criteria for each metric should be measured and verified against an agreed set of internationally accepted standards.

The technologies for second-generation biofuels are maturing but commercialisation will depend on the price of oil, the price of enzymes needed to convert feedstocks to fuel and financial incentives. If governments support these technologies and address economic and market issues, second-generation biofuels are likely to be commercially competitive without subsidies around 2020.

The global R&D challenge in second-generation biofuels

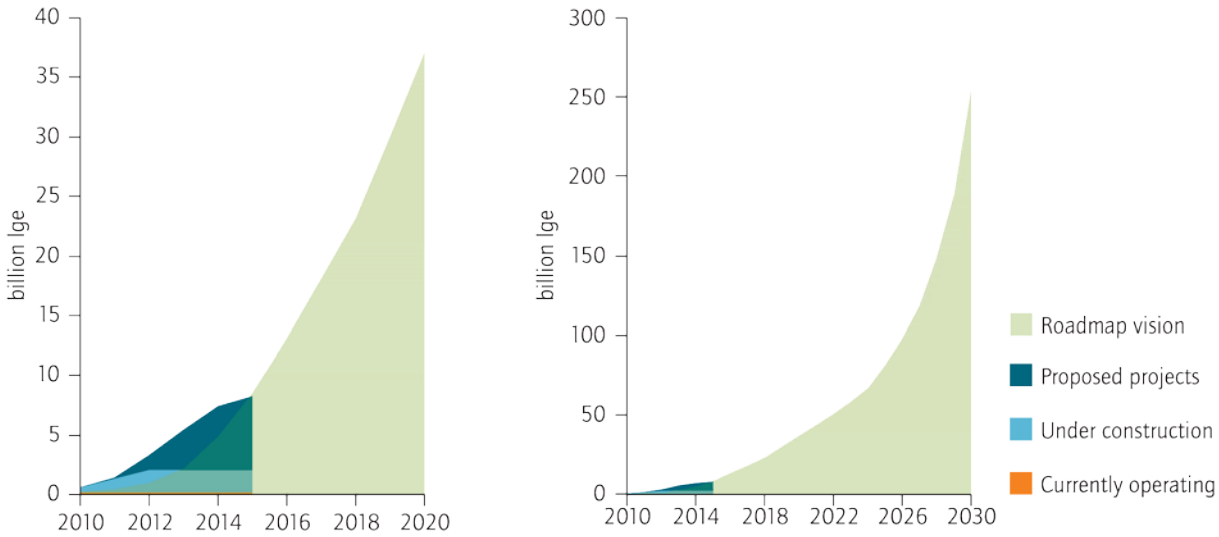
Europe is trailing the US in advanced biofuels research. Most of the $100 million to $150 million BP is investing in this field each year is spent in the US. Biofuels is BP's largest single research programme, signalling the company's belief that they will become a major source of energy for transportation. "We are reasonably confident biofuels can deliver on both costs and sustainability, although the latter is a very complex issue," said David Eyton, head of technology at BP. "The question is whether other issues around biofuels can be solved, such as the use of genetically modified organisms and the impact on land use."

That unanswered question means companies are reluctant to invest in developing and demonstrating second-generation biofuels. As a result, producers are stuck in limbo. To bring a new biofuels asset to production takes anything from three to five years, said BP Biofuels' Mace. "The earliest we will see an increase in supply again is 2013 or 2014."

Still, some governments are wielding incentives to encourage the private sector to invest in second-generation biofuels. The US mandate requiring the blending of cellulosic ethanol in transport fuels has prompted BP to invest in its development. "That gives a strong signal to investors and that is a price signal for cellulosic ethanol, which allows investors like us to start building a plant in 2012," Mace added.

Ausilio Bauen, senior research fellow and head of BioEnergy Group at the Centre for Energy Policy and Technology, Imperial College London

Figure 2: Advanced biofuel production capacity to 2015, 2020 and 2030



Note: A load factor of 70% is assumed for fully operational plants. Actual production volumes may be well below nameplate capacity within the first years of production.

Source: Based on IEA analysis in IEA, 2010a; IEA, 2010c; IEA 2010f.

Fixing the policy framework

Harmonised policies for biofuels deployment are vital to speeding new sustainable fuels to market. "Industry will never say 'no' to money, but really what is needed right now is the policy framework," said Novozyme's Hansen. Instead of providing huge subsidies to industry, he said the Commission should focus on creating a positive environment for investors, including guidelines for sustainability, harmonised standards and EU-wide regulations.

Hansen said EU policymakers should take two steps. First, they should ensure the necessary biomass is in place by using the Common Agricultural Policy to incentivise farmers to collect an appropriate share of their agricultural residues or produce crops for advanced biofuels. They should also introduce much more effective mechanisms to incentivise a shift towards the best-performing biofuels, including a specific mandate for advanced biofuels. If policymakers treat all biofuels equally, participants argued, the sector won't necessarily shoulder the risks involved in a continual evolution to more sustainable biofuels.

"There is insufficient discrimination in policy at the moment around the key attributes that we want biofuels to have," said Paul Jefferiss, head of policy, BP. "If we can identify what those attributes are and reward and incentivise those attributes, then we will see industry investing in that general direction." The attributes, he added, are the potential for significant carbon abatement, and the potential for cost reduction and then sustainability in various forms but with clear, quantifiable and verifiable metrics and indicators.

"There is great potential to improve plant science and cultivation practices…[But] we need to understand what we can grow and where. We need to demonstrate that we have a sustainable feedstock base."

- Ausilio Bauen, senior research fellow and head of BioEnergy Group at the Centre for Energy Policy and Technology, Imperial College London.

Creating sustainable fuels

Because most biofuels in use today are derived from crops that could also be used for food, they have triggered growing concerns over future food shortages and spiralling food prices.

"Is it ethical to produce biomass if there is a scarcity of food in a lot of countries in the world?" MEP Csaba Tabajdi asked the symposium. "In thirty years, there will be two more billion people in the world, but there will be a scarcity of food, a scarcity of fresh water. We should find a balance between these two elements."

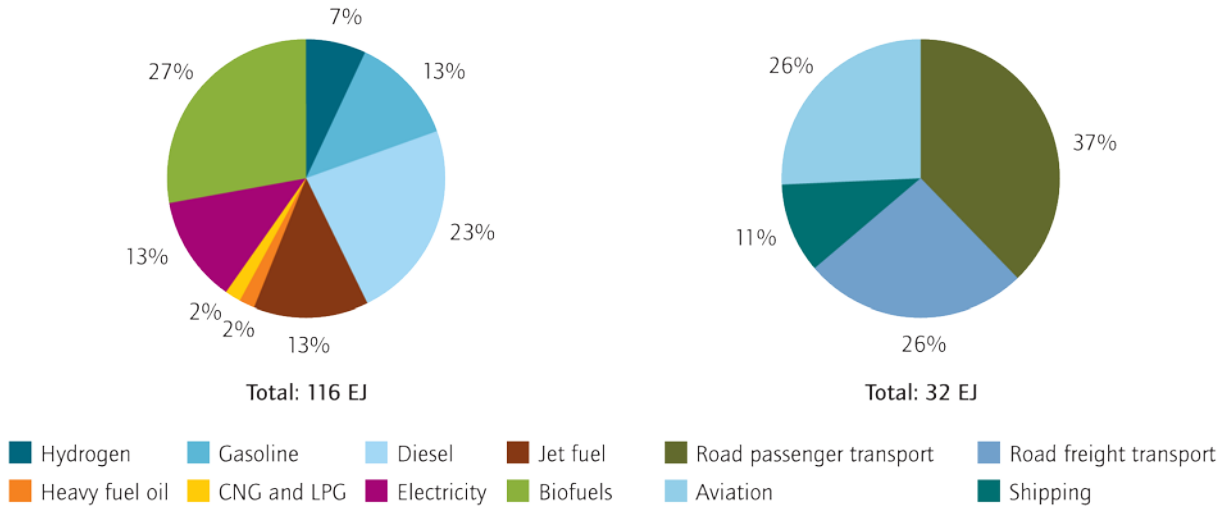
One way through the current impasse would be to run carefully targeted trials aimed at addressing policymakers' concerns about the land-use implications of second-generation biofuels. For example, so-called suitability studies could determine the extent to which dedicated fuel crops, such as willow, miscanthus, switchgrass and agave, can be grown on marginal or degraded land and how they can be integrated into the existing agricultural and ecological systems.

"There is great potential to improve plant science and cultivation practices," said Ausilio Bauen, senior research fellow and head of the BioEnergy Group at the Centre for Energy Policy and Technology, Imperial College London. "We need suitability research involving growing new crops in different areas. We need to understand what we can grow and where… We need to demonstrate that we have a sustainable feedstock base."

Some scientific studies that indicate concerns about a dramatic impact of biofuels on food prices are over-exaggerated. Jeremy Woods of Imperial College London believes the growing use of biofuels may have only contributed a few per cent to the increase in food prices in recent years, noting that the rising price of crude oil has had a much greater impact. "The future of agriculture is very sensitive to fuel prices," he said, pointing out that greater use of second-generation biofuels may actually keep a lid on food prices by lowering the use of fossil fuels in fertilisers, tillage, harvesting, transport, storage and cooking. "There is a huge global resource of biomass. Eighty per cent is in the form of lignocellulose material. [Converting a fraction that into energy] is a enormous prize if done well, if done in a sustainable way," Woods told the symposium.

Photo: Jeremy Woods, Co-Director, Porter Alliance, Lecturer and chair, UK working group of the Scientific Committee on Problems of the Environment (SCOPE), Imperial College London

Figure 3: Global energy use in the transport sector (left) and use of biofuels in different transport modes (right) in 2050 (BLUE Map Scenario)



Note: CNG= compressed natural gas; LPG= liquefied petroleum gas.
Source: IEA, 2010c.

Grasping the GMO nettle

Claiming that prize, however, may require the biofuels industry to make extensive use of genetic engineering, which some people fear could do irreparable harm to the environment and perhaps to human health.

Genetically modified organisms (GMOs) are needed to help break down lignocellulose, which is a highly complex biomolecule, into the sugar units needed for ethanol production. "To exploit the full potential of these feedstocks will require the more efficient degradation of lignocellulose," Christine Raines, professor of plant biology at the University of Essex, UK, told the symposium.

Raines said researchers have developed a genetically modified switchgrass with an altered lignocellulose structure. Its bioethanol yield is 30 per cent more than conventional switchgrass, and the amount of cellulases needed to break down the lignocellulose is only a quarter to a third that used for ordinary switchgrass, meaning the conversion process requires less energy.

Recent advances in genomics have made it possible to identify which genes produce which attributes and design new plants or organisms specifically for biofuels. "We could compare genomes of 500 different types of algae, for example," said Raines. "We could completely redesign a plant or an organism."

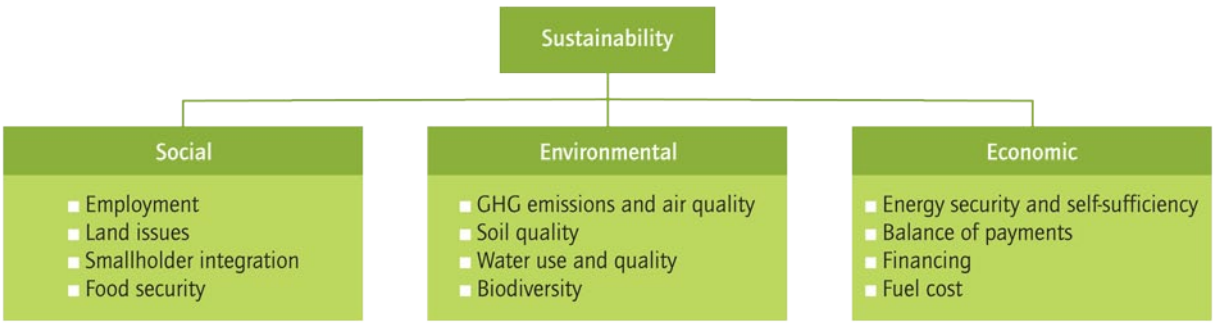
Some policymakers believe Eastern Europe could be a willing testbed for biofuels from genetically modified crops. "There is a lot of possible supply in Eastern Europe," Rudolf Strohmeier told the symposium. "In these countries, the GMO debate is not as strong as elsewhere and they need investment… But we need to make it clear that GMOs cannot enter the food chain – people are concerned about what they eat."

Seeking standardisation

Another key challenge for European policymakers is to harmonise biofuels standards across the continent – including standards for fuels and engines – to help both biofuel producers and users access economies of scale and lower costs. "We need the common introduction of biofuels in all Member States – that's a key point," said Muriel Desaeger, senior principal technologist, Energy Research Group, Toyota Motor Europe. "The Member States have plans to move to 10 per cent of transport fuels from renewables. We have analysed them all in detail and there are clearly not aligned. That will provide major confusion for the consumers and for harmonisation of technical developments."

Another related concern is whether drivers will buy biofuels at the pump if they don't understand what they are buying or are faced with a confusing array of options. "We need to consider the demand side of the equation – somebody has to buy these products and services," noted Kyriakos Gialoglou, policy officer, consumer policy, DG Health and Consumer Policy, European Commission. "We need to ensure people are not confused when they are buying. We need to think about how to communicate clearly what the sources are and we need to clarify the impact of fuel on food."

Figure 4: Environmental, social and economic aspects of bioffuel and bioenergy production



Backing new business models

Building up the feedstock necessary to underpin a larger biofuel sector is also going to need new thinking in the agricultural sector. That's because most of the second-generation of biofuels are derived from perennial plants rather than the annual plants that are the mainstay of arable farming. As a result, farmers may have to dedicate fields to specific crops for longer periods of time, incurring greater risk.

"Farmers make the decision," Angela Karp, director, Centre for Bioenergy and Climate Change, Rothamsted Research, UK, told the symposium. "They must be confident that when they plant the crop, there will be a market for it. If you commit to a perennial crop, you are talking about 20 years minimum. If you change your policy two or three years after a farmer planted, it leaves them completely stranded."

Most farmers are not prepared to take that kind of risk. That has led to some energy companies, which are experienced in high-risk capital projects, diversifying into farming. "Different players in the value chain have hugely different risk appetites," said BP's Eyton. "Farmers just can't take the level of risk that may be required at that end of the value chain. The only way we have found to solve this so far is to participate in the whole value chain from the fields and the crops right through to the marketplace… We have actually done that in Brazil."

One way to reduce the level of risk across the biofuels supply chain would be to create a greater diversity of sources of feedstock and to develop a greater range of usage for each feedstock. But achieving that diversity is likely to depend on greater investment in biofuels R&D and demonstration plants.

A systems approach to innovating in biofuels

Many of the problems of bringing second-generation biofuels to market lie outside the lab. Ultimately, the emergence of biofuels as a significant source of energy for Europe may depend on an unprecedented alliance between the energy sector, the environmental movement, agriculture and the transport industry. But this kind of cross-disciplinary collaboration is unlikely to happen without a clear vote of confidence in a new generation of sustainable biofuels from European governments – and a game plan for creating a harmonised European market.

To create momentum for "biofuels done well", policymakers need to set up the missing regulatory framework, taking a flexible approach that manages risk at both ends of the value chain, from farm to pump. Policies must also be better integrated with the Common Agricultural Policy, and with the Emissions Trading Scheme (by integrating carbon offsets from biofuels into the ETS). Governments should consider the potential role of biofuels in reducing oil demand and damping down oil price volatility. Finally, regulators need to set clear objectives on carbon emissions goals and harmonised rules across Europe. Clear rules are key to driving the innovation system for biofuels. R&D programmes and incentives alone will not suffice.

The first technologies for creating second-generation biofuels are at hand – and more are in the pipeline. Researchers working in this field are pioneering a whole-life-cycle approach to energy R&D. But getting these sustainable biofuels to market will require a determined policy approach that bridges all the interests touched by this promising technology.

Photo: Csaba Tabajdi, Member, European Parliament (S&D, Hungary)
and Rudolf W. Strohmeier, Deputy Director-General, DG Research and Innovation, European Commission

The energy technology roadmap - The case of biofuels

Participants of the Science|Business symposium

Royal Flemish Academy of Belgium for Science and the Arts - Brussels, 28 June 2011

Niall Ainscough, Director, Technology, Strategic Cooperations, BP

Ulrich Balfanz, Advisor, Global Fuels Technology, BP

Guy Barker, Director, Genomics Resource Centre, Life Sciences, University of Warwick

Ausilio Bauen, Senior Research Fellow and Head of BioEnergy Group, Centre for Energy Policy and Technology, Imperial College London

Adam Brown, Senior Energy Analyst, International Energy Agency; co-author, "Technology Roadmap, Biofuels for Transport"

Laure Chapuis, Member of Cabinet, Vice-President Siim Kallas, DG Transport, European Commission

Howard Chase, Director, European Government Affairs, BP

Marc de Wit, Researcher, Bioenergy, Utrecht University

Muriel Desaeger, Senior Principal Technologist, Energy Research Group, Toyota Motor Europe

Willem Dhooge, Project Manager, Industrial Biotechnology, FlandersBio, Belgium

Gail Edmondson, Editorial Director, Science|Business

José Ruiz Espi, Project Officer, New and renewable energy sources, Unit K3, DG Research and Innovation, European Commission

David Eyton, Head of Technology, BP

Yann Germaine, State Aid Rapporteur, Unit B2, DG Competition, European Commission

Kyriakos Gialoglou, Policy Officer-Consumer Policy, Unit B6, DG Health and Consumer Policy, European commission

Lars Christian Hansen, Regional President Europe, Novozymes; Chair, Steering Committee, European Biofuels Technology Platform

Conny Haraldsson, Head of Research, Chemistry and Material Technology, SP Technical Research Institute of Sweden

Jørgen Henningsen, Senior Energy and Climate Advisor, European Policy Centre

Richard L. Hudson, CEO & Editor, Science|Business

Paul Jefferiss, Head of Policy, BP Group Strategy and Policy Team, BP

Angela Karp, Director, Centre for Bioenergy and Climate Change, Rothamsted Research

Oliver Mace, Head of Technology, Strategy and Regulatory Affairs, BP

Heidi Moens, Policy Officer, Energy and Environment, Unit B1, DG Enterprise and Industry, European Commission

John Pierce, Chief Bioscientist, BP

Andreas Pilzecker, Policy Officer, Bioenergy and Biofuels, Unit H4, DG Agriculture and Rural Development, European Commission

Milan Pospíšil, Vice-Rector for Research and Development, Institute of Chemical Technology in Prague

David Pringle, Correspondent (and Rapporteur), Science|Business

Christine A. Raines, Professor in Plant Biology, Head of Department of Biological Sciences, University of Essex; Chair of the Plant Section, Society of Experimental Biology, UK

Guido Reinhardt, Scientific Director, Institute for Energy and Environmental Research Heidelberg GmbH (IFEU), Germany

Frank Seyfried, Head of Research, Fuel Cells and Fuels, Volkswagen

Robert Sorrell, Vice President for Public Partnerships, BP

Rudolf W. Strohmeier, Deputy Director-General, DG Research and Innovation, European Commission

Piotr Świątek, FP7 National Contact Point, Research Centre Juelich, Germany

Csaba Tabajdi, Member, European Parliament

Maria Angeles Tuohy, Lecturer & Head, Molecular Glycobiotechnology Group, Biochemistry, School of Natural Sciences NUI, Galway City, Ireland

Maria Velkova, Policy Officer, New and renewable energy sources, Unit K3, DG Research and Innovation, European Commission

Oyvind Vessia, Seconded National Expert in Energy, DG Energy, European Commission

Jeremy Woods, Co-Director, Porter Alliance, Lecturer and chair, UK working group of the Scientific Committee on Problems of the Environment (SCOPE), Imperial College London

SCIENCE|BUSINESS POLICY BRIDGE

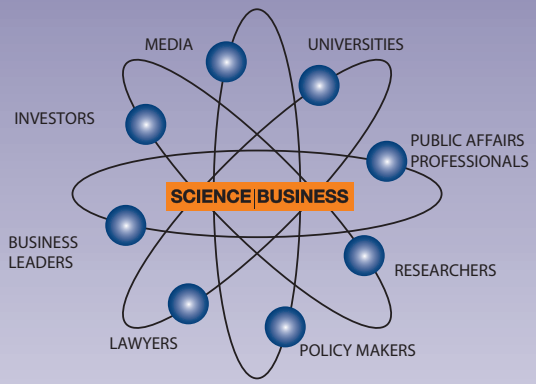
The media network to bring fresh ideas into the European policy debate

An independent network for R&D investment

Science|Business is the fastest-growing pan-European news and events network targeted at university, corporate and policy professionals seeking business opportunities in the scientific marketplace.

With its unique expertise, Science|Business is:

- Focused on science, well-connected with academia and business R&D leaders
- A European network with continuous input of fresh perspectives
- A group of top communicators with unique insight into R&D and the EU
- Innovative communications and events

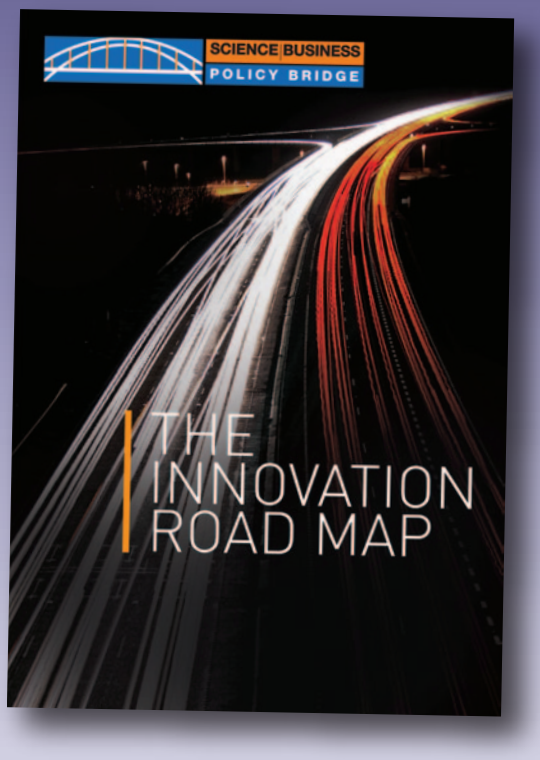


Our partner network

Aristotle University of Thessaloniki
Chalmers University of Technology
Delft University of Technology
ESADE
ETH Zurich
Imperial College London
INSEAD
K.U.Leuven
Karolinska Institutet
Medical University of Warsaw
Nencki Institute of Experimental Biology
Norwegian University of Science and Technology (NTNU)
ParisTech
Politecnico di Milano
SETsquared
Université de Versailles Saint-Quentin-en-Yvelines
University College London
University of Cambridge
University of Warwick
Warsaw University of Technology

Innovative format

- A mix of online and offline
- Not just one-off events
- We create a community around each topic



Why you should get involved

Keep tech and innovation policy high on the political agenda

- Help build a "Speakers' Corner" here in Brussels
- Place your ideas and proposals in front of key policy makers

Act now: the plans of the new European Commission are in the works today

Join today:

- Get a 30% discount on founders' fees
- Secure a seat on the steering committee
- Guaranteed access to all members-only events
- Guaranteed access to all subscribers-only content
- Brand your organisation as an innovation leader
- Current founding members

For more information, please e-mail us at info@sciencebusiness.net, or call our Brussels office +32 2304 7577

A BRIDGE ACROSS THE GAP DIVIDING INDUSTRY, UNIVERSITY AND POLICY

SCIENCE|BUSINESS

Science|Business is the first independent media company that brings together researchers, investors and policy makers in the European innovation community. It publishes news, organises networking events, conducts innovation-policy research, and provides communications consulting tailored to the specialized world of research and innovation. It also manages a non-profit policy think tank, the Science|Business Innovation Board AISBL.

The company works with a membership network of leading research universities, multinational technology companies and government agencies across Europe, from Norway to Greece. It was founded by some of Europe's top science and technology journalists, applying their contacts and communications skills to catalyzing change and progress in the climate for innovation in Europe.

General Correspondence
Rue Belliard 197 Box 12
1040 Brussels, Belgium
info@sciencebusiness.net
Tel: + 32 2 304 7577
Fax: +32 2 304 7572

Press releases and articles
news@sciencebusiness.net

Science Business Publishing Ltd. is a company registered in England, No. 5100435, at 166 Northwood Way, Northwood, Middlesex, HA6 1RB

WWW.SCIENCEBUSINESS.NET