

# The challenge of sustainable biofuels

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**B**iofuels have a long history that tracks back to the late 19th century, but it was not until the 1970s that the sector witnessed some growth in Brazil and the US which both put support policies in place. In most other regions, a significant growth in biofuel production took place only in the last 10 years. Global biofuel production grew around five-fold during this period reaching 1.8 million barrel/day (mb/d), driven by concerns over energy security and climate change, as well as governments' will to create new sources of income in rural areas.

## Medium-term outlook

Dramatically rising oil prices in the first half of 2011 would appear to be a boon to biofuels production going forward. Indeed, from 2010-2016, the IEA's Medium Term Oil & Gas Markets 2011 forecasts that biofuels output will rise by 0.5 mb/d, a near 30 per cent increase. Yet, market conditions and production economics have also become more challenging, even with high oil prices, undermining production in Brazil and Europe in particular. Difficult weather conditions, strong emerging market demand, increased energy costs, and to some extent usage from the biofuels industry itself have all tightened balances in many agricultural commodities. As such, biofuels production growth is expected to slow in 2011 after a strong 2010.

Over the medium term, biofuels will still help satisfy a significant part of oil demand growth, though less than before. From 2004-2010, biofuels supply growth, on an energy-adjusted basis, met 23 per cent of global incremental gasoline and gasoil demand, with ethanol at 48 per cent of gasoline and biodiesel at 10 per cent of gasoil growth. From 2010-2016, with combined gasoline and gasoil demand growing by 4.3 mb/d, biofuels supply growth should meet only 9 per cent, with ethanol constituting 24 per cent of gasoline and biodiesel accounting for 4 per cent of gasoil growth. By 2016, ethanol and biodiesel should displace 5.3 per cent and 1.5 per cent of total global gasoline and gasoil demand, respectively, on an energy content basis.

Feedstock prices and production economics for conventional biofuels will likely remain volatile in the medium term. Conventional biofuels, often referred to as first generation, are produced from starch, sugar or oil-burning crops. As such, government policies – blending mandates, production subsidies and blenders' credits – will continue to serve as key production supports. In an environment of fiscal austerity, financial incentives

are increasingly at risk, particularly in the US. However, mandated quotas and targets continue to rise, with EU Member States, Argentina, Canada, Thailand, Peru, and Malaysia all increasing required blending volumes. Notably, the fulfilment of government usage targets as they currently stand suggests production upside. Our 2010-2016 growth forecast of 520,000 b/d undershoots by 670,000 b/d the potential supply increases, were national level policy targets in major biofuels markets to be met.

Biofuels will face a number of challenges, including both economic as well as non-economic ones such as policy uncertainty, competitiveness of biofuels, sustainability requirements and consumer acceptance that might affect potential output. It is therefore important to identify these potential challenges and address them in the short term to achieve long-term targets. The IEA – in its recently launched technology roadmap *Biofuels for Transport* – assesses key actions and milestones that need to be taken to allow for a large-scale development of the biofuel sector to 2050 under an ambitious emission reduction scenario, cutting energy-related CO<sub>2</sub> emissions by 50 per cent in 2050 over 2005 levels. The roadmap analysis indicates that biofuels could provide up to 27 per cent of world transportation fuel by 2050 and thus avoid about 2.1 Gigatons (Gt) of CO<sub>2</sub> emissions in the transport sector when produced sustainably. Despite considerable potential for energy efficiency measures, and electrification of light duty vehicles, biofuels will play an important role to provide low-carbon fuel in particular for airplanes, marine vessels and other heavy transport modes.

The roadmap envisions an increase in global biofuel consumption from 55 million tonnes oil equivalent (Mtoe) today to 750 Mtoe in 2050 with demand for biofuels expected to pick up considerably in all world regions. Engaging developing and emerging economies in technology development and capacity building will therefore be crucial in meeting the roadmap targets.

## Efficient technologies needed

Conventional biofuels have been criticised in recent years regarding their limited potential to save greenhouse gases, their high production costs and potential competition for land and grain for food production. It is important to note, however, that some biofuels perform well in terms of land-use efficiency, life-cycle greenhouse gas savings and production costs. Nonetheless, deployment of more energy- and land-efficient conversion technologies, in →



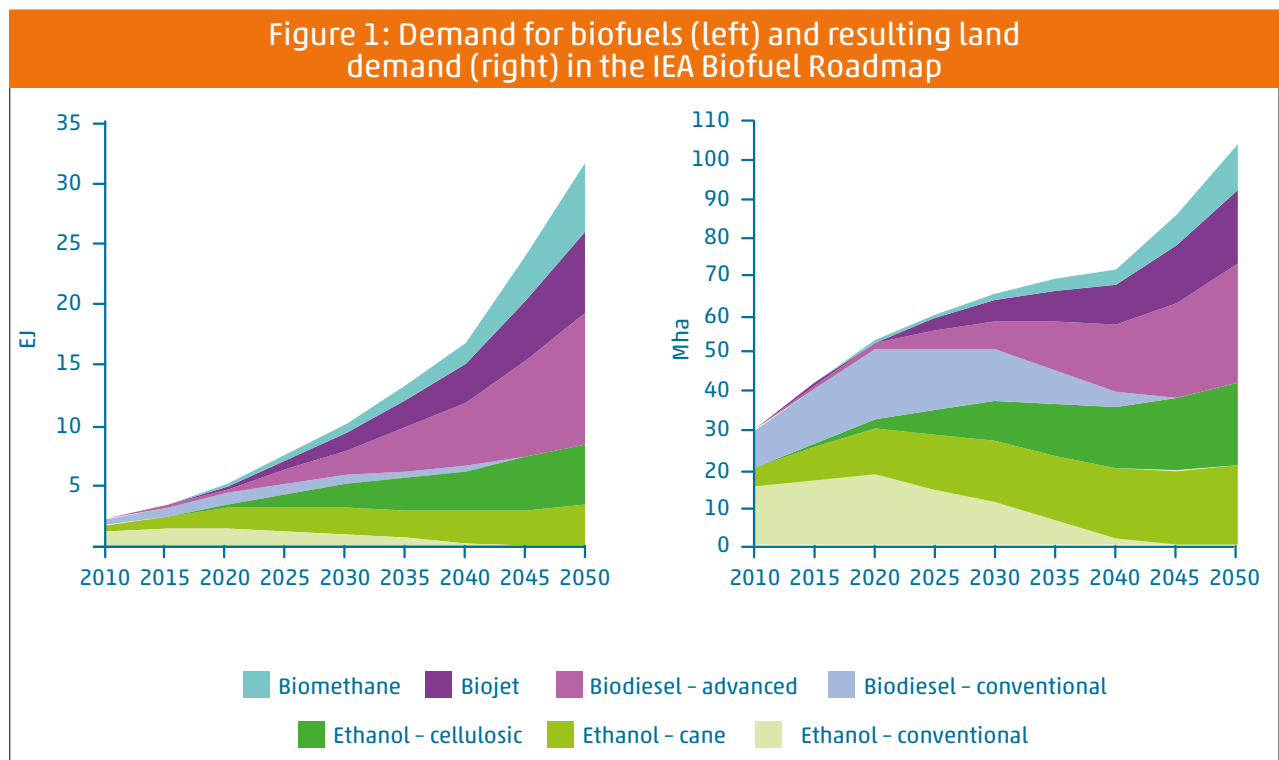
→ particular advanced biofuels produced from lignocellulosic energy crops and residues, is required to achieve a significant contribution of biofuels to future transport fuel demand. Support for advanced biofuel research, development and demonstration is still needed in the short term. Most crucial, however, are specific support measures that address the high investment risk associated with pre-commercial advanced biofuel technologies. Government action will be crucial to provide a stable, long-term policy framework for biofuels will be vital to trigger industry investments in first commercial plants and sustained investments in sustainable biofuel expansion.

### Sustainable biomass supply

To produce the amount of biofuel envisaged in the IEA Biofuel Roadmap will require biomass feedstocks of more than 3 billion tonnes of dry biomass, in 2050. This feedstock demand could well be met with low-risk biomass sources, such as residues and wastes as well as sustainably grown energy crops. The latter still have great potential for yield improvements, in particular in developing countries, as many potential feedstock varieties have not yet been

subject to commercial breeding efforts. This could limit the amount of land needed in 2050 to around 100 million hectares of land, a three-fold increase of the gross area under biofuels compared to the current level. In addition, better efficiency of biomass use, for instance through integrating biofuel and bio-material production in biorefineries, will also be vital to reduce land competition and associated negative land-use changes, and help improving the economics of biofuel production. Meeting the targets of the IEA biofuel roadmap will require substantial investments in crop breeding and large-scale field trials for promising biofuel feedstocks as well as the vigorous adoption of best agricultural practices to achieve sustainable yield improvements. Improved land-use mapping will also be vital to identify those areas with good potential for feedstock cultivation and little risk of food-competition and indirect land-use change.

Having a sound international policy framework in place is a prerequisite to ensure the required amounts of feedstock and land can be made available in a sustainable way, without compromising food security, threatening biodiversity or limiting smallholders' access to land. Sustainability





certification of biofuels, following internationally agreed sustainability criteria, and involvement of all stakeholders along the production chain will be vital elements to ensure sustainability of the biofuel sector. Since many sustainability issues related to biofuels are in fact concerning the whole agricultural sector, biofuel policies should be aligned with those in agriculture, forestry and rural development. In the longer term, an overall sustainable land-use management strategy for all agricultural and forestry would help to avoid land-use changes with negative impacts on the environment and CO<sub>2</sub> emissions, and to support the wide range of demands in different sectors.

### Economics of biofuel production and use

With substantial investments in place, most biofuel technologies could get close to cost-competitiveness with fossil fuels, or even be produced at lower costs in the longer term. Production costs for advanced biofuels could reach cost-competitiveness with gasoline or diesel around 2030 in optimal cases. However, future production costs will depend on the impact of oil price on feedstock and capital costs. Depending on the actual production

costs, total expenditure on biofuels required to meet the roadmap targets is estimated between US\$ 11-13 trillion over the next 40 years, representing a modest share of 11-12 per cent of total spending on transport fuels. Even with a strong correlation between rising oil prices and feedstock and capital costs, the additional costs of biofuel use compared to use of diesel/gasoline are in the order of 1 per cent of total costs of transport fuels over the next 40 years. With lower production costs, biofuels could even lead to actual fuel cost savings.

### International collaboration is vital

International collaboration, to ensure technology transfer, capacity building and involvement of all stakeholder, in particular in developing countries, will be critical to realising the vision of a sustainable, large-scale biofuel deployment laid out in the IEA Biofuel Roadmap. In order to stimulate financing on the scale required to realise the deployment of sustainable biofuels envisioned in this roadmap, governments must take the lead role in the coming years to create a favourable climate for industry investments. ■

*IEA Biofuel Roadmap is available at the IEA website: [www.iea.org/roadmaps](http://www.iea.org/roadmaps).*

*Brazil harvests sugarcane for biofuels*

