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Advanced Biofuels – Potential for Cost Reduction

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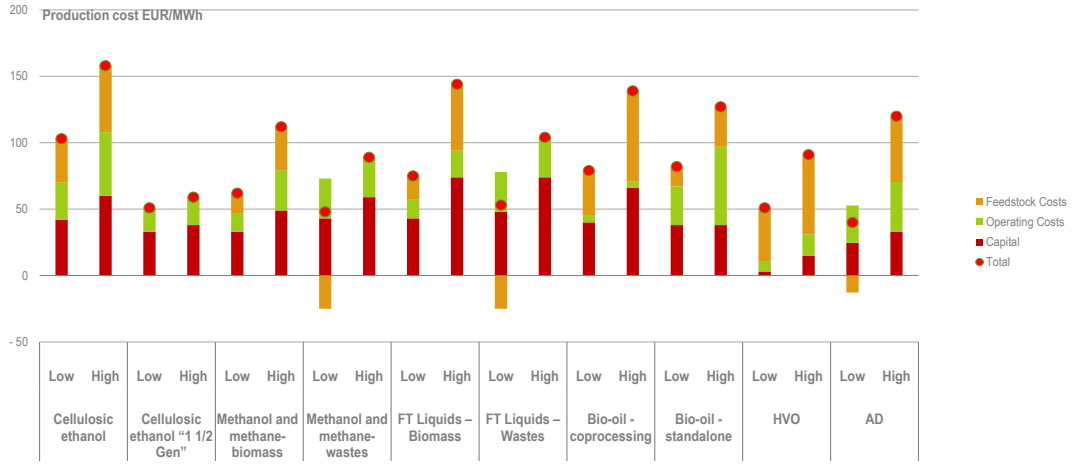
INTRODUCTION

Bioenergy already plays an important role in the global energy economy, and its expanded use is a critical element in future low carbon scenarios, where it can especially play an important role in reducing greenhouse gas (GHG) emissions from the transport sector. Decarbonising transport will require a range of bio-based transport fuels, and especially advanced low carbon fuels which are suitable for long-haul transport applications including aviation. A number of appropriate technologies to produce such fuels are being developed and commercialised. However so far, their production has only reached a limited scale. The costs of these advanced biofuels are currently higher than those of the fossil fuels which they can displace and of more conventional biofuels such as ethanol from sugar or corn, or biodiesel. It is therefore important to consider what **scope** there is **to reduce the production costs of a range of advanced biofuels, and to identify under what conditions they could become affordable**.

This project used as its starting point a study on the costs of advanced biofuels carried out within the programme of work of the Sub-Group on Advanced Biofuels (SGAB) (under the European Commission's Sustainable Transport Forum (STF)) and published in 2017. The report on this study reviewed data available on the current costs of producing a range of advanced biofuels, based on extensive contact with industry and other players active in the field. The aims of this project are to: (1) update and extend the SGAB study to provide estimates of the current costs of producing a selection of relevant advanced biofuels; (2) identify the scope for cost reduction for these advanced biofuels; (3) develop a model for likely cost reduction progress as deployment grows; (4) compare these costs and cost trajectories with likely trends in fossil fuel prices, and those of conventional biofuels; (5) examine the impact of policy measures, including carbon pricing, on the economic competitiveness of advanced biofuels.

CONCLUSIONS

Information gathered from industry and other sources for this study has largely confirmed the estimates of the current costs of producing advanced biofuels contained in the earlier SGAB cost analysis report. Costs lie in the range of 65 to 158 EUR/MWh (17-44 EUR/GJ) for production based on biomass feedstocks and 48 to 104 EUR/MWh (13-29 EUR/GJ) for waste-based production, illustrating the cost advantages of using waste feedstocks. This compares with a recent range of fossil fuel prices of 30-50 EUR/MWh (8–14 EUR/GJ).



Current cost ranges of advanced biofuels, including cost breakdown

Early market opportunities exist for producing lower cost advanced biofuels from wastes, and through integration of advanced biofuel production with existing biofuels processing plants. However, such opportunities are relatively limited and will not in themselves enable production at levels likely to be needed to meet low carbon scenario expectations.

There is significant potential for cost reduction through R&D and through experience being gained in the current generation of demonstration and early commercial plants. If a number of additional commercial plants are built, it is anticipated that capital and operating costs could be significantly reduced, while scope for feedstock cost reduction is judged to be more limited. Overall production costs could be reduced by between 5-27% compared to the current cost estimates. In addition, if increased experience makes it possible to finance plants on more favourable terms which would reduce costs further. For example, reducing the financing rate from 10% to 8% and extending the financing term from 15 to 20 years would further reduce costs by some 5-16%. Taken together these measures can reduce the production costs range for biofuels produced from biomass feedstocks to between 42 and 119 EUR/MWh (12-33 EUR/GJ) and 29-79 EUR/MWh (8-22 EUR/GJ) for waste-based fuels.

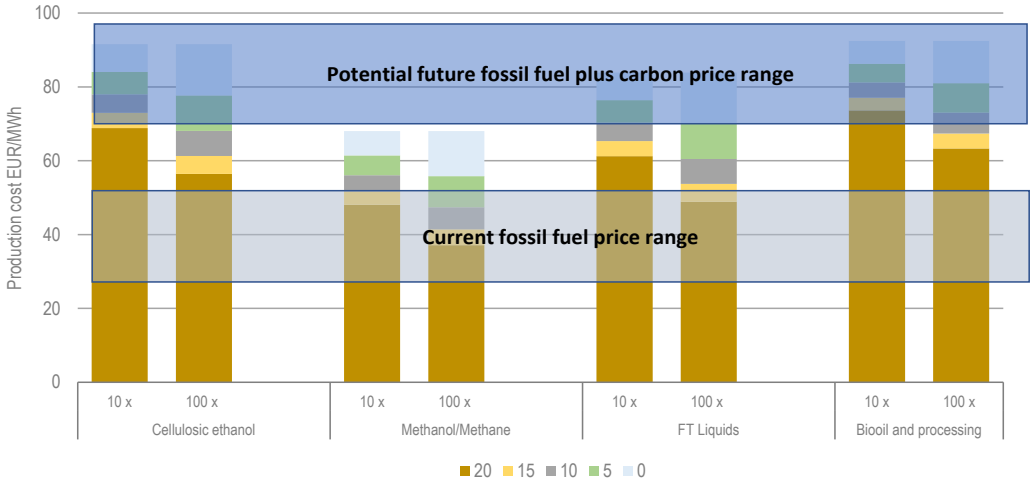
Large scale deployment of the technologies, in line with the patterns needed to meet the ambitions for advanced biofuels within a number of low carbon scenarios, could lead to additional significant cost reductions through **technology learning**, if plant capital and operating costs fall in line with a learning curve. Such reduction could be significant given large scale roll-out of the technologies (potentially up to 50% further reductions in the most optimistic cases studied), although given the range of complicating factors it is difficult to estimate the scope for such reductions precisely.

As capital and operating costs fall, the **feedstock costs** assume a greater importance in the overall cost structure. It is difficult to predict feedstock cost and price trends particularly in situations where demand is significantly scaled up. While global and regional studies indicate that significant quantities of wastes residues and energy crops could be available at roadside costs below 20 EUR/MWh (5.6 EUR/GJ), more detailed studies are needed to confirm that feedstocks could practically be delivered at these costs taking all the logistical and market factors into account.

Comparison of the estimates of the current costs of production of the range of advanced biofuels with the prices of the fossil fuels that they aim to replace indicates a significant **cost gap** of between 40 and 130 EUR/MWh (11-36 EUR/GJ). If the medium-term cost reductions discussed above can be achieved this gap **could be narrowed but it will still be significant** (except for some waste-based projects).

Policy support will be therefore be needed to enable these technologies to mature either in terms of added value for low carbon fuels or a substantial carbon costs applied to fossil fuels. For biomass based fuels a **carbon price** in the range of 49-525 EUR/tonne CO2eq would be needed to bridge the current gap. This would be reduced to 0-300 EUR/tonne CO2eq if the medium term cost reductions discussed above are achieved, and could be reduced further by cost reductions linked to learning effects stimulated by large-scale deployment.

In the longer term, the effective cost of using fossil fuels may rise through a combination of higher prices and more extensive carbon pricing, or other incentives may be available for low carbon transport fuels. If there is an extensive increase in the production capacity of advanced biofuels at the scale envisaged within low carbon scenarios, then there is the prospect of the technologies being cost effective in the context of anticipated fossil and carbon prices such as those in the IEA's World Energy Outlook scenarios.



Impact of learning on costs of advanced biofuels, and projections for fossil fuel and carbon prices

While the costs of advanced biofuels and other fuels discussed above are an important factor, a broader range of issues also need to be considered when comparing these and other low-carbon options. These issues include the extent to which they can directly replace fossil fuels, the costs of any modifications or of distribution costs associated with the fuels, the likely availability of feedstocks and the life-cycle GHG emissions and other sustainability criteria associated with particular routes. Large scale deployment will depend on continuing policy support. First, industry will need support during the risky and costly demonstration and early commercialisation of the technologies, so as to bridge the "valley of death". Continuing strong support will also be needed to offset the differences between biofuels and fossil fuel prices, either by internalising external costs associated with GHG emissions associated with fossil fuel use or by incentivising low-carbon transport fuels.