European Biofuels TECHNOLOGY PLATFORM

European Biofuels Technology Platform/ETIP Bioenergy

Input Paper Version 2 – SET-Plan Action n°8 Issues Paper "Strengthen market take-up of renewable fuels needed for sustainable transport solutions"

Specific recommendations on the proposed priorities/targets proposed

The targets set for 2020 correspond to the already set regulatory targets from the EC under Directive 2015/1513 EC and thus consented by us even if they will be difficult to achieve unless bold measures are immediately taken. The paper says that production won't reach 0.5% by 2020 despite *"extensive funding programmes"*, but then it mentions targets for 2030 that are way beyond the 2020 percentage, and recognizes the positive contribution of **advanced biofuels**. We do agree that to cope with the challenges ahead, an ambitious target is needed, even though it also needs to be realistic. In order to make targeted increases in biofuels possible, stronger policy instruments will most likely be needed (more or less immediately). Target price levels and industry's willingness to invest in new processes will be highly dependent on this, as will the competition between different technology development routes. Making a rough calculation, we end up with 5 to 30 biofuels industrial scale plants equalling the set target of 25TWh advanced biofuels in 2020, depending on the type of feedstock, the integration with other industries and the conversion technologies used. The lower number corresponds e.g. to the size of the currently largest HVO production sites or a future large-scale plant based on gasification of forest residues, while the high number corresponds to current large advanced ethanol plants. In general the advanced biofuel production capacity targeted for 2020 is already installed, especially through HVO, but it depends on the actual feedstock used whether it is considered eligible as an advanced biofuel according to the ILUC directive 2015/1513 EC.

The projection to have an installed production capacity of 200TWh (roughly 17.1 MToe) advanced biofuels (liquid or gaseous) in 2030 is ambitious. For 200 TWh fuels the number above would need to increase to 250-300 plants, each producing less than 1 TWh (e.g. 100000 tons of EtOH is 0.74 TWh; 100000 tons renewable diesel is around 1.15 TWh; often smaller plants for biogas/biomethane).

The time left until 2030 is limited and the deployment of new technologies and the construction of advanced biofuel plants are challenging . This is if policy and incentives are in favour of the new advanced biofuels development and investments. For the time being it is also still unclear which capacity for conventional biofuels will still be on the market for 2030.

The set target of 5TWh (2020)/25TWh (2030) **renewable liquid and gaseous fuels**, rightfully, is much lower than that of biofuels. The reason is that the potential for economically viable implementation (at least within this time frame) is low. It is highly unlikely that such a capacity can be reached. It would correspond to 1250 MW of power to be used for 8000h/year with 50% energy efficiency from power to product (2020) and even five times more in 2030.

In the case of overproduction in energy systems with a high share of renewable generation, renewable electricity with a very low carbon footprint can be seen as a valuable co-feed[1] in many biofuel production processes. Technologies that enable the utilization of electricity are in the early commercialisation phase (e.g. electrolysis) or in the research and development phase (e.g. plasma assisted conversion, electro-catalytic conversion). Electricity can generate hydrogen through electrolysis which together with a carbon source (e.g. CO_2) can be converted to methane or liquids.

[1] Renewable fuels can also be based on electricity only as the energy containing feedstock and are then called electrofuels. This process chain is based on electrolysis (production of hydrogen) and a subsequent chemical/biological synthesis with a carbon source to produce a gaseous (e.g. Synthetic Natural Gas) or liquid fuel (e.g. methanol, Fischer-Tropsch-Diesel).

The production price is dominantly depending of a continued low or even negative price of electricity. Yet another way to make use of cheap power, if available, is to let the hydrogen produced from electrolysis be bled into synthesis gas from a biomass gasification plant and in that way avoid the so called water gas shift unit. This is a very efficient use of hydrogen where the energy in the hydrogen becomes product energy with an efficiency of about 90% at the same time as the capacity of the plant increases between 50 and 100%. The reason for the large improvement is that the green carbon in the feedstock becomes product bounded carbon instead of becoming CO_2 vented to the atmosphere. As a general observation to this concept it can be concluded all bioenergy used for fuel generation via gasification can achieve this boost in production potential via the addition of hydrogen to the production chain.

There are first pilot units whose costs are so far not comparable with already existing industries. In general, renewable electricity is not available in surplus (strong expansion, large investments needed also there, to meet GHG targets for electricity production). Power-to-gas is supporting the storage of renewable energy especially in those European regions where an existing natural gas grid can be used.

As a consequence it makes sense to keep a strong focus on bio-based fuel production to reach results in the short time frames (2020 and 2030) under discussion here. It is important not to be tempted by a (possible) long-term potential to shift implementation focus too early and too strongly. It should be clear that biofuel and “renewable fuel” are not competing “against” each other, but will contribute together to decarbonisation. In addition, they are linked via the availability of clean CO2-streams from biofuel production.

There is no clear distinction possible between the set groups of targets. Both biofuels and other renewable fuels can be liquid OR gaseous, drop-in and “pure”. In general, we think that the unit of the targets in TWh might be misleading. We suggest to add a more common unit in the area of renewable fuels, the oil equivalent (1Mtoe ~ 11,6TWh).

With regard to the set target estimated **GHG savings**, the 60% reduction is a minimum level set by EC regulations; it should not be possible to come below. The target should be to go beyond this (on average) and that the best biofuel production units should reach substantially higher reductions. Appropriate incentives should be created that drive such a development.

The paper does not foresee **any cost or price targets** but somehow still states that ‘*the target price in 2020 and 2030 for advanced biofuels and renewable fuels should be at least comparable to the target price of the other competing transport options including renewable electricity from wind and solar and within a reasonable margin from parity with the fossil based fuels’*. Biofuels and e-mobility should be seen as two different and complementary markets rather than competing with each other. Both will be needed to grow at highest possible pace to face the challenges of sustainable transportation. Thus the costs of biofuels do not need to be compatible with transport options based on renewable electricity. Biofuels will compete with fossil fuels (liquid and gaseous), including environmental costs for both. The recently published study ‘Integrated Fuels and Vehicles Roadmap to 2030’ from Roland Berger[2] points out that biofuels are the most cost-efficient solution for the society in the area of passenger vehicles having a look at the GHG abatement costs and the lifetime mileage. Applying the principle of lowest abatement cost for society, future regulatory frameworks need to be introduced to support these technologies until 2030. Such a framework has also to ensure a path to low and zero carbon emission technologies at lowest possible costs for society beyond 2030.

[2] http://www.rolandberger.com/media/pdf/Roland_Berger_Study_Integrated_Fuels_and_Vehicles_Roadmap_to_2030_v2_20160428.pdf

*What are your **specific recommendations on prioritising R&I activities** on these issues (and building where appropriate on relevant existing initiatives)?*

In principle R&I activities should be prioritized based on the technologies' (research), or specific process and integration solutions' (demonstration plant or similar) potential for reaching:

- Cost reduction for high TRL, which e.g. can take place through energy and material integration and integration with existing process industry
- Scale up and total potential. All "contributions" are valuable, but feedstock resources and process chains with large replication potentials (in volumes) need to be prioritized in order to meet the challenges faced.
- Sustainability, based on scientifically based criteria (not type of feedstock "only"), including positive effects of integrated production and high efficiency of biomass utilization in general.

To a large extent, the targets are expected to be met by value chains already identified, in which large development efforts are already invested. Ideally however, the exact technology solutions should not be specified by "The Commission", but by the actors proposing technological solutions. To set too specific limitations in terms of technology focus creates a risk of lock-in effects and barriers for new innovation.

As long as one of the most limiting factor in the large deployment of advanced biofuels is their cost vs fossil fuels (i.e. capital expenses (CAPEX) and operating expenses (OPEX)), it is advisable to focus on the individual steps contributing to their cost structure:

- Feedstock: biomass should be cheap and sustainable, any research effort targeting biomass cost reduction is welcome (e.g. selection of high yield/low input crops, identification of marginal land potential in EU, logistics for collection of forest-agri waste/residues, synergistic effect between energy crops and phytoremediation of polluted soils, etc.). In parallel, robust yet affordable sustainability criteria should be established as to insure environmentally yet economically sustainable feedstock for EU production of advanced biofuels.
- Conversion: the conversion rate is fundamental to get to a decent production cost fuel. Both biological and chemical conversion rate should be further improved and more research is needed to identify improved catalytic systems. One of the specific R&I activities should focus on the development of catalytic systems able to convert biomass into chemicals and fuels simultaneous.

CAPEX: first-of a kind or second of a kind plant need robust financial support as capital expenses are a major factor impacting final renewable fuel cost and advanced biofuel projects are typically hardly bankable. This is not strictly speaking an R&I activity but certain new ideas to create a new financial support structure are needed anyway.

*Who are the **best placed actors to implement the targets/priorities** (Industry, EU, Member States, regions, groups of countries/organisations/etc.)?*

The actors will emerge by the market, once clear and long-term targets and policy frameworks are in place. According to existing rules, the 0.5% target for advanced biofuels is not binding and MS might adopt different targets. This scenario will simply jeopardize the advanced biofuel market and will negatively impact European potential investors.

However, it is important to point out the importance of building on existing industrial infrastructure to achieve a development on this scale. Innovative biofuel value chains will differ in various parts of Europe and industrial clusters will have to build around these specificities. This includes e.g. the forest industry and oil industry with already developed large-scale logistic systems; the pulp and paper as well as food industry developing their side streams into new products rather than developing a new "industry"; existing conventional and advanced biofuel and fossil fuel industry, with market and process know-how and possibilities to utilize and integrated existing equipment for extending their resource base and so on.

The frameworks must therefore be set NOT to exclude actors or create additional barriers for these actors.

Possible gaps/barriers to meet the priorities/targets

The Issues Paper seems to be based on the expectation that promising technologies still under development will deliver: There is strong emphasis on fuel cells for transport (with renewable hydrogen) and power-to-gas liquids – plus electrification. Those technologies and their conversion steps are not yet cost competitive and ready for the market uptake. New infrastructure needs to be installed for gaseous fuels and electric vehicles.

Like Brazil and the US the paper states that *'in petrol market there is need to move rapidly to fuel flexible engines'.* European examples in Germany and Sweden have already been there and have failed so far, due to the lack of existing support schemes. This emphasizes the need for appropriate long-term support schemes AND confidence in the markets (also on the sustainability of biofuels). Large fleets of E85 flexible fuel vehicles exist in Sweden. This fleet could as well run on mixes of ethanol, methanol and gasoline called GEM fuels.

Diesel vehicles can function with B10 (even B30 under specific conditions, essentially for captive fleets). There is no such limit for drop-in biofuels such as BTL or HVO as long as the final fuel complies with Diesel fuel quality norm EN590. As for gasoline vehicles, they can run with E10, knowing that E15 and E20 fuel specifications are not defined yet. Unlike what is written in the text Flex Fuel vehicles may not be the best solution for gasoline vehicles: there are several reasons to this including requirements of engine optimization, and in the fuel distribution network. It is difficult to predict by how much the costs of fuel cell technologies will decrease in the future to become competitive with internal combustion engines.

A consortium consisting of automotive manufacturers and energy companies has concluded recently that biofuels could contribute to some 14 % of transport energy in Europe by 2030[3]. The amount of biofuels was 4.9 % equal to 14 Mtoe in 2014[4]. In some countries this 2030 figure could even be higher, 40 % and more, like in Northern Europe due the existing governmental policies, strong industry stakeholders and vast sustainable biomass resources. The ILUC Directive will limit the food chain based biofuels, often called 1st generation traditional biofuels, up to 7 % by 2020. There is an urgent need to catalyse the development and market take-up of advanced biofuels to reach the 2030 targets.There are several large HVO and Ethanol plants in production in EU using several raw materials, technology is commercial and the industrial interest is to widen the raw material base for increasing new capacity. Innovative development is needed for cost reduction e.g. using low price raw materials, co-production of added value by-products and process development.

The installed/planned capacity of HVO production (e.g. Neste, UPM, ENI, and Total) is exceeding 3 Mtoe/a with an expectation to double to 7 Mt/a already by 2020 and further capacity growth is expected to occur beyond 2020. To be eligible as an advanced biofuel, the feedstock must comply with Annex IX of Directive 2015/1513 EC. But the limiting factor is the raw material supply with low carbon foot print and processing costs.

The potential synergies between sectors are undervalued in the Issue paper:

Synergies

- By existing industrial infrastructure (see "actors" above)

[3] http://www.e4tech.com/wp-content/uploads/2015/06/EU_Auto-Fuel-report.pdf

[4] Biofuels Barometer 2015

- By development of processes able to easily produce both diesel and jet fuel.
- Between biofuels and other biobased products
- Between electrification and biofuels in reaching climate targets.
- By integration of biorefineries

In the paper, integration of processes for producing biofuels and other products (electricity, materials, chemicals, etc) is discussed. When considering large-scale production plants, integration with process industries (e. g. pulp and paper, chemical/petrochemical, oil refinery industries) can result in considerably lower CAPEX and OPEX (both energy and material integration). This should be highlighted. The text refers to the Value Chains and target prices to the customer defined under the EIBI as a way to monitor key performance indicators. It needs to be kept in mind that these KPIs need to be revisited based on more recent information. They are currently not up to date.

The barrier of viable financing solutions for demonstration and "first-plants" is extremely important and should be highlighted. Industry ready to develop plants must be able to this initially by accepting public funding (in part), with this leading to decreasing risk levels (and not the opposite).

Lack of strategic knowledge about potential development paths may be a barrier. In recent years many developments have been abandoned or deprioritized and others have caught a higher interest. This means that the knowledge of the long-term possible competitiveness has been relatively low in some cases. This has been a frustrating development for stakeholders and decision makers. Hence, increased knowledge of "road maps" of different development routes is important, especially how such developments possibly could compete also after 2030 (given some different scenarios). The majority of the developments must have a life time also long after 2030. This should be important for industry to make strategic decisions.

Some of the development routes having the highest TRL levels today may not be the most interesting in a long-term perspective (as discussed above). Resources for developing not only demo plants with a high TRL but also pilot plants with a somewhat lower TRL should be included.

There is demand for increased coordination in targets, priorities and R&I implementation between "energy" (biofuel production) and "transport" (electrification, hybrids and engine development).

Even with the set targets in the Issues Paper, it is unclear who will install such capacity with no real long-term initiatives. To the contrary, even in this Issues Paper biofuels are somehow seen as a stopgap. The text says: '*Biofuels have therefore an important role to play* <u>*before*</u> *electrification can be fully realised and certainly for specific applications such as aviation, shipping, and heavy duty road transport where electrification is* <u>*not yet*</u> *possible.'* It seems, sooner or later the long-term is based on electrification. The big strength of biofuels is that they are ready to allow a GHG reduction in transportation without further infrastructure investments. This initiative should be taken before companies decide to opt out of the biofuels business.

Biofuels cannot be seen as a transitory solution before full electrical aircraft. Even if the "more electrical aircraft" is a huge tendency, the full electrical aircraft is a very long term vision. Biofuels will most likely be a long-term, substantial, component of a sustainable transportation sector and needed together with electrification, efficiency improvements, vehicle development etc. To reach efficient, sustainable and economically viable systems that meet the climate challenges, we will need combinatory solutions for the foreseeable future. If the demand for biofuels, through other technological breakthroughs, become smaller than expected that is only a positive development, but we cannot rely on that at this point. As stated in the Issues Paper, even with extensive efforts, the targets will be difficult to reach.