http://dx.doi.org/10.21622/RESD.2016.02.2.060

Biofuels – On the way to sustainability? Opinion

Prof. Dr.-Ing. Martin Kaltschmitt
Head of the Institute of Environmental Technology
and Energy Economics (IUE)
Hamburg University of Technology (TUHH)
Hamburg, Germany
Email: kaltschmitt@tu-harburg.de

Biofuels contribute to cover the strongly increasing energy demand within our global transportation system. The current status of biofuel production can be summarized on a world wide scale as follows [1, 2]:

- Bioethanol. About 97 Billion l of ethanol (2,218 PJ) were produced in 2015. Roughly 57 % were provided within the US (56.1 Billion l; 1,282 PJ; primarily from corn) and approx. 28 % in Brazil (26.8 Billion l; 614 PJ; mainly from sugar cane). The remaining 15 % were produced in Europe and Asia.

- Biodiesel / HVO. In 2015, ca. 32 Billion l (1,050 PJ) Biodiesel / HVO have been sold. Brazil provided ca. 3.5 Billion l (116 PJ) and Germany roughly 3.2 Billion l (105 PJ). The market in North America is dominated by the US with 16 % of the global production (168 PJ). The remaining rest is widely distributed throughout the world and comes from smaller markets like Argentine, Indonesia and other countries.

- Other biofuels. To a very minor extend, also bio-methane as well as pure vegetable oil are used within the transport sector. But on a global scale the contribution of these options is negligible.

Related to the overall energy demand for transportation purposes this biofuel use of roughly 3.3 EJ (2015) represents a share of less than 3 % [3]. This small share could only be realized over time due to administrative measures implemented by various governments already years ago. There have been manifold communicated reasons to justify these legal measures as well as the resulting financial support from the public purse [4]:

- Contribution to the reduction of greenhouse gas (GHG) emissions;
- Protection of scarce and finite fossil fuel resources;
- Domestic energy provision and thus an increased security of fuel supply;
- Use of agricultural surplus production and thus avoidance of set aside land;
- Creation of employment and income in rural areas as well as development of perspectives for farmers e.g. suffering from low prices due to over-production;
- Convenient inclusion into existing technology and market structures of transportation based on fossil fuels;
- Development and demonstration of technological processes with a high export potential and thus the option of creation of value.

These arguments were always questioned critically by parts of the public and especially by environmental NGOs. Among others, the following arguments have been presented:

- The GHG savings are marginal because the production process for biofuels is quite energy consuming (i.e. no or only negligible net GHG savings);

- Due to direct and indirect land use change effects (LUC and iLUC) possible GHG reductions are inverted to (significantly) higher GHG emissions compared to fossil fuel use (i.e. biofuels contribute to rain forest clearing);

- Biofuels contribute to food scarcity and hunger especially in less developed countries due to increasing food prices that are triggered by an increasing demand for land and agricultural products as well certain political instruments that distort the market (e.g. subsidies);

- Biofuels contribute to monoculture and industrial agriculture as well as to the reduction of biodiversity.

Due to this ongoing social debate, significant efforts to minimize negative consequences and to increase acceptance have been made especially within the European Union (EU) in recent years. For example, the following measures have been implemented by the European Commission (EC):

- Agricultural feedstocks used for biofuel production need to come from sustainable sources; this has to be certified by an independent body. In contrast, no legal sustainability requirements for agricultural feed and food products exist.

- The subsidies for biofuels are tied up with an assessment of the achieved GHG savings, which are calculated based on a pre-defined mandatory methodology [4]. By decision of the European Parliament, indirect land use change effects are not taken into consideration due to unsolved methodological problems related to their assessment [5].

- According to the European Commission (EC), additional land demand that results from ambitious biofuel targets can mostly be fulfilled by conversion of land that has been set aside since decades in order to stabilize market prices resulting from overproduction [6].

- The markets for biofuel feedstock are small compared to the respective markets for food and fodder [7]. Thus, the biofuel markets influence the price creation on the global stock markets only to a minor extend.

Nevertheless, serious concerns of a considerable share of the politically active population especially in Western world countries still exist. In order to increase acceptance and to reduce negative consequences of biofuel provision and use, the measures outlined above can only be seen as a (promising) starting point. The overall long term development goal should be that markets for food and feed, markets for biomass as a raw material as well as energy markets support each other by stabilization of the respective biomass prices. Additionally common sustainability standards need to be implemented for these various markets. This is true because typically a large share of biomass is produced regardless of its later use. Market mechanisms “decide” for which purpose (e.g. food, feed, raw material, or biofuel) the biomass available on the market will ultimately be used.

Fertile land and thus also biomass produced on this land are a priori a limited resource. Additionally, yields vary due to changing environmental conditions (e.g. drought, flooding, and infestation). Due to these uncertainties, producers are forced to realize a certain over-production exceeding the expected demand to survive economically. Thus – from the view point of the producer – it would be helpful to implement market based measures to level or at least to slow down price variations at the global biomass markets. Energy markets can act as such a stabilizing element because biofuels and conventional fossil fuels can be exchanged completely and immediately. They can help to level out price variations of biomass by

http://dx.doi.org/10.21622/RESD.2016.02.2.060

taking up agricultural products in case of a global production exceeding the demand from the food and feed market. Vice versa, biofuel production could be reduced in case of low yields and a resulting shortage of biomass to alleviate pressure on the food and feed market. One precondition for creating such a harmonized or stabilized market is that sustainability criteria, which are already mandatorily applied to biomass feedstocks used for biofuel production, are applied to all traded agricultural products regardless of their use. Consequently, such a concept could boost a more sustainable agricultural and forestry primary production

Furthermore, the following targets need to be achieved in the years to come in order to increase competitiveness, reduce negative environmental consequences and to promote acceptance of biofuels:

- Widening of the biomass resource basis; this includes better crops, the use of organic wastes as well as "new" biomass feedstocks (e.g. algae);
- Technological advances in biomass production and downstream processing in order to increase efficiencies throughout the overall provision chain;
- Better combination of biomass production and processing for the various markets to exploit synergy effects and minimize losses (e.g. promotion of the bio-refinery concept);
- Improved assessment of sustainability criteria throughout the overall provision chain; this includes also aspects like impacts on biodiversity and soil properties, iLUC, child labor etc.

Such aspects are essential to cope with an increasing demand for biomass driven by a growing world population, changing consumption patterns as well as an increasing demand for renewable energy provision and industrial purposes. All over, tremendous progress has been made in recent years in increasing sustainability and efficiency of biofuel production. Nevertheless, this process has not come to an end yet.

References

[1] Bloche-Daub K, Witt J, Kaltschmitt M, Janczik S (2016) Erneuerbare Energien. Globaler Stand 2015. BWK 68(7/8): 6–23.

[2] Kaltschmitt M, Hartmann H, Hofbauer H (2016) Energie aus Biomasse. Springer Berlin, Heidelberg.

[3] BP p.l.c. (2016) BP energy outlook 2015 edition.

[4] (2009) Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[5] (2015) Directive 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

[6] European Commission - Directorate-General for Agriculture and Rural Development (2007) The impact of a minimum 10% obligation for biofuel use in the EU-27 in 2020 on agricultural markets. Directorate G. Economic analysis, perspectives and evaluations. Internal Memo

[7] OECD (2014) OECD-FAO agricultural outlook. OECD, Paris

About Professor Martin Kaltschmitt

Professor Martin Kaltschmitt studied for petroleum engineering and did his PhD in the field of renewable energies. Afterwards he headed a research group in the field of biomass / renewable energy at Stuttgart University where he did his habilitation. After a research stay at King's College in London and at the University of California at Berkeley he has been promoted to the managing director of the Leipzig Institute for Energy. In 2006 he has been appointed to a full professor at Hamburg University of Technology where he is heading the Institute of Environmental Technology and Energy Economics. Between 2008 and 2010 he was in parallel the scientific managing director of the German Biomass Research Centre located in Leipzig/Germany. He published more than 15 books and more than 350 articles in scientific magazines. He gave also more than 400 presentation on scientific conferences and seminars. He has been active in supporting the EC, several German ministries, DFG, DAAD, FFG, GIZ and others.