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RENEW – Renewable fuels for advanced powertrains

Integrated Project
Sustainable energy systems

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MARKET IMPLEMENTATION

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CONTENT

ABBREVIATIONS

BtL	biomass to liquid
CAP	Common Agricultural Policy (of the EU)
DME	Dimethylester
EN	European norm
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
FT	Fischer-Tropsch
GHG	greenhouse gas
hl	hectolitre
LCA	life cycle analysis
LPG	liquefied petroleum gas
R&D	research and development
RES	renewable energy sources
SNG	synthetic natural gas
SRC	short rotation coppices
SRW	short rotation wood
WTO	World Trade Organisation

1 INTRODUCTION

It is generally known that the countries of the EU are depending on energy imports and in particular on fossil oil imports to secure their own heat, electricity and fuel consumption. As the prices for these imports are tending to rise, they are not only a political, but also an economic challenge. At least since the ratification of the Kyoto protocol it is also commonly accepted that through the use of fossil fuels the EU is a large emitter of greenhouse gases (GHG), which contribute to global warming. For these reasons the substitution of fossil energy by renewable energies is an environmental objective of the EU too. Therefore the concrete target for all EU countries is the reduction of their total GHG emissions by about 21 % till 2008-2012 in comparison to 1990 (by about 30 % till 2020).

Especially the transport sector – both commercial and private – is a main oil consuming and a GHG-generating sector in the EU (approximately 28 % of the CO_2 emissions in 2020, EU 25 /11/). Thus, increasing the efficiency, securing and diversifying the energy supply for transport in an environmentally sound way are key objectives of the transportation, energy and environmental policy of the EU. Road transport is the largest energy consumer and GHG emitter amongst transport modes. Hence, the introduction of alternative fuels of renewable sources, whose production and use patterns differ from those of conventional oil-based fuels, in the road transport is a crucial factor for meeting the EU policy objectives.

In it`s efforts to downsize the dependence from crude oil the European Union places emphasis on renewable biofuels, which could contribute significantly to the security of supply. Additionally, the production of European biofuels increases the local/regional added value in several regions and branches including the agricultural sector. Hence the European biofuel industry boomed since 2003, when the political frame conditions esp. for bioethanol and biodiesel have been improved. The 2nd generation biofuels and esp. BtL fuels show significant advantages compared to first generation biofuels; thus BtL fuels are an interesting option in the years to come. Besides the GHG reduction advantages a market implementation of BtL fuels would also bring a substantial increase of the production potentials of biofuels as there is a very broad base of input materials applicable for a BtL production.

To achieve the political goals a broad market implementation has to be initiated by the political decision makers on the national and European level. Presently, there exists no coherent political concept for the implementation of advanced biofuels and how they could be integrated in the existing fuel market structure. Therefore the following proposal for a market implementation strategy, which is based on results of WP5.3 within the RENEW project (e. g. /1/, /2/, /3/, /4/), shall pave the way to an increased use of BtL fuels in Europe.

2 CHALLENGES AND POSSIBLE MEASURES

First generation biofuels (e. g. biodiesel and bioethanol) for transportation purposes are mature already. Advanced biofuels of the second generation like BtL fuels are however still in the earlier stage of R&D resp. pilot projects. Therefore there are many challenges and risks, which have to be kept in mind to come to a successful market establishment, i. e. a competitiveness of biofuels in comparison to fossil transportation fuels without political support.

In the following the most important of these challenges are discussed. Possible counter measures and ideas to overcome such challenges are presented.

Economy

2.1.1 Economic challenges

Energy prices

The economic advantageousness of BtL facilities is highly dependent from the prices for the input materials, which are a main determinant of the costs, and the prices for fossil fuels, which are the main determinant of the revenues. Both prices are highly volatile (see Figure 1 and Figure), hence their development is a main uncertainty regarding the economic efficiency of a BtL production.

The costs for the biomass represent – depending on the production concept – between 35 to 60 % of the overall BtL production costs. Hence their volatility causes an uncertainty, Moreover, a correlation between the prices for fossil energy sources and the biomass market price has recently started to develop, reducing the scope for bioenergy to increase its relative competitiveness vis à vis fossil energy with rising oil prices. But other market related factors are also relevant.

Another uncertainty occurs on the revenue side: in the FT-BtL production process some marketable by-products like naphtha accrue. Their price development is hardly to predict as a large scale production of BtL fuels will increase the supply of those by-products significantly. Thus, if the by-product demand increases not at the same level a declining market price for the by-product will occur (e. g. comparable to glycerine production & market price development in GER)[1].

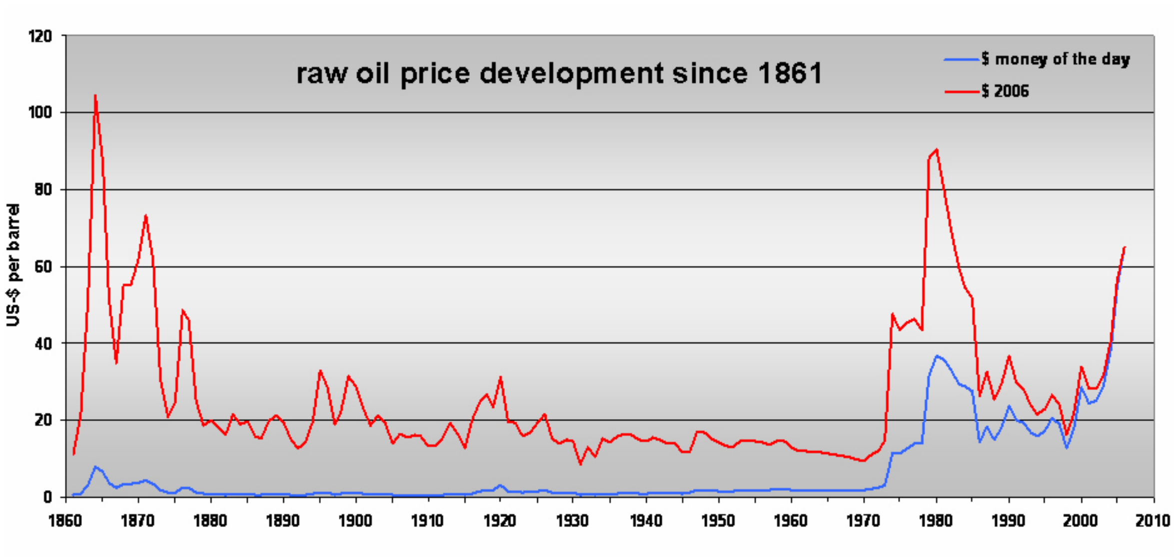

Figure 1 Oil price development (source: BP Statistical Review of World Energy, June 2007)

[1] One option to solve this problem is the upgrading of naphtha on motor fuel quality (see Del. 5.4.2.4 Progress Report on Technical Analysis); but therefore further R&D is required.

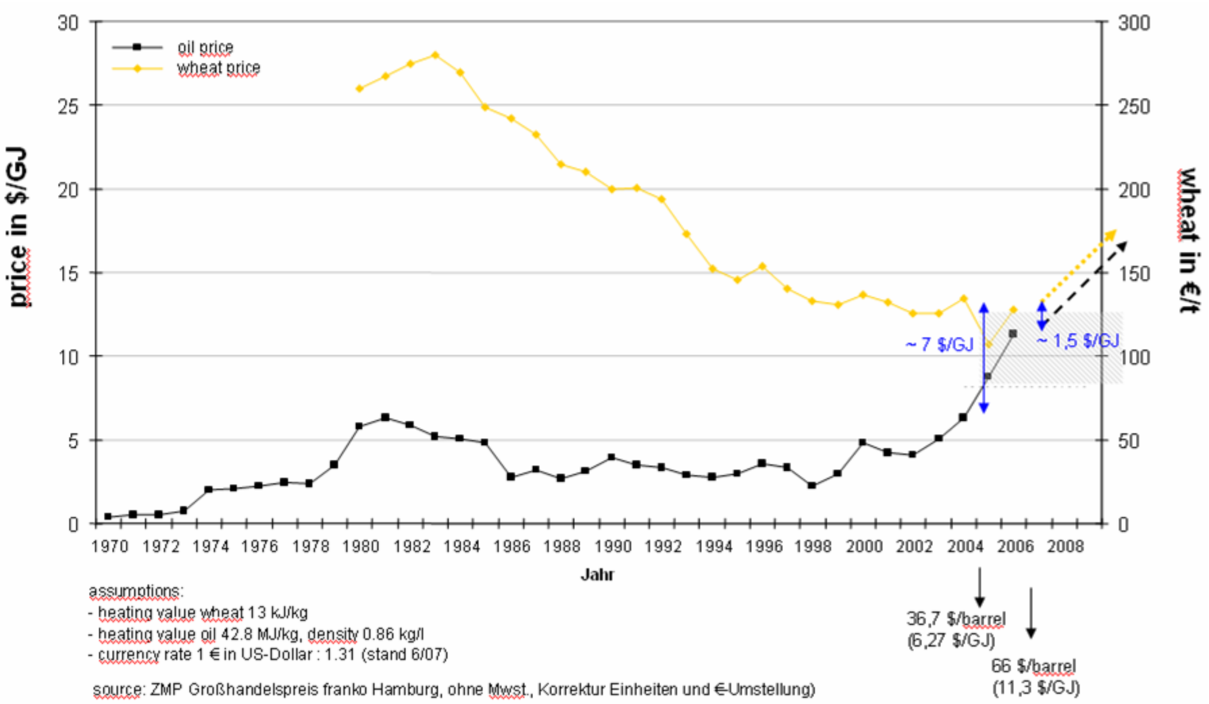

Figure 2 Wheat price development as examples for the volatility of biomass prices

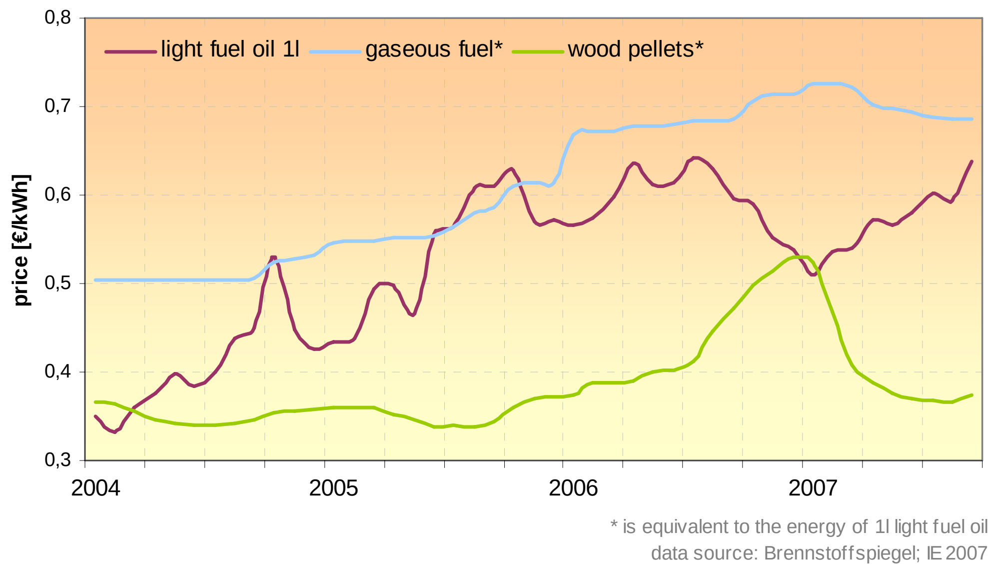

Figure 3 Price development of wood pellets and fossil fuels as examples for the volatility of prices

<u>*CAPEX risk*</u>

CAPEX (CAPital EXpenditure) is connected with risks for any investor. But investments in BtL plants are more risky than both investments in traditional technologies and in other renewable energy facilities for different reasons:

- The construction of BtL facilities needs higher investment sums than investments in other renewable energy facilities as for technological and economic reasons the commercial plant size will be larger than the most existing renewable energy production facility. The investment also depends on what kind of BtL that is to be produced.

- CAPEX costs per unit of capacity production for liquid energy is also much higher for BtL than for their fossil refinery based equivalent.
- The cost calculation regarding BtL plants is at this stage more uncertain than the calculations for plants in traditional sectors because there are no industrial reference up to now (“level of detail” influences the cost estimation significantly).
- Because of the lack of industrial references money lenders will be very careful and will ask for first class securities. Because of the very large amount of investment needed, no single entity will take the risk alone and it will probably be managed by consortiums of investors.
- When the BtL production can achieve market establishment and several large scale BtL plants will be installed it could cause a significant increase in the demand for appropriate facilities, equipment etc. Additionally, the world market price for many raw materials (e. g. steel increases) continually during the last years. Both factors could lead to rising prices of BtL technology components. A similar effect could be observed in some fields of the chemical industry (see the following Figure 3).

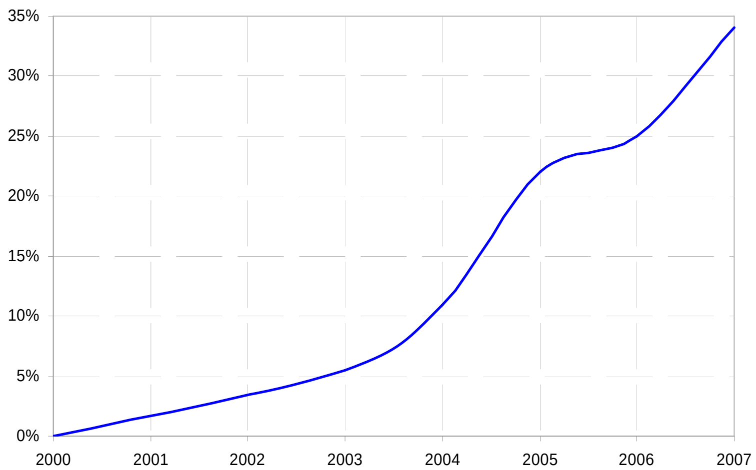

Figure 3 *Development of TCI for chemical plants and machinery according to Kölbel-Schulze-Index, 2000 - 2007 /5/*

Political frame conditions

As at the moment most biofuels are not competitive economically, their economic advantageousness currently depends highly on political support and reliably long-term stable political frame conditions.

In some countries already exist legal regulations concerning biofuels (e. g. in Germany the Biokraftstoffquotengesetz (BioKraftQuG), but their time horizon is not sufficient for the development, construction and operation of BtL plants.

2.1.2 Possible counter measures

The economic challenges could be solved or at least softened by different political measures. Those measures have to be sustainable and long time reliable to be effective.

Quota / Fixed prices

Politically fixed prices and a purchase commitment for the mineral oil companies (analogue to e. g. the feed-in tariffs for electricity in the German *Erneuerbare-Energien-Gesetz* /6/) would erase the economic risk on the revenue side of the BtL production. The most important properties of such a "biofuel feed-in-tariff" would be:

- guaranteed tariffs for the produced fuel for a (pre-)defined period of time
- guaranteed tariffs for all plants being built within a certain period of time; plants built afterwards get a declining tariff
- tariffs have to be paid by the mineral oil industry and passed on to the consumers
- tariffs should cover the production costs, i. e.:
  - they must be differentiated according to the production technology and
  - the present and future production costs must be evaluated to avoid an over-subsidising
- the tariff system must include an element of degression that reflects the technological progress and hence decreasing costs
- Only certain biofuels with determined fuel properties and production technologies should benefit from such a support scheme (e. g. high quality fuels, sustainable biomass production, conversion efficiency…)

Biofuel quota, which are committing for the mineral oil industry, would secure a use of biofuels in the degree that is politically wished. As a simple quota system has the disadvantage that it does not differentiate according to the degree of environmental impacts of the appropriate biofuels, the implementation of a system of different factors depending on the CO_2 emission reduction of the appropriate fuel or other sustainability criteria can be imagined. A quota system offers the opportunity to differentiate between biofuels in a different stage of development and market implementation. A difference between (standard) biofuels and “biofuels with promising future opportunities” seems to be reasonable.

Sustainability related taxation system

Taxes have not only a fiscal function, but are also a steering instrument. Against this background a taxation system related to the sustainability of the products would be reasonable. With differentiated tax rates for different fuels an internalisation of external costs of environmentally hurtful technologies could be achieved. As different biofuels have different environmental impacts, there should not only be a differentiation between fossil and biogenic fuels, but also specific tax rates for the different biofuels according to their CO_2 emission reduction. A proposal has been made by Volkswagen (see Figure 4).

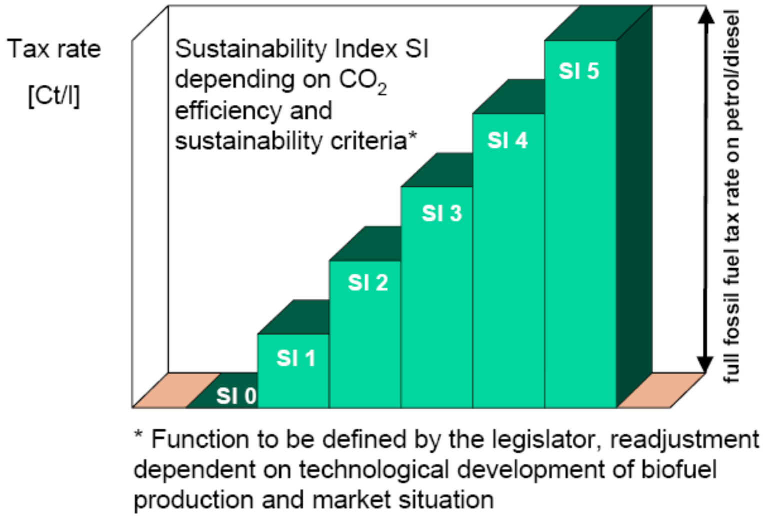

Figure 4 Preliminary proposal of Volkswagen for the taxation of biofuels

To become more precise, a taxation system could be classified in a certain number of steps, e. g. in 6 classes which represent a certain “grade” of sustainability. In Figure 4, SI 5 would coincide with the conventional mineral oil tax for fossil based fuels. In dependence of the classification in terms of sustainability the fuels receive a certain tax reduction, in the best case, i. e. SI 0, fuels will have a full tax exemption. The certificates have to be prepared by independent persons. They have to be provided by the plant owners. They have to prove a certain sustainability level, so that the process can be classified, otherwise the fuel is ranked as fossil fuel. Whether the number of classes is 6, 10 or only 3 is not that important. Real decisive are two aspects:

1. Well to tank classification based on sustainability performance and
2. pre-determined adjustment of the tax reduction over market penetration in order to prevent misallocation of money.

The latter is especially important to increase the confidence of potential investors. They need to know under which circumstances which tax benefit can be calculated before they spend money, i. e. in the planning and developing phase. An adjustment could be based on e. g. the amount of fuel in the market.

The important benefits of such a taxation system are:

- it is technology neutral, i. e. it offers generally the same opportunities for the first and second generation biofuels
- it is market driven and not a market intervention based on “non-market” aspects
- it gives long term security for investments
- it could be a basis for taxation harmonisation in EU

On the other hand, such a system does not consider how to implement innovative and promising biofuels which in an early stage of development and market implementation generally suffer from higher production cost. The reasons for that are higher spec. investment and operating costs (beginning of a learning curve), lower reliability and not yet optimized conversion chains. An incentive system just based on CO2-difference contains high risk for the BTL sales price as it will be a speculation on the difference of fossil oil prices, prices on competing biofuels as e.g. imported palm oil based biodiesel and the supposed CO2 reduction ratio.

Loan guarantees

Governmental loan guarantees with investment friendly frameworks/conditions would encourage external creditors to engage themselves in the financing of BtL plants.

Investment subsidies

The special CAPEX risk of BtL facilities (see above) could be compensated by the provision of investment subsidies. The frame conditions and terms of investment subsidies must be known at least 5 years in advance to give reliability for the project planning and investment.

Low interest rates

As already mentioned to invest in BTL facilities a considerable credit volume is required – combined with high liabilities and risks. To overcome these obstacles and to encourage potential investors special credit conditions with low interest rates and an obliging repayment period would be helpful especially for the pioneer large scale BTL facilities.

Biomass Supply

2.1.3 The challenge of biomass supply

The availability of biomass in sufficient masses and qualities is a necessary condition for a commercial BtL production in large scale plants. In combination with the aim of a sustainable biomass supply this challenge requires a combination of measures which integrate several parties from the politics to the farmers.

Security of supply

Biofuels and especially synthetic biofuels can be generated from very different input sources. Although also non-renewable industrial by-products and organic waste can be used, the potentials result mainly from biogene raw materials. Regarding biogene raw materials there are two basic use competitions which determine the available input and hence the potential for the biofuel production. It must be assured that the food production is affected neither by the provision of raw materials for a material nor for an energy use ("priority of alimentation").

Sustainability of supply

A significantly increasing energetic use of biomass has some sustainability risks. The following sustainability concerns result from an increasing biomass use for energetic purposes:

- unsustainable harvest regimes or agricultural methods
- natural habits and landscape destruction
- regional food shortages
- effects on resources and pollution
- soil degradation or water scarcity
- loss of biodiversity
- uncertain impact of genetically mutated biomasses
- biomass import which wasn't grown, harvested and transported in a sustainable way

Competitiveness of supply

As the agricultural areas may be used for the production of crops for different uses, it must be ensured that the production of energy crops is profitable for farmers and all other stakeholders of the biomass provision process. The cultivation of energy crops like short rotation wood (SRW) is especially expensive during the first years. No harvest is possible but there are expenditures for establishment, fertilisers etc. Thus the attractiveness of the cultivation of SRW for farmers is low.

2.1.4 Possible counter measures

For farmers and agricultural companies the production of renewable raw materials for an energetic use is a second pillar of their entrepreneurial activity. An increasing demand for agricultural products will probably lead to higher prices. Therefore these stakeholders will be affected positively by an increased production of biofuels. Against the background of high subsidies for the agriculture in the EU, this increasing demand is also welcome from a political point of view.

On the level of the companies for the forestry the same impacts as for the agriculture are valid. From the political point of view it has to be assured that despite of the increased demand the forestry remains sustainable!

The most effective measures to ensure a sufficient provision of input material for the BtL production are the following:

Incentives for the cultivation of energy crops

The cultivation of energy crops is fundamental for the commercial production of BtL. To ensure a sufficient provision of biomass for an increasing BtL production stable and long term reliable incentives for the cultivation of energy crops will be necessary. These incentives – e. g. a system of subsidies, grants and direct payments – must provide energy crops profitability.

Basically both subsidies in the form of a fixed payment per hectare and year and in the form of a one-time establishment incentive are possible. Since the beginner position is estimated to be strongly inconvenient, especially for small businesses and organisations a significant part of efforts should be paid to the period of plantation establishment. The reduction of the set up costs can be achieved by providing preferential credits or direct payments.

Tax incentives

Furthermore tax incentives are under research /7/. Three tax measures have been established concerning costs connected to equipment and labour of RES ventures:

- The income tax credit**:** a certain percentage of the equipment costs and possibly of the labour costs can be reimbursed to the taxpayer on the sum to be paid as income tax on the fiscal year in which the investment was made. If the total sum of the tax to be paid is less than the sum to be deducted, then the difference is paid to the taxpayer
- The income tax reduction**:** using the same principle as the previous measure, but in the case where the sum to be deduced is higher than the tax to be paid, the taxpayer does not receive the difference
- The tax allowance: a certain percentage of the equipment costs and possibly the labour costs can be deducted from the net taxable income (tax base).

The choice which tax system is the most effective could be made by monitoring the four European countries in which the preferential tax measures already have been introduced and the case studies in two more countries in Eastern Europe.

Establishment of a sustainability assessment system

The energy production from biomass seems to be environmentally sound per se, as biomass emits only such amounts of CO_2 in the combustion as it binds while growing. But that is only half of the truth, any life-cycle analysis (LCA) calculation of the BtL production process shows that a significantly increasing energetic use of biomass has some sustainability risks as well. So “the lack of an effective governance system may turn bio-energy into a threat instead of an opportunity” /8/.

Against this background an effective system for the governance – or at least guidance – of the bioenergy markets as a whole and the markets for input and output of the biofuel industry in special has to be developed and implemented. A proposal was given e. g. by /8/. This proposal was elaborated by an analysis of existing governance systems of markets for comparable commodities (e. g. governance system for fair trade coffee or the EU sugar market and the Forest Stewardship Council (FSC)). The elaborated system is mainly based on the FSC, amended by the lessons learned of other systems. It suggests a two-pillar consisting of a *Bio-Energy Labelling Organisation* and an *UN Agreement on Bio-Energy*.

Whether or not this proposal is realised – to secure an environmentally sound production and use of biofuels an appropriate system for market guidance has to be implemented as soon as possible. As a basis for a sustainability assessment system especially for energy crops also the sustainability standards published by the WWF Germany /9/ could be used.

Research in energy crops

As the usable agricultural area is limited, high yields per hectare have to be aspired. As more and more land of lower qualities will be cultivated, the breeding of self-sustaining high-yielding crops growing on poor soil and with less water is an important task. R&D as well as training & publishing the knowledge in this topic should be promoted and supported.

Dissemination of SRC cultivation techniques

There are high yield potentials in the agriculture which can be made accessible by a dissemination of the knowledge about SRC cultivation technologies. Therefore education programmes for farmers have to be installed that teach the management of energy crops farming.

Among European countries the helpful knowledge of different actions and projects and success stories should be disseminated in conferences and workshops to the farmers. Aspects of financial aid and support schemes by investigation into SRC-techniques can be integrated.

Technology

The large scale production of BtL will be a new technology, and like all new technologies it still is tainted with some technological challenges, which have to be softened to initiate private engagement.

2.1.5 Technological challenges

The most important technological challenges in the field of a large scale BtL production are discussed in the following:

Maturity displayed e. g. in the reliability and performance

As a new technology the production of BtL will reveal some technological weaknesses. In the early stage of operation, the full load operating hours per year will probably be below standard petrochemical facilities. Thus lower yields and higher expenditures for maintenance and repairs can be expected.

In /10/ it is pointed out that none of the different concepts for BtL production can be called “proven technology” or bought off-the-shelf. Some of the concepts show a promising maturity justifying the development of a first industrial demonstration project in 500 MW-range together with (industrial) monitoring. Others need further development and demonstration in pilot scale (< 10 MW-range), others may require intermediate scale-up steps to the 50 MW range also including monitoring.

Staff recruitment

Both the R&D in new technologies and their market implementation resp. the production process need highly qualified staff – researchers, engineers and skilled workers. Against the background of the existing lack of qualified engineers in many European countries this could become a serious problem.

2.1.6 Possible counter measures

Support for pioneers

The technical challenges can only be overcome with the help of sufficient experiences. To collect those experiences it is necessary to motivate private investors to go ahead. Therefore support for the 1st pre-commercial demo plants (~ 50 MW_{th}) and for the 1st commercial demo plant (some hundred MW_{th}) of each advanced technology is essential. This support could be given in the form of e. g. loan guarantees or direct investment subsidies. Direct subsidies help to create a viable business case considering the higher costs of a first-of-a-kind investment and the lower reliability. If no loan guaranties will be provided, exorbitant high profit has to be shown to get the funding e.g. from risk capital entities that have to be convinced. Effective access to loan guaranties helps to speed up the market implementation of new technologies as BTL significantly

Having analyzed the existing support tools, it has to be stated that in contrast to programs in the US in all over Europe, no tool or program is known that is able to fund a several hundred million Euro project as required.

Support for complementary R&D

Practical experiences are crucial for the further development of BtL plants. In parallel some more R&D efforts are necessary. These have to be promoted and supported by European and/or national institutions resp. programmes.

Enhanced education efforts

Both universities and companies have to boost their efforts to qualify personnel, especially engineers, in technologies necessary for the BtL production from the biomass provision to the production and the fuel supply. This concerns a qualified technological education and a permanent off- and on-the-job training from engineers to skilled workers.

BtL market

In the long term BtL fuels will have to compete on the international fuel markets. This should be prepared in the medium term by the introduction of appropriate frame conditions.

2.1.7 Market challenges

Competition to other alternative fuels

There is a multitude of biofuels of the first and second generation with rather different characteristics, e. g. regarding the potentials, the production technologies, the distribution or the usage technologies. Also the specific frame conditions of certain concepts or plants influence the results significantly. In Table 1 the characteristics of different biofuels for certain model cases (taken from literature) is given exemplarily – those results are not fully in line with the assessment results of the RENEW pathways. Each biofuel resp. each conversion path has it´s special advantages and disadvantages, so that currently no “first-best-solution” or “silver bullet” for biofuels can be identified. An impression of important evaluation criteria and the comparison of several 1st and 2nd generation biofuels are presented in Table 1. More detailed technical information to the fuel suitability of specific BtL-fuels investigated within the RENEW project can be found in the final project report (e. g. drivability, storage properties etc.).

Table 1: Characteristics of different biofuels according to **Fehler! Verweisquelle konnte nicht gefunden werden.**

Evaluation of different criteria and renewable fuels

	Climate Impact	Energy Efficiency	Land Use Efficiency	Fuel Potential	Vehicel Adaption	Fuel Costs	Fuel Infrastructure
Biodiesel	++	+++	+	+	+++++	+++	++++
Synthetic Diesel	+++++	+++ / ++++	+++	+++	+++++	+ / +++	+++++
DME[1]	+++++	++++ / +++++	++++ / +++++	+++++	++++	++ / +++++	++
Methanol	++++ / +++++	+++ / +++++	++++ / +++++	+++++	++++	++ / +++++	+++
Ethanol	+ / +++	+ / +++	+ / ++	+++	++++	+ / +++	+++
Biogas	++++ / +++++	+++	++++	+++++	+	++ / +++	+
Biogas + Biodiesel	++++	++++	++++	+++++	+++	+ / +++	+
Hydrogen + Biogas	++++ / +++++	+++	++++	+++++	+	++ / +++	+
Rating key:	CO_2-reduction in comparison to conventional diesel fuel	proportion of energy reaching the vehicle's driven wheels [2]	biofuel quantity per energy used in harvesting, production and transport etc.	amount of fuel that can be produced	technical complexibility of adapting vehicles to use the new fuels	"Well-to-tank" production cost (in comparison to conventional diesel oil, excluding tax[4])	distribution (infra-structure) & hand-ling (including safety & environ-mental aspects)
+	0 - 25 %	und 14 %	over 10 000 km	70 - 139 TWh	suitable for all heavy applications	+ 100 to 140 %	liquid gas at low pressure
++	26 - 50 %	14 - 16 %	7 501 - 10 000 km	140 - 209 TWh	suitable for most appl. To low cost	+ 60 to 99 %	high pressure gas or liquid gas
+++	51 - 75 %	17 - 19 %	5 001 - 7 500 km	210 - 279 TWh	suitable for most appl. to high cost	+ 20 to 59 %	major changes (liqid fuel)
++++	76 - 90 %	20 - 22 %	2 500 - 5 000 km	280 - 349 TWh	suitable for up to half of all applications	0 to + 19 %	minor changes (liqid fuel)
+++++	91 - 100 %	over 22 %	over 10 000 km	350 - 420 TWh[3]	suitable for all heavy applications	cheaper	no changes (liqid fuel)

[1] Dimethylether; [2] fossil diesel reaches app. 35%; [3] 350-420 TWh range is equivalent to appr. 10-12% of the predicted energy demand for petrol and diesel in the EU in 2015; [4] assuming a crude oil price of US $ 70

Source: VOLVO: Climate issues in focus - CO_2-free Renewable fuel transports. Göteborg (SE), 08/2007

2.1.8 Possible counter measures

Sustainability based tax system resp. quota / feed-in tariffs based on sustainability assessment

To support the use of BtL in the competition with other renewable fuels basically the political measures discussed in chapter 2.1.2 are capable, namely quota / fixed prices for BtL fuels and a sustainability related taxation system, which would privilege the ecologically very sound BtL fuels against e. g. biofuels of the 1st generation.

Short term BtL quota for 1st plant

To overcome the technical uncertainties the implementation of a (temporary) system of commitments and incentives to help synthetic biofuels to enter the markets would be advantageous. As an immediate measure short term quota for BtL coming from the 1st plants could be an incentive for private investors to go ahead very soon and give a starting signal for the whole industry.

Standardisation of fuel qualities

The market position of BtL fuels against other fossil and renewable fuels could be strengthened by the establishment of national or even better European standards. Those standards could be used for the establishment of a quality assurance system.

Information campaign

The market position of BtL fuels could be improved by communicating their environmental advantages, e. g. their significantly lower CO_2 emissions compared to both fossil and other renewable fuels.

Establishment of a distribution infrastructure

The targets regarding the biofuel provision can only be achieved, when an appropriate logistics system for the distribution is established. To realise that, some decisions have to be met in advance: Which kinds of biofuels will be used? Will they be used pure or as blends?

3 MARKET IMPLEMENTATION PLAN

The presented (and some potential additional) measures can be implemented independently. But as some measures have a positive influence on the realisation of other ones (see Figure 5), an intelligent choice of the order of the implementation of the different measures is advantageous.

As a result of Figure 5 it can be concluded, that measures which affect other measures positively should be implemented at an early stage, while measures that are affected positively by other ones should in tendency be implemented as soon as the affecting measures are effective.

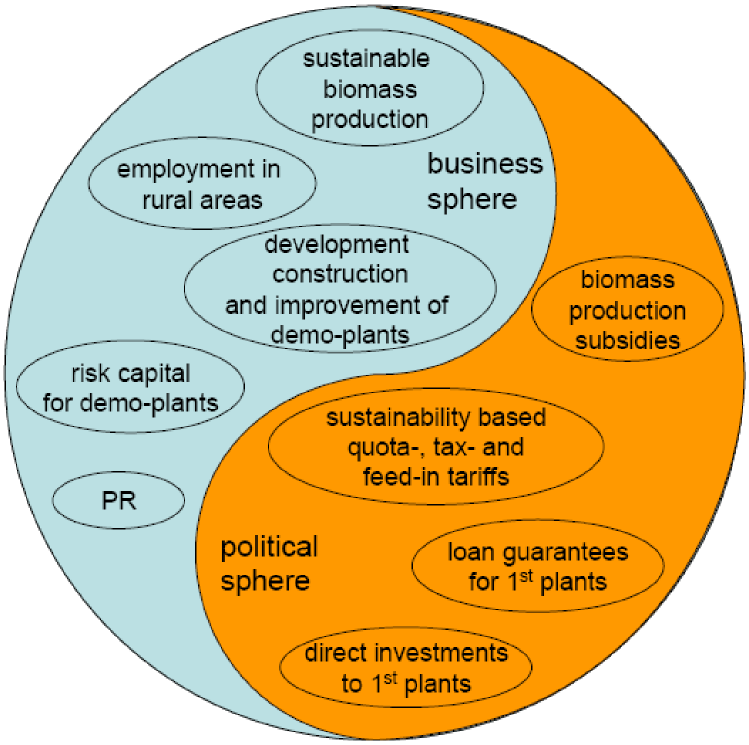

Figure 5: Dependencies between different measures to promote biofuel production and use

As Figure 5 shows that “the right” political measures would have a positive impact on potential measures of the industrial sphere, the process of market implementation of BtL fuels should be started with a strong “political impetus”!

General approach for market implementation

Summarising the status quo, the challenges and the options for synthetic biofuels, the general approach for market implementation should be argued as following:

(1) Synthetic biofuels are an interesting option for the transport sector due to the potential for high fuel quality, high reduction potential of GHG emissions and high yields/hectare.
(2) The provision of synthetic biofuels is linked with technical uncertainties and for the first plants high costs in comparison to both fossil fuels and so called first generation biofuels (biodiesel, bioethanol).
(3) If an overall environmental advantage (LCA) is ensured (and can be specified), adapted support schemes for synthetic biofuels should be designed. It can be expected, that the production increases very fast, if new players enter the market. Therefore the financial risks need to be reduced as much as possible. This demands support schemes as reliable and long-term stable as possible: Only such a long-time reliability can initiate private investments as very high amounts of money have to be tied up for a rather long time. Therefore support schemes should include clear targets and benchmarks, e. g. for expected costs, fuel qualities and environmental effects as well.
(4) Even knowing that the specific support of synthetic biofuels needs to be embedded into an overall bioenergy strategy and harmonised with support schemes for bio-heat, bio-electricity and biomass for material utilisation as well, it should be clear that biomass is the only available renewable energy carrier for the transport sector while both power and heat may be provided by various RES as solar, wind, geothermal,…

Development of a road map

By 2020 Europe may host up to 50 large scale BTL facilities supplying about 2 % of the expected fuel demand. Figure 6 gives a possible forecast of the technically possible development of BtL production capacities in the EU 25 until 2020 (against the background of necessary measures to be taken). To realise the presented development preconditions have to be fulfilled and the appropriate measures have to be initiated:

- Long term stable product off-take conditions to be supported by the public
- Developing a common understand, how much synthetic biofuels can contribute in the middle and long term, e. g. by the definition of realistic achievable targets, in the context of the ongoing discussion of the biofuel directive, in 2008.
- Support of the development of sustainability criteria for the production of biomass and biofuels, as they have been started under the biofuel directive and in certain countries.

This is not a specific issue for synthetic biofuels but has to be linked from the beginning on, this means 2007/2008.

- Harmonisation of national and EU bioenergy policy (targets and support schemes for heat, electricity and fuels) to embed the market implementation of synthetic biofuels into an overall bioenergy strategy.
- Elaboration/calculation of a suitable sustainability based support scheme for synthetic biofuels by a consortium of stakeholders (e. g. mineral oil, biofuel industry, politics, car industry, NGOs) to evaluate the overall economic affects (what money must be spent, what is the effect to the society / national economy) in order to be able to decide for the least costly measure, in 2008
- From a technical point of view at least three large scale industrial production of synthetic biofuels could be in operation by 2015 starting with the first in 2011/2012. This seems to be realistic if the appropriate R&D efforts will be continued in the years to come and if loan guarantees will be established for the first 3 large scale plants (≥ 500MW), i. e. loan guarantees must be ensured in 2008. Set up of an investment incentive budget, which means e.g. funds for large loan guaranties and direct investment subsidies.
- To ensure the availability of appropriate amounts of feedstock in 2012, appropriate energy plant systems like e.g. short rotation wood plantations must be planted in 2009, as the growth of the plants until harvesting needs three to five years. Hence incentives for the cultivation of short rotation coppices would have to be installed in 2008!
- To enable a large scale industrial production of synthetic biofuels specifications of the appropriate fuels should be available in the form of European Norms (EN) about one year in advance, i. e. in 2010.

After the start of the large scale industrial production of synthetic biofuels, the R&D efforts have to be continued, e. g. to improve the facility standards to achieve a further decrease of cost. This includes ongoing R&D support of demonstration plants within FP7 or national based programmes in 2008.

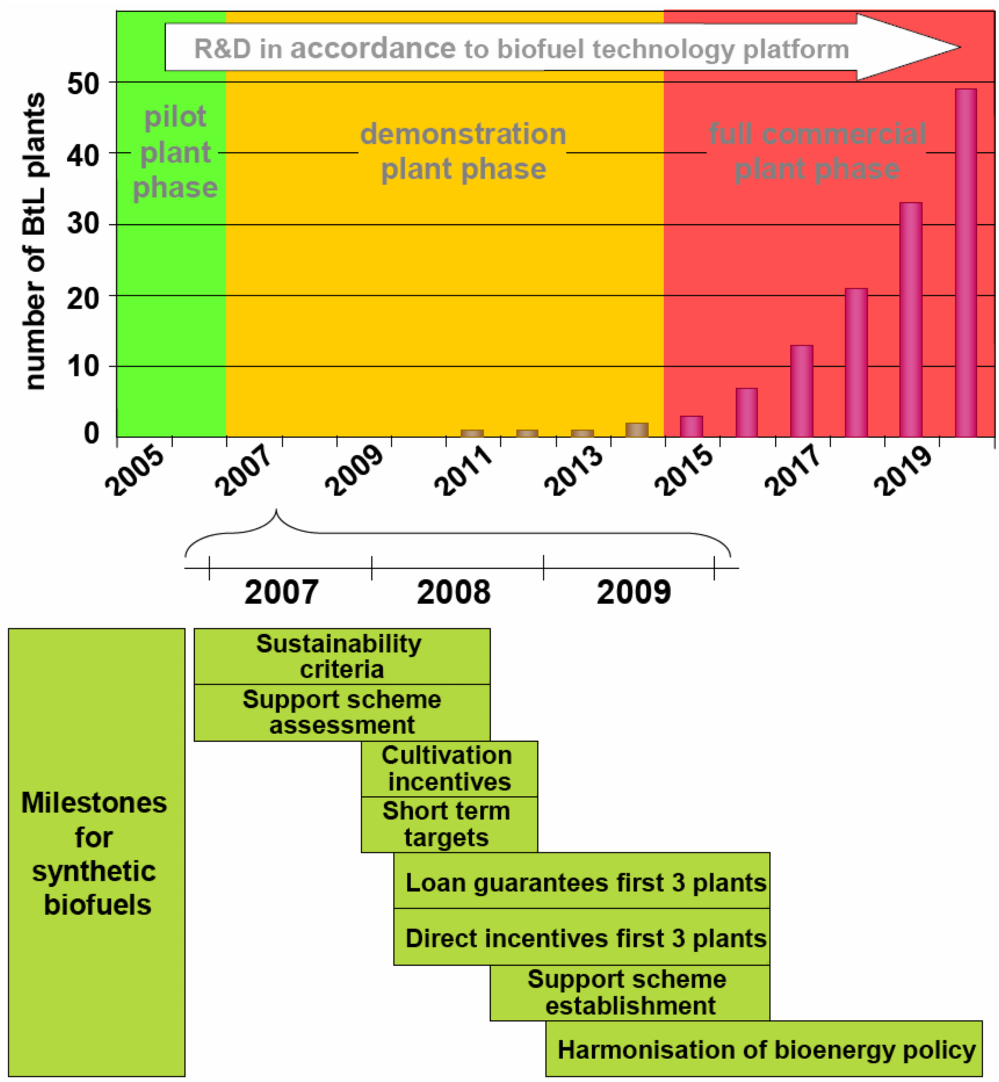

Figure 6: Chronological order of some measures as part of a market implementation road map /12/

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