1. Defining a sustainability system

The objective is to define sustainability criteria that Member States can effectively implement along with national biofuel targets. Member States should be required to report on sustainability criteria together with biofuel production and use.

In general a sustainable biofuel production and use system includes the following elements:

1. Considerable greenhouse gas savings (GHG) compared to the use of fossil fuels (see 1.1);
2. The use of environmentally sound forestry and agricultural management systems for biofuel feedstock production (see 1.2);
3. Non-obstructiveness to the preservation of landscapes with significant value for biodiversity, nature conservation, and cultural heritage (see 1.3);
4. Safeguard of concerns for impacts of social exclusion (see 1.4);
5. Integration with food, feed and various materials production in a way that reflects societal aspirations and priorities in relation to national/regional supply and demand for energy services, food and material products – considering also the economic, security and environmental implications of this supply/demand pattern.

All five elements apply equally to domestically produced as well as imported biofuels and biofuel feedstocks. The following criteria aim at measuring and monitoring compliance with the above stated sustainability goals.

1.1 Greenhouse gas (GHG) savings

Criterion 1.1 – Achieve a minimum level of GHG savings compared to fossil fuel use

1.1.1 The proposed procedure

The procedure proposed in the consultation document implies a two-step process for *defining* whether specific biofuels fulfil the requirements of the legislation or not:

- set a minimum amount of greenhouse gas savings
- define "default values" for net greenhouse gas savings from different types of biofuels

This would lead to a default sorting of available biofuels into two categories:

- biofuels that count towards national biofuel targets and are eligible for tax reductions and similar types of financial support
- biofuels that would not count towards targets and would not get financial support.

It is stated in the consultation document that: "biofuel producers could choose to use these default values, or to provide more precise information on the savings from their particular production process". This opens for a possibility for producers of (by default) non-eligible biofuels to prove that their particular production process generates a biofuel that fulfils the requirements of the legislation and is therefore eligible for financial support.

1.1.2 Draw-backs of the stop-go nature of the proposed procedure

Because biofuel will either meet the minimum amount of GHG saving or not, the proposed procedure has a strong stop-go nature. This has two essential drawbacks:

- The setting of default values and/or minimum level of GHG savings may become subject to intensive debate and strong lobbying: it may be politically very difficult to establish the procedure if the Commission is "too ambitious" in the eyes of strong lobbies and

representatives of nations with large investments in biofuels with rather low GHG savings. There is a risk that the threshold level will have to be set rather low, and default values of biofuels rather optimistic, in order for the system to be widely accepted.
- Setting one threshold level does not have a strongly motivating effect on innovation and GHG performance improvement. Biofuel chains that meet the basic criterion do not need to improve; only biofuel chains that can meet the criterion with some innovation will try to do so, but they will probably not reach an excellent GHG performance.

The latter drawback could be overcome by updating e.g. the GHG standard over time. This leads to the investment insecurities: it will be risky to invest in a chain which GHG performance is close to the threshold to, since an update of this ‘moving target’ may lead to the project not being eligible any more to any biofuel incentive. On the other hand, this could also be considered a positive effect, since biofuel chains with a GHG performance close to the threshold would become less attractive than ones with a performance clearly better than the threshold.

1.1.3 A possible alternative

The Commission may consider an alternative approach to differentiated support of biofuels that:
- is less politically difficult to use as a lever for improving the average performance of eligible biofuels over time
- reduces the risk of creating a too strong discouragement of investment in “good enough” biofuels.

One possible way forward could be to keep the procedure suggested by the Commission, but instead of the sorting of biofuels into eligible/non-eligible, the Commission could use a performance based support system where the financial support that different biofuels receive depends on the GHG saving they achieve. Such a support system could of course also include a minimum level which could be set rather low (for political reasons) without adversely degrading the functionality of the system.

Such as performance based support system could use as basis the (default from e.g., Concawe or reported) GHG savings of the eligible biofuels. To illustrate this in a system with financial incentives for biofuels (not an obligation system):
- full financial support for the best performing 25% of the eligible biofuel chains,
- 75% of full financial support for the biofuels performing above the average of eligible biofuels but below the top 25% of eligible biofuel chains,
- 50% of full financial support for those performing below average but better than the lowest performing 25% chains, and
- 25% of full support for the lowest performing 25% of eligible biofuel chains.

The system could also be directly based GHG savings, e.g. defining the first category with full support being biofuels with a GHG emission reduction of 75% and more compared to their fossil reference.

In such a system, standards could still be made stricter over time, e.g. by deleting the lowest category after a number of years.

1.1.4 On the minimum level of GHG savings

If the procedure is to be introduced as proposed, the minimum level should be updated to account for best practice and state-of-the-art technologies and should be increased over time.

(The 10% minimum level mentioned in the consultation document seems to be rather low in the light of GHG savings being one of the key drivers for biofuels).

The climate change debate and associated requirements for GHG savings are key driving forces for replacing fossil fuels with biofuels. Higher minimum levels of GHG saving will lead to better acceptance by the general public of policies promoting biofuels. Also, higher minimum levels of required GHG savings will render 2nd generation biofuels more competitive and will favour agricultural management systems with reduced agricultural inputs.

It is vital that all relevant greenhouse gases are included in the evaluation, and is based on specific information about the feedstock and processes used for production of the biofuel at hand. This may prove difficult, particularly as long as only limited practical tools are available for biofuels producers to estimate the GHG emissions involved in the full chain production[1]. In this respect the CONCAWE “well-to-wheel” study is a good starting point for estimating default GHG emissions savings. However, in the future new evidence may emerge and GHG savings for certain production lines would have to be updated accordingly. For example the role of N_2O emissions produced during agricultural production (via fertilizer application) is debated (e.g. for rapeseed, currently the most widely grown biofuel crop in Europe). These considerations are important not only for guiding domestic EU feedstock production but should be applied as well when evaluating and regulating biofuels and biofuel feedstock imports.

When providing default values to be used when specific chain information is not (yet) available, it is however vital that the defined default values offer an incentive to producers to estimate the specific (or real) GHG emissions related to their products, in stead of choosing the default values. If, for example, the default value is set equal to the *average* values from the ranges given in the Concawe W-t-W study, only those biofuels producers emitting less-than-average GHGs will gain by making specific estimations. We therefore recommend that default values are selected carefully, and rather conservatively, so that they represent e.g. the 20% most GHG emitting technologies, farming conditions, etc. In this case most producers will have an incentive to prepare better, more qualified GHG emission estimates than just default values in order to meet the sustainability threshold on GHG. This will have two key benefits:

- The public database on GHG emissions of biofuel chains will gradually be enlarged
- Producers will obtain more detailed information on their specific production chain, clarifying the production steps in which they could best realise improvements in the GHG balance

1.1.5 Land use efficiency needs to be considered

The environmental sustainability criteria listed by the Commission includes GHG savings and two concerns related to land use change: carbon stock reductions and biodiversity losses.

But the Commission does not suggest any type of measures to stimulate land use efficiency as one strategy in relation to the concerns related to land use change. There is a risk that the focus on GHG savings as performance metric leads to that low yielding (per hectare) biofuel options that generate high GHG savings per unit biofuel become too much favoured, at least in the beginning of a biofuel expansion period in Europe (until increasing land use competition drives up land prices). Often, GHG savings and land use efficiency go parallel, but this is not always the case. Biodiesel from rape seed is one example of a biofuel option that can have a

[1] With respect to N_2O emissions, it should be noted that field measurements are at present expensive and difficult to obtain. This can be a problem for biofuel producers that want to provide more precise information on the N_2O emission in order to claim eligibility for their biofuel option. Thus, there is a need for less expensive measurement methods or improved indirect methods to estimate the N_2O emissions with higher precision.

reasonable GHG saving per GJ of biofuel but that does not produce high volumes of biofuel per hectare.

Aiming for high land use efficiency is motivated not only in relation to concerns about carbon stock reductions and biodiversity losses due to land use change. To the extent that higher land use efficiency leaves room for biomass production for heat and electricity generation, it is also motivated in relation to the cost effectiveness of GHG reduction in the heat and power sector.

It is therefore recommendable to include land use efficiency as an additional metric in its monitoring and evaluation of progress in relation to the new Energy Policy for Europe. This, however, should not lead to a one-dimensional incentive for productivity increases. The art will be to combine (relatively) high yields with environmentally sound management systems including low energy inputs. It may for example be favourable to have a bit lower output per hectare but at the same time a limited pesticide and fertilizer use: from a sustainability point of view the highest yielding options may not always be the optimal ones.

Criterion 1.2 –GHG emissions from induced land use change should not seriously impair the GHG savings of biofuels production and use

The exploitation of biomass for the purpose of biofuel production can have positive, negative or neutral effects on biospheric carbon stocks. For example, while the effect would be negative for biomass energy obtained from felling of natural forests, it is likely to be positive for short rotation forests established on previously non-forested land. In some cases, the increased production of biofuel feedstocks will simultaneously enhance carbon sinks (for example, the establishment of biomass crops on carbon-depleted lands), and in other cases it may lead to lower carbon stocks.

The Commission proposes that the directive specifies distinct land uses /land types, associated with high carbon stocks, from which feedstocks cannot be taken by biofuel producers that want to fulfil the requirements of the directive. This would likely exclude biofuel feedstock production on certain land use types such as wetlands.

The critical issue will be the specification/quantification of “major reduction of carbon stock”, which will guide the selection of “allowed” land use change. This task may also require that the Commission specifies allowed land use change for each specific feedstock production systems. For example, the utilization of former pasture land might be an option only for reforestation or cultivation of herbaceous biofuel crops (e.g. miscanthus, switch grass, etc.) under zero-tillage systems. In this way no ploughing is required and there is no or negligible soil carbon release.

The question of what should be regarded a too high reduction in carbon stocks will have to be specified in relation to the GHG savings of each specific biofuel option – in the absence of the carbon stock change consideration. A given level of carbon stock reductions[2] might be acceptable when connected to certain biofuel options with a very positive score on criterion 1.1. The critical issue is to make sure that GHG emissions from induced land use change do not seriously impair the GHG savings of biofuels production and use.

Depending on the specification/quantification of “major reduction of carbon stocks…” it may also exclude intensified silviculture if the average rotation period in forests is shortened so much that the standing stock reduction becomes “major”.

The Commission may also consider the possibility to allow certain biofuel options be credited for carbon stock increases due to induced land use change. This can for example happen if short rotation coppice crops such as willow are established on arable land that has been used for the production of annual crops such as cereals for many years.

If the Commission chooses the approach proposed, this criterion can be implemented through appropriate land use monitoring schemes for domestically produced feedstocks. In the case of imported biofuels a certification scheme could aim at achieving and enforcing this criterion.

An alternative approach would be to include carbon stock changes in the calculation of GHG savings of a particular biofuel option. Then eligibility would be determined by qualification for an overall threshold level – “minimum amount of greenhouse gas savings”. However, experience on land use, land use changes and forestry (LULUCF) issues in the context of the Kyoto protocol suggest that GHG impacts of land use change are still complex and relatively hard to monitor. The required translation of e.g. a net gain in soil carbon stocks into a GHG impact per GJ biofuel will raise additional complications, which plead for separate treatment of land use issues versus GHG emissions in the biofuel chain.

[2] Given that it does not lead to substantial soil productivity reductions

1.2 Environmentally sound agricultural and forestry management systems

Criterion 2.1 – Apply cross compliance rules to biofuel feedstock production

As for *agricultural commodities*, cross compliance is an essential part of the reformed Common Agricultural Policy (CAP). Through cross compliance, it is ensured that in order to receive support, farmers must fulfil certain rules and standards. These relate to the environment, public, animal and plant health, animal welfare and the maintenance of the land in good agricultural and environmental condition. This has the dual aim of making agriculture more sustainable and making the CAP more compatible with the expectations of consumers and taxpayers.

CAP cross-compliance rules are thus designed to ensure environmentally sound agricultural management methods. They should be reviewed and possibly extended in view of potential increased biofuel feedstock production.

Large scale production of biofuel feedstocks will likely intensify discussions on GMO plant use and possible conflicts should be anticipated now.

For imported biofuels and biofuel feedstocks adequate agricultural management standards would have to be achieved through a certification scheme.

As for *forestry products and residues*, policy instrument that can be applied to biofuel feedstock production are less well-developed as for agriculture. Nevertheless, with biofuels creating an extra demand for forestry products and residues, there is a stronger urge for a further development of such policy. This need, as recognised in the EU Biofuels Strategy and Forest Action Plan, should also pay attention to sustainability of forestry.

1.3 Preservation of landscapes with special value

Criterion 3.1 – Respect existing designated areas

In Europe an extensive system of designated areas exists. In particular those in the NATURA 2000 framework should be safeguarded. Member countries must ensure that biofuel production has no negative effects on designated areas, neither due to plantations being introduced within the NATURA 2000 areas, nor due to regional impacts such as fertiliser leakage or groundwater depletion.

Criterion 3.2 – Avoid major biodiversity loss from land use change

This criterion mostly correlates with Criterion 1.2. In essence certain land use changes should be prevented.

1.4 Safeguard concerns for social impacts and limit market distortions

As with other agricultural commodities a profitable biofuel market may trigger intensified agricultural production systems favouring large scale farms. Small land owners may not be able to compete with large scale producers and land prices may rise due to competing demands. In certain areas this could lead to increased social imbalances or degradation of social infrastructure. A primary concern relative to the ongoing development of the biofuel sector is the potential impact on food security due to competing demands for productive land. Avoiding detrimental effects on food security caused by higher biofuel production is of importance for public acceptance of biofuels.

In particular for imported biofuels effects on food security are to be considered and receive support from targeted research.

1.5 Integration with food, feed and various materials production

Ideally, any biofuels policy would be integrated with food, feed and various materials production in a way that reflects societal aspirations and priorities in relation to national/regional supply and demand for energy services, food and material products – considering also the economic, security and environmental implications of this supply/demand pattern. This, however, introduces new complexities into any biofuels incentive, and would require e.g.:

- Specific criteria for the maximum allowed increase in food, feed prices induced by biofuels
- Specific criteria for the impact prices related to lignocellulosic feedstock, used in a wide variety of sectors ranging from pulp and paper to construction materials.
- A further analysis of impacts of different chains in terms of economics, security of supply, and environmental issues.
- Extensive monitoring in order to gather data to base these criteria on

The setting of such criteria would also enhance innovative feedstock production for biofuels, e.g. from ‘new’ types of feedstock or from waste materials.

However, at the moment it seems rather impossible to translate this point into a set of well-defined criteria including threshold values. While it does not seem feasible to elaborate this issue in a comparable way to the other points, it should be a point of attention in further elaboration of any biofuels policy.

2. Monitoring effects on land use and land use change

Land use change issues here are subsumed under Topic 1 (sustainability criteria). We recommend a comprehensive monitoring scheme on land use changes including statistical data (EUROSTAT) and georeferenced land use data (e.g. CORINE). Agricultural statistics should distinguish between crops for bioenergy and crops for food and feed.

Outside of the EU, increased biofuel feedstock production may trigger food and feed production being pushed into using forest or grassland due to limited land availability. Even certification schemes may not prevent such indirect effects on land use change due to competing demand for land. In consequence there is an increased need for monitoring land use changes such as deforestation. Potential detrimental environmental effects could then ex-post entail changes in biofuel policies.

The proposed “possible way forward” in the Consultation document, namely to quantify additionality of land use changes due to biofuel production, seems inapplicable and hardly feasible to implement for point 1 (how land use would have developed if biofuel use had remained constant) and point 3 (the estimated effect on overall land use of increasing biofuel use). Specific research would be required at assessing overall land use effects of increased biofuel use. Generally, it would be wise to learn from the experiences on this topic gained in the development of procedures and modalities linked to land use, land use changes and forestry (LULUCF) within the Kyoto protocol: especially on issues like additionality, choosing of a baseline, and assessment of leakage effects.

3. Encouragement of second-generation biofuels

3.1 Definition of second-generation biofuels

Especially when a specific incentive is to be created on a subgroup of biofuel options, this group needs to be clearly defined. Generally, the definition should be made functional to the way of target setting and the drivers behind this. Some remarks on the proposed definitions:

- Using definition (a) (based on the type of raw materials), production of methane by anaerobic digestion of grasses could also fall within the definition, since (hemi)cellulosic material is also (partly) converted in this process, but with a relatively low efficiency. In general, an additional prerequisite in terms of conversion efficiency might be useful in order to avoid lignocellulosic options with very low efficiencies.
- On the other hand, inclusion of specific technologies in the definition can provide a barrier for innovative new technologies, not included in the list. This could be overcome by a regular update of such a definition or list of technologies.

Generally, we feel that advanced biofuel technologies, to be supported by a specific incentive should have at least two merits:

- A good greenhouse gas performance in terms of CO_2 emissions per GJ of biofuel
- A good land efficiency performance in terms of GJ biofuel per ha.yr of land use for feedstock production.

In such a definition, which is by the way still difficult to make operational, some residual options such as biodiesel from waste oils and fats would also count as '2^{nd} generation'. If the purpose is to support only options with prospects for substantial contribution (which would have to be specified), this could be prevented by adding the criterion that the feedstock base for the option should be significant and not limited to a residual stream only.

But again, such a definition still requires an operationalisation of 'good greenhouse gas performance', 'good land use efficiency' and 'significant feedstock base'. For the short term, a simple definition on the basis of feedstock and/or technology might suffice, with the possibility to update the definition regularly, e.g. to include innovative chains based on polygeneration and biorefinery concepts.

3.2 The possible way forward

Given the (potential) merits of second-generation technologies, it seems to be well-defendable to introduce specific incentives for these technologies. The design of this incentive, however, will greatly depend on the value that policy attaches to the different drivers for biofuels, and each instrument will have its pros and cons. Here, we shortly review a number of options, and indicate the most important impacts that we foresee. Please note that, while we may need more text to explain some specific pros or cons of the different options, we have tried to be as neutral as possible in our description of them, and do not have a specific preference ourselves. We do evaluate the options in the light of the conclusions of the Spring Council, in which it was stated that "(…) the binding character of this [biofuels] target is appropriate subject to production being sustainable, second-generation biofuels becoming commercially available (…)"

Here, we go into the following options:

- Allowing 2nd generation biofuels to count extra to the biofuels obligation (as suggested in the consultation document)
- Allowing for a specific obligation for 2nd generation biofuels
- Allowing for a specific higher subsidy (or tax exemption) for 2nd generation biofuels (as suggested in the consultation document)
- Limiting a general biofuels incentive to fuels from domestically produced feedstock only, so that land scarcity becomes an issue earlier and 2nd generation biofuels are forced into the market
- Creating an incentive for all biofuels on the basis of their GHG performance

3.2.1 2nd generation biofuels counting extra to the obligation

Apart from the need for a clear definition of 2nd generation biofuels, this policy option is relatively easy to implement, which is an obvious advantage. Furthermore, it delivers a clear signal that 2nd generation are the preferred option for the mid-term, but at the same time it sets a limit on the maximum extra costs: if 2nd generation options remain too costly, 1st generation options will remain dominant.

There are, however, also some considerable drawbacks. It may be difficult to make a reliable estimate of the impact of a specific ‘objective contribution multiplier’ of 2nd generation biofuels. Which multiplier is necessary, for example, to make meeting the target with 2nd generation biofuels equally expensive as meeting it with 1st generation options? A complicating factor in this is that the picture is now also influenced by developments in the fossil fuel prices (for a short explanation see the Box on the next page): if the fossil fuel price changes, the relative attractiveness of 2nd and 1st generation options for meeting the target also changes and, counter-intuitively, an increasing fossil fuel price makes the option with 2nd generation biofuels less attractive.

This influence of fossil fuel price developments has another drawback. One of the advantages of a biofuels obligation versus e.g. tax exemptions is that a separate market is being created for biofuels, in which bio-based options have to compete among each other but are hardly influenced by fossil energy market dynamics, reducing this part of the financial risk for an investor in biofuels. However, with the multiplier incentive for 2nd generation biofuels, fossil prices do have an influence on the financial attractiveness of the option, thereby increasing the investors risk for an investor in both 1st and 2nd generation options.

While all options have their pros and cons, this indirect impact certainly seems to be one to take into account.

Box: Counting extra for 2nd generation biofuels: How the fossil fuel price gets into the picture.

Let's assume that a biofuels target of 10% of total fuel supply (in energy terms) is imposed on a fuel supplier, and this supplier can choose either to fulfil this target by (1) 10% 1st generation biofuels, or by (2) 5% 2nd generation biofuels. Which of the options will be most cost-effective?

In (1), his costs for this part of his fuel supply are simply the energy amount equal to 10% times the (average) price of 1st generation biofuel. In (2), his costs are twofold: the energy amount equal to 5% times the (average) price of 2nd generation biofuel, *plus* another amount equal to 5% times the fossil fuel costs (because he will have to cover the entire fuel demand after all). It may seem a paradox, but this means that an increasing fossil fuel price makes the option with 2nd generation biofuels less attractive, while a lower fossil fuel price makes the option more attractive.

With some simple mathematics, it can be derived that the price at which the 2nd generation option is more attractive when:

$$c^{b2} \leq x \cdot c^{b1} - (x-1) \cdot c^{f}$$

With:
c^{b2}: the cost of 2nd generation biofuels (in €/GJ)
c^{b1}: the cost of 1st generation biofuels (in €/GJ)
c^{f}: the cost of fossil fuels (in €/GJ)
x: the multiplier factor with which 2nd generation biofuels may be multiplied (x>1 in this case)

Or, at given costs for the three fuel options, the break-even multiplier factor x^{b-e} at which 1st and 2nd generation options are equivalent is:

$$x^{b-e} = \frac{(c^{b2} - c^{f})}{(c^{b1} - c^{f})}$$

It is important to see that the factor *x* does not say anything about the ratio between the costs of 1st versus 2nd generation options, but merely about the ration between the *cost gaps* of both options versus fossil fuels.

3.2.2 Allowing for a specific obligation for 2nd generation biofuels

In this measure, it is e.g. set that of the 10% biofuels target (or higher), 2% (or one fifth) should be met by 2nd generation biofuels. This option also has several pros and cons. A major pro is that a specific submarket is created for advanced biofuels, in which they only compete with each other: price developments in fossil and in 1st generation biofuel markets hardly affect the attractiveness for an investor. At the same time, this can also be the major drawback: if 2nd generation options remain extremely costly, a strict obligation still forces them into the market, thereby ignoring the precondition state in the Spring Council that biofuels should be 'commercially available'. This effect might be overcome by the introduction of a price cap: if the cost of 2nd generation options does not decrease towards a certain level (or is foreseen to do so shortly by then), the options are still not considered to be economically viable and the 2nd generation subtarget is not imposed onto the market, reducing the overall biofuels target from e.g. 10% to 8%.

Another drawback of this approach is that an obligation is being imposed on an early market, with small initial production flows, possibly rapid increases in production whenever a new (large-scale) facility comes on-stream, resulting price fluctuations. Policy then may be compelled to adapt their target setting. This market and policy volatility may result in considerable investment insecurities. Experiences in early biofuels and RES-E markets indicate that an obligation system may not be the most effective instrument in an early market, and that this instrument is more appropriate for more mature markets. Such negative impacts may be softened by the introduction of trading, banking and borrowing mechanisms.

3.2.3 Allowing for a higher subsidy (or tax exemption) for 2nd generation biofuels

The merits of this option are largely in accordance with the pros and cons of any policy instrument based on (feed-in) subsidies or tax exemptions. That is, investors risk due to competition among biofuels is greatly reduced, but in this case uncertainties due to variations in fossil fuel prices remain. Uncertainties on the final supply of 2nd generation biofuels that will be delivered (one of the drawbacks of an open-end subsidy scheme) could be overcome by introduction of a quota system such as currently operational for biofuels in France. Remaining issue is the risk of overcompensation: an optimal subsidy level depends on the costs of 2nd generation biofuel production and on developments in fossil fuel prices. As for the first factor, a government will inevitably face an information asymmetry compared with the industry; as for the second, the insecurity is quite inherent. Finally, an often-mentioned argument is that a constant subsidy over the years does not create an incentive towards further cost reduction. However, it is questionable whether this is the case, since cost reduction may also be seen as an autonomous process, driven by gain maximization. Furthermore, experiences in RES-E markets indicate that a cost reduction incentive may also be built into a regulation, e.g. by a gradual decrease in the subsidy amount.

Generally, it could be argued that subsidy schemes are a very effective instrument in early markets; when a market becomes more mature, budgetary risks may increase and an incentive to reduce costs may need to be created.

3.2.4 Limiting a biofuels incentive to fuels from domestically produced feedstock

In this option, the biofuels target is set as 'a minimum biofuels target of 10%, with biofuels and their feedstock produced within the EU region." The effect of such a target would be that land and feedstock availability becomes a limiting factor for 1st generation biofuels, forcing production into 2nd generation options with a broader feedstock base and a lower land demand compared with 1st generation options. Such a policy would also answer to the third driver of biofuels policy, i.e. sustainable development of rural areas by the production of energy feedstock.

However, there are also some fundamental drawbacks:

- Creating stress on feedstock markets for 1st generation options would lead, at least temporarily, to increasing and increasingly volatile commodity prices, including a variety of indirect effects (such as wheat import for food with domestic wheat being used for biofuels).
- Such a policy might be difficult to defend in a WTO procedure. An argument could be that one of the drivers for biofuels is security of energy supply, which is best served by domestic production, but it is questionable whether this argument would suffice.

3.2.5 Creating an incentive for all biofuels on the basis of their GHG performance

Most previous measures create an incentive that is specific to a certain type of technology (or feedstock use, depending on the definition). One could also argue for an incentive that generally rewards the better-performing biofuels. A logical criterion would then be the full-chain greenhouse gas (GHG) performance. This would then enhance the opportunities for the more GHG-efficient 2nd generation chains, but would also create an incentive for conventional biofuels to improve their GHG performance. Obviously, a side-effect would be an increased attractiveness of sugar cane-based ethanol from efficient production chains such as in Brazil. Very large-scale imports could halt the desired investment in second generation biofuels technologies in Europe and consequently stall the desired GHG balance and efficiency improvements (in GJ/ha.yr) of European produced biofuels.

In order for such a system to function properly, a significant amount of data is required, at least to set first-order standard GHG emissions for the most-know biofuel chains. This system could be gradually refined by allowing producers to prove, by own research, that their production chain performs better than the standard GHG profile, thereby increasing data availability.

3.3 Additional measures spurring 2nd generation options

In addition to these market-based instruments, several other policies could be thought of:

- An active information dissemination system (on biofuel GHG issues; state of the art technologies; best practices)
- Specific subsidy/incentive schemes and research to foster technological learning
- Measures to build confidence in a 2nd generation biofuel feedstock future

The lignocellulosic supply systems are central components of 2nd generation biofuel options and need to be developed in parallel with the development of the conversion systems. Forest biomass can be important in some forest rich countries, notably those with an established forest industry such as Sweden and Finland. But lignocellulosic crops from agriculture have the prospects to become the most important feedstock in Europe. However, these crops are not much cultivated today, and one measure for spurring 2nd generation options is the mobilization of EU farmers to produce lignocellulosic crops. This is a major challenge, since these crops are new to farmers and there are many rational reasons for farmers to be reluctant to trying new crops with the uncertainties and risks that this implies, considering for example:

- Risks of frosts, pests and diseases.
- Unclear long term yield performance.
- The energy sector is a new market for the farmers and they would also need to interact with actors (e.g., companies selling seeds and machinery) on a yet immature market for goods and services related to lignocellulosic crops.
- Crops are in infant development stage: future clones expected to be much better than the presently available ones.
- There may be a need for investments in new specialty machinery and – equally or even more important – farmers need to make use of already made investments into machinery and other capital for the production of conventional crops.

The experience in Sweden, where willow production for energy has been in practice for more than 15 years, indicates that it is difficult to convince farmers to switch to the new lignocellulosic crops only by showing that such practice leads to reasonable profits. Promoting lignocellulosic crops by introducing very high (area based) incentives can be problematic, since too high subsidies induce unwanted responses such as when farmers plant the crops (often on low-productivity land) in order to receive planting grants but afterwards do not manage the plantations for reaching high yields.

The eventual expansion of conversion plants producing 2nd generation biofuels at competitive costs should not be awaited as drivers of lignocellulosic crop production. Instead, there is a need to identify and develop more near term markets for lignocellulosic feedstocks. Cost-effective ways to initiate markets for lignocellulosic biomass in the EU, which can stimulate the establishment and development of a supply infrastructure leading to cost reductions along the biomass supply chain, need to be found. In some countries, the implementation of biomass co-firing can serve as an important initial market for lignocellulosic biomass. In other countries, biomass use in district heating systems may be the best early option.

However, a farmer's decision to switch to lignocellulosic crops is not only about approaching something new, but also about leaving the present situation. Therefore, farmers' view on the prospects for continuing their present practice – which is cultivating conventional crops – is an important aspect to consider for policy makers that want to stimulate lignocellulosic crop production.

The present response to the EU biofuels directive – expanded production of 1st generation biofuels – may make the directive counterproductive with respect to the goal of promoting lignocellulosic crop production. This since the expanding numbers of 1st generation biofuel plants in the EU represents a new market for farmers and therefore they see good prospects for those conventional crops that are feedstocks for the production of 1st generation biofuels (cereals, oil crops, sugar beet): the biofuels directive reduces farmers' interest in switching to new lignocellulosic crops.

From this agricultural perspective, removing barriers against competitive exporting nations such as Brazil may improve the prospects for 2nd generation biofuels by making farmers less reluctant to switching to lignocellulosic crops due to good prospects for producing the traditional crops as feedstocks for 1st generation biofuels production. The issue of balancing biofuel import and domestic production also needs to reflect that entrepreneurs contemplating investing in biofuel plants should be able to view the prospects for their alternative investment strategies in relation to a situation that is expected to become prevailing over the time horizon of their investment. This also applies to farmers in relation to their investments in machinery and other capital for the planned crop cultivation. Unless it is the intention to maintain over a long time period a protected position in EU for domestically produced biofuels for transport, barriers against importable alternatives that are presently more competitive seem questionable.

At the same time, from the perspective of investment in 2nd generation technology, massive imports could halt the desired investments in second generation biofuels technologies in Europe and consequently stall the desired GHG balance and efficiency improvements (in GJ/ha.yr) of European produced biofuels. Thus, if the international market price for cheaply produced tropical biofuels stabilize at levels below the production cost for European 2nd generation biofuels, support policies may be needed ensuring that the domestic producers of 2nd generation biofuels can see good prospects for making profits from selling their products on the European market.

4. Further actions for reaching the 10% target in 2020

4.1 Measures for the introduction of 10% (by volume) biodiesel blends

Conventional biodiesel is applicable in low blends, but the environmental performance of diesel cars decline when the blend exceeds 5% because of the inhomogeneous nature of biodiesel. Particularly in cities higher blends could be problematic due to higher emissions of NO_x and fine particles. Higher biofuel blend in diesel could be achieved with biofuels based on hydrogenated vegetable oils and fats or BTL. Furthermore, biodiesel offer poor results in terms of energy yield per hectare of agricultural land used for energy crops, compared to other types of biofuels.

The recommendation of the REFUEL stakeholder workshop in Brussels (March 2007) was that "*biodiesel blends should not exceed 5% (B5) to allow for acceptable fuel performance. In the longer term, blends up to e.g. B50, could be reached with biofuels based on hydrogenated vegetable oils and fats or BTL. The latter two can be blended in without any significant end-use issues.*"
The legislation therefore should aim at performance standards, leaving the regulation as flexible as possible without jeopardizing the environmental performance requirements, and thus allowing for higher biodiesel blend if environmental performance requirements can be met.

4.2 Measures for higher blend of biodiesel and bioethanol, and for other biofuels

Since 10%-by-volume blends of conventional biodiesel and bioethanol will not suffice to meet an overall 10% biofuels target by energy, additional efforts are necessary. Different options are foreseeable, as summarized in the consultation document: ETBE, higher biodiesel and bioethanol blends, other biofuels requiring specific vehicle adaptations such as biomethane, DME, pure methanol, etc, or the introduction of FT-diesel or methanol in blends.

On one hand, one could argue that the success of biofuels will strongly depend on 2nd generation biofuels. Their supply could be absorbed by a combination of two:

- General introduction of high ethanol blends at common filling stations, combined with a strong penetration of flexible fuel vehicles (FFVs), of which the extra cost compared to conventional gasoline vehicles is relatively minor.
- Introduction of BTL in any diesel mix, with a fair possibility of fuel improvement and no essential blending problems.

On the other hand, the picture is still relatively unclear, and other fuels may become important in the long run as well. If this is to be facilitated, the possibility should be created to do local or regional projects with high blends and other fuels, e.g. in specific fleets. Since such projects would have an experimental character and should be fit to specific local conditions, this might best be given shape at national levels. For example:

- In April 2007 a commitment between the Austrian Ministry of Agriculture and Environment, a Bioethanol producer, fossil fuel producers/distributors and the car industries (Volvo, GM etc.) was signed to promote E85 all over Austria to reach the Austrian biofuels targets. This commitment should provide the infrastructure for E85 on the one hand and stimulate investments in FFV-fleets.
- In October 2006 a commitment between the Austrian Ministry of Agriculture and Environment, Biogas producers and natural gas distributors was signed to promote CNG with 20% biogas-content till 2010 all over Austria also to reach the Austrian biofuels targets.