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SCIENCE FOR A SUSTAINABLE DEVELOPMENT

BIOFUELS SUSTAINABLE END USE

"BIOSES"

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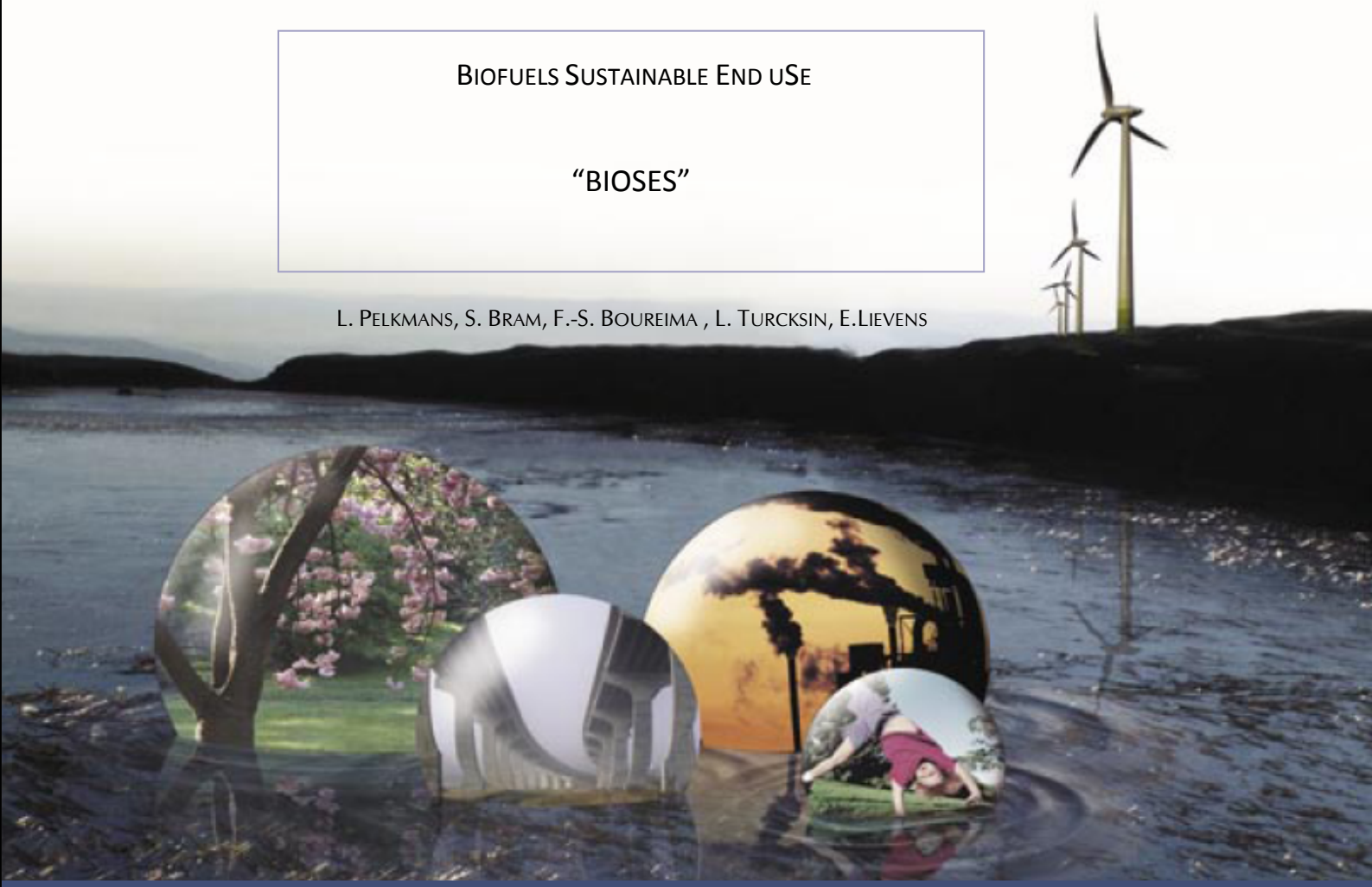

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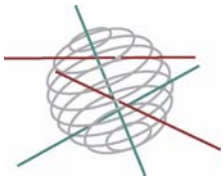

Energy

FINAL REPORT PHASE 1
SUMMARY

BIOFUELS SUSTAINABLE END USE

"BIOSES"

SD/EN/03A

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Biofuels are currently in the middle of the attention. The European Parliament has recently accepted a new European 'Renewable Energy Directive', which includes a binding target of 10% renewable fuels (mostly biofuels) in transport in 2020. Different scenarios are possible to reach this.
With biofuels now reaching a visible scale at the European level, discussions are emerging about the sustainability of biofuels compared to fossil fuels. They focus mostly on the origin of the feedstock and the greenhouse gas emissions associated to its production; however the effects due to the use of vehicles running on biofuels should also be considered. The use of biofuels in the transport sector should happen in a sustainable way that balances the main transport related challenges of greenhouse gas reduction, reducing oil dependency and improving air quality.

The BIOSES project analyses the impact of different market introduction scenarios of biofuels in the Belgian transport system, with the focus on the end user perspective (demand side). Time horizon for the analyses goes from short term (2010) over medium term (2020) up to long term (2030).
Based on up-to-date data (complemented with own measurements) of energy use, emissions and cost, the project looks into the practical feasibility and the ecological, socio-economic and macro-economic impact of the introduction of biofuels in Belgium. The project will use the results to create a roadmap for the introduction of biofuels in Belgium, with the emphasis on the demand side (end users), identifying technical and policy needs on short, medium and long term.

The project runs from begin 2007 till end 2010. This report shows the results of the first phase of the project (2007-2008), which focused on

- defining possible biofuel introduction scenarios, in consultation with stakeholders;
- gathering up-to-date data on energy use and emissions on well-to-wheel basis for different biofuels; this also includes own emission measurements on vehicles;
- gathering cost figures and estimations for future costs of different biofuels, from user perspective;
- feasibility and practical barriers for the introduction of biofuels, including first policy suggestions;
- preparing the necessary tools and methods for analysis on macro-level (system perturbation analysis, macro-economic analysis).

Scenarios

There are various strategies to introduce biofuels in transport. The most obvious choice is to blend a limited percentage of biodiesel, HVO or BTL to all diesel fuel and a certain share of ethanol (or derived ETBE) to all gasoline fuel. Future, current, and even older vehicles need to be compatible to these biofuel blends. The general blending of biofuels should be dealt with on European level, in cooperation with the fuel and vehicle sectors.
On the other hand there are number of advantages to introduce higher biofuel blends, and even pure biofuels. (1) using high blends is much more visible. The application can be supported through clear incentives on vehicle level (which is not possible for general blending). (2) Only high blends / pure biofuels can really provide an alternative to become independent from fossil fuels. (3) Certain high blend biofuels provide very low exhaust gas emissions, so these can be promoted for direct environmental reasons (air quality) in city traffic.

Based on the technological evolution in vehicle models, the likely biofuel blends on the European markets, and the possible interest of certain end user groups (e.g. public transport, agriculture, …), 10 scenarios were described. One was the business-as-usual scenario, basing assumptions on actual policy. Further we have two scenarios with increased general blending of biodiesel to diesel, ethanol to gasoline and on the longer term BTL to diesel. On top we defined 6 specific high blend scenarios, with a specific focus on certain high biofuel blends: E85; B30; B100, PPO, E95; bio-methane and a combined scenario of B30, E85 and bio-methane.

The scenarios show that increased general blending, supplemented with support for high biofuel blends in certain niche markets seems to be optimal to reach highest biofuel shares. With the amounts in each scenario quantified, these will be the basis for future impact analysis in the further work packages of the BIOSES project.

TTW and WTT emissions

When comparing the impact of different fuel options, we need to look into the combination of end use (TTW or tank-to-wheel), but also the production of the feedstock, the fuel conversion process and distribution (WTT or well-to-tank) need to be taken into account. In this part we will specifically analyse the impact on emissions and energy consumption, divided into WTT and TTW.

Concerning WTT emissions most data are based on the extensive Ecoinvent database. The assumptions such as the location, farming machines and treatment, transport distances and conversion technologies have been extracted from the Ecoinvent reports and used for new calculation and adaptation to the Belgian situation. A special attention has been paid to the allocation of emissions to the different co-products during the conversion phase. Indeed, the emissions in the Ecoinvent database were allocated to the co-products according to their unit price and their carbon content. We have re-allocated them according to the energy content of each co-product, as is also suggested in the proposed Renewable Energy Directive.
An extensive overview of WTT emissions has been produced per considered biofuel. This will be used in the future elaboration of overall EcoScore values and impact analyses.

We put specific focus on the impact of biofuel (blends) on vehicle emissions. There is quite a lot of data available for older vehicle models, but the effect on new engine systems, with high pressure direct injection in combination with various systems of emission control, is not always clear. Within BIOSES we started with a literature review on the effect of biofuel (blends) on tailpipe emissions. Based on these results, various new type vehicles were selected for tests on biodiesel blends (diesel vehicles), ethanol blends (gasoline vehicles and FFVs) and PPO fuel (converted diesel vehicles). The test programme is under way, and will be finalized in the course of 2009.

Socio-economic feasibility

With a focus on the practical implementation of biofuels in the market, we looked into aspects of costs and barriers for biofuel introduction. There are various barriers to overcome, in which policy can play a role:

(1) first is the economic barrier, as biofuels are still more expensive than fossil fuels,
(2) an important technical barrier is the (in)compatibility of existing car fleets to certain biofuel blends. Car manufacturers should anticipate future biofuel blends (e.g. E10, E85, B10, B30) in their current models and search for solutions to convert existing models to higher biofuel compatibility. The introduction of flexi-fuel models can be very important in this sense.
(3) distribution may also have compatibility problems with certain biofuel blends, so sometimes dedicated infrastructure is needed. The extra costs (e.g. for E85 pumps) are only worth making if there are clear market prospects of vehicles able to run on these fuels (chicken and egg problem).
(4) Related to the previous aspects is that biofuel blends are clearly standardized and checked for their quality. This creates confidence for vehicle manufacturers and end users.
(5) Currently the aspect of sustainability and ethics plays a crucial role in the acceptance of the market. In the past year, there has been large media attention and public debate about the potential risks of (large scale) biofuel production. There is a clear need for sustainability requirements for biofuels (and also other biomass use) to avoid these side effects. The proposed Renewable Energy Directive gives a first start to the implementation of sustainability requirements for biofuels.

(6) The lack of knowledge on biofuels for politicians, decision makers and the general public, particularly for higher blends or pure biofuels is an undeniable barrier
(7) The complexity of biofuels is an important aspect to take into account. Indeed, biofuels refer to environment, energy, agricultural, political, legal and fiscal aspects at the same time. It is very complicated to deal with these main sectors in order to satisfy all stakeholders on the implementation of biofuels.

Apart from direct costs and the impact of fuel tax, a study was initiated on vehicle life cycle costs. Life cycle cost are all the anticipated costs associated with a car throughout its life and include all the user expenses to own and use vehicles. The purchase of a biofuel car can become a rational economic decision if these cars provide lower or equal private consumer costs relative to other vehicle technologies. Private consumer costs consist of the vehicle financial costs, fuel operational costs and non fuel operational costs.
Various alternatives were taken into account (diesel, gasoline, LPG, hybrid, FFV). The results of the life cycle cost analysis will be produced in a report in 2009. It is already clear that there is a clear role of policies in overall costs through the fiscal system (vehicle and fuel taxes) and certain aspects like CO2 emissions or EcoScore could be used as a parameter.

Further steps:

From the elaboration of scenarios, the collection of accurate data on emission performance, energy demand and cost aspects, and the listing of barriers and first policy ideas, the BIOSES project will continue more on macro-level.

Some work on micro-level still needs completion, like completing the data sets for WTW emissions and energy use, some remaining vehicle tests to derive emission factors, and also cost estimations of future biofuels. The results will then feed into the macro impact of biofuels introduction scenarios. This includes a system analysis, macro-economic analysis via system dynamics modelling and quantifying the effect of scenarios on total emissions related to transport in Belgium.

There is also a specific task to assess the performance of different technologies: the objective is to analyse the energy and environmental impact of the different biofuel vehicles (biodiesel, bio-ethanol, biogas, etc.) and compare them with conventional and other alternative vehicle technologies on a well-to-wheel basis. Three indicators will be developed: Ecoscore, global warming and energy consumption.
This approach allows comparing vehicles with different fuels (petrol, diesel, liquefied petroleum gas, compressed natural gas, biofuels etc.) and/or different drive train technologies (internal combustion engines, hybrid electric drive trains, battery electric drive trains, fuel cell electric drive trains, etc.). Consequently the impact of every single vehicle can be calculated.

Phase 2 of the project will have a clear focus on policy recommendations and stakeholder feedback. A first step in this process will be the workshop of 4 June 2009, in which we will apply the MAMCA method to include stakeholder's positions in biofuel scenarios and policy choices. Step by step we will evolve to a biofuel roadmap for the Belgian situation, with all policy options, linked to scenarios and impact analysis. This roadmap will be disseminated to the policy level, various stakeholders with a focus on end-user, as well as the scientific community in Europe. This way we intend to have the largest possible impact of the outcomes of the project and have a clear impact on Belgian policy decisions on the matter