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RENEWABLES IN ROAD TRANSPORT – GEARING UP FOR MORE MARKET SHARE?

DECARBONISATION STILL IN THE DISTANT FUTURE, THOUGH TECHNOLOGIES ARE AVAILABLE

In the EU's energy mix, transport plays a special role. It claims more than 30 percent of final energy demand. At the same time, the sector, dominated by road transport, is one of the biggest sources of greenhouse gas (GHG) emissions. In a sector comparison with power and heat, the share of renewables in the transport sector is by far the lowest. Solutions are at hand, but have a hard time. Road-bound e-mobility attracts attention, but has yet to gain market share. Low fossil fuel prices hamper market expansion. At the same time, a phase out of crop based biofuels is discussed in the EU. Alleged risks of indirect land use change (ILUC) as well as the food versus fuel debate have left their mark. The lack of progress of renewables in road transport is even more poignant as a modal shift towards more rail transport is not on the horizon. This paper looks at the current state of play for renewables in the transport sector with a special focus on passenger transport on roads.

AT A GLANCE

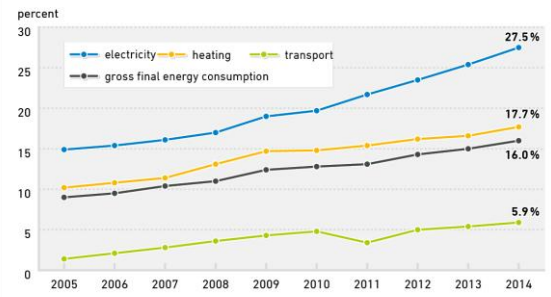
- At 5.9 percent, the share of renewables in the transport sector is by far the lowest in the EU (power: 27.5 percent, heat and cooling: 17.7 percent).
- While EU policy for decarbonising transport has so far rested on fuel economy and emission standards as well as targets for renewables, the latter look set to lose importance.
- According to European Commission scenarios, there is a sizable gap to reach the necessary GHG emission reduction in transport by 2030.

1 RENEWABLES IN THE EU TRANSPORT SECTOR – GOALS AND STATUS QUO

In the EU transport sector, renewables are lagging behind. With a share in energy consumption of just 5.9 percent in 2014, their performance in the transport sector has been lacklustre. By contrast, the power and heating sectors have seen a strong market expansion of renewables in recent years, with market shares reaching 27.5 and 17.7 percent respectively, according to Eurostat figures[1]. Due to the gains in the power and heating sectors, the EU is on track to reach a renewables share of 20 percent of EU gross energy consumption by 2020, as stipulated in the 2009 Renewable Energy Directive (RED) due to be revised from late 2016. The RED also sets a 10 percent renewables goal for the transport sector – just half the average to be reached overall. The sector therefore is an underachiever by law, in a way. Yet, given current growth rates, the EU as a whole is not on target to reach the 10 percent sectoral goal.

So far, this 10 percent objective has been part and parcel of EU climate and energy goals: Two years after the passage of the RED, the Commission set a 60 percent GHG emission reduction target in the transport sector to be reached by 2050 compared to 1990 levels[2]. The regulatory framework for decarbonising road transport in the EU thus rests on two pillars: Improving fuel economy and car performance by means of caps on carbon dioxide (CO_2) emissions on the one hand and expanding the use of renewables via a mandatory 10 percent goal on the other. In late 2016, it looks as if the latter goal will be all but abandoned, while emission standards will be further tightened and are planned to cover heavy duty vehicles too.

Development of the share of renewable energy in final energy consumption in the European Union



Source: Eurostat
as of 02/2016

In the overall strategy of the EU to achieve GHG emission reductions in the transport sector, the pivotal role of renewables is in danger of getting lost out of sight without binding targets for renewables. In 2014, the EU Council had agreed on a renewable energy target of 27 percent of final energy consumption in the EU as a whole to be attained by 2030 – binding national targets will no longer apply after 2020. In contrast to that approach, the EU Commission set individual Member States' targets in her proposal on GHG emission reductions in the non ETS sector published in July 2016. The aim is to attain an average EU emissions cut of 30 percent (on 2005 levels) in the non ETS sectors, to which transport, like agriculture, belongs[3]. In the non ETS area, transport has been off track to reach the GHG emission reduction targets now envisaged. For 2014, the European Environment Agency (EEA) recorded EU GHG emissions of 1,161 million tons CO_2 equivalent (eq.) from transport, a slight rise from 2013 figures and a steep 21 percent increase on the 1990 level. At the same time, this equaled an 8 percent decrease on 2005 figures, the relevant reference year for the 2030 aims[4]. If the Commission proposal is implemented in its current form, Member States will have huge leeway as to how to attain this GHG reduction goal. They will be no longer bound by EU targets on renewables for individual Member States.

Those bare EEA figures bear witness of the lack of progress on decarbonising transport. The potential to reduce the carbon footprint of the EU transport sector is huge, though. However, crop based biofuels as the most readily available alternative transport option with sizable market potential have been reigned in by new legislative measures. Doubts about their environmental performance have led to the introduction of a 7 percent cap on the contribution of crop based biofuels to the 10-percent-target. Their future beyond 2020 is uncertain. New developments such as biodiesel made from algae are not yet marketable. While biofuels have to grapple with a poor image, the advent of e-mobility is accompanied by huge expectations for clean passenger car travel, and also holds huge potential for light duty vehicles.

Source: Deutsche Post AG

Fields of clean mobility: Rapeseed in flower side by side an E-van from Deutsche Post.

The diesel emissions scandal has added impetus to the expectations connected with new powertrains that are slowly beginning to attract customers. While the efficiency of batteries and the low variable costs of e-mobility are a strong argument for switching from the internal combustion engine, the relatively high prices for electric vehicles (EVs) still put off potential customers, as are surrounding infrastructure and logistics issues such as establishing recharging networks. Amid the hype for EVs one should not forget that rail transport as a climate friendly e-transport alternative has been around for decades, but has to grapple with structural disadvantages such as tax issues in many countries. A modal shift in mobility patterns has not set in yet. Infrastructure figures are an indication: The EU's motorways system expanded to more than 74.000 km in 2014, an increase by 35 percent on the year 2000. Simultaneously, the EU's railway network has failed to grow and remains stuck at the turn of the millennium length of 221.000 km[5]. About 52 percent of all EU railway lines are electrified.

2 A GLOBAL PICTURE: RISING OIL DEMAND AND SMALL SHARES OF RENEWABLES

Globally, the transport sector is responsible for almost a quarter of all anthropogenic CO_2 emissions. By 2030, transport emissions are expected to increase by roughly two thirds to 15 billion tons (Gt) CO_2, according to the International Council on Clean Transportation[6].

The rapidly increasing attractiveness of individual road transport in emerging economies is one driver of this development. In 2013, already a quarter of all vehicles were sold in China, while the EU and the US claimed shares of 19 and 17 percent respectively. A "peak car" of plateauing demand for automobiles is not yet foreseeable. The International Energy Agency (IEA) expects that global demand for oil in the transport sector will rise to 56.9 million barrels per day by 2030, up by some 20 percent on current levels[7].

Efforts to save energy and to increase the share of renewables in road transport are urgently needed to curb emissions of the sector. The smaller the need for energy, the greater the share a given amount of renewable resources can contribute: Brazil has attained a share of some 20 percent of renewables in the transport sector (at a consumption level of some 11.5 m tons of oil eq.). By contrast, US biofuel consumption of 33.97 m tons contributed just 5 percent to the country's transport fuel needs in 2015.

3 WHY WE NEED RENEWABLES IN TRANSPORT

Road transport based on the internal combustion engine is energy intensive and brings with it high variable costs - although fossil fuel prices are currently quite low. EU legislation has reacted by tightening requirements on engine efficiency. By 2021, phased in from 2020, fuel consumption of manufacturers' new car fleets may not cause more than 95 grams of CO_2/km on average. This means a fuel consumption of around 4.1 l/100 km of petrol or 3.6 l/100 km of diesel, according to the European Commission. Weaknesses in the calculation of CO_2 emissions from cars are to be addressed in the EU by the introduction of the Worldwide harmonized Light vehicles Test Procedure (WLTP) that is to become mandatory from September 2018. Tightening efficiency standards is highly conducive to decarbonising transport. In order to achieve the EU climate and energy goals, raising efficiency standards however will not suffice. Tighter fuel economy standards for passenger cars do not address the continuous rise in traffic we have seen over the last few decades. Further increases, especially in freight volumes and in aviation traffic, have been forecast. The avoidance of traffic, a modal shift to other modes of transport and the adoption of renewables in transport therefore have to be reinforced.

Apart from being a climate friendly solution, renewables in transport strengthen the economic base in Europe. Due to the EU's fuel needs, energy import dependence has constantly increased this century. While the average dependency rate was 47 percent at the start of the millennium, it had risen to 53 percent in 2013. For petroleum and related products, energy imports now claim a share of 88 percent of consumption. The fiscal framework offers little if any incentives to further the use of renewables in the EU transport sector. The share of environmental taxes on transport as percentage of total taxation fell to 4.6 percent in 2014, down from 5.0 percent in 2010, according to EU Commission figures[8]. At the same time, reform of energy taxation, which the EU Commission had aimed at, has been shelved due to the reticence of Member States governments. Such a reform should have geared taxation towards using the energy content of fuels as the basis for taxation. The European Commission still reckons that, in the mid-term diesel taxes will go up significantly in Member States where those are relatively low, such as in Germany and the Netherlands[9].

4 A 2030 GAP ON LOW EMISSION MOBILITY

In July 2016, alongside the above mentioned non ETS proposal, the EU Commission published a Communication on a European Strategy for Low-Emission Mobility. That paper contains the announcement of pushing ahead with further proposals on the fuel efficiency of vehicles, such as post-2020 carbon dioxide standards for cars and vans. The Commission also advocates a gradual phase out of conventional biofuels which are to be replaced by "more advanced biofuels". In the run-up to a legislative package on renewable energy sources expected before the end of the year, the Commission Communication sets out policy options and makes assumptions on the future of certain technologies in the transport sector.

In the Staff Working Document accompanying the Communication, scenarios for the development of the transport sector and CO_2 emissions are sketched out. None of the scenarios attains a CO_2 reduction rate of 30 percent in 2030 – the target set for the Non ETS sectors in the Commission proposal. Under current trends and adopted policies only a 12 percent emissions reduction is forecast, the "central scenarios" achieve a 18-19 percent reduction, while others achieve more than 20 percent reduction. The Commission therefore concludes that "additional policies could be needed, especially post-2020, in order to close the gap" and provide "a cost-effective transport contribution to the 2030 Climate and Energy policy framework".

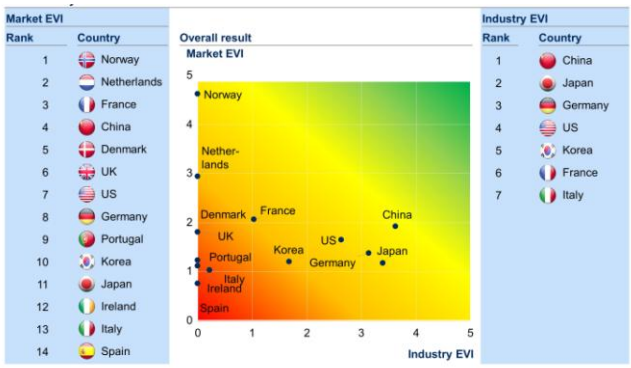
In the above mentioned scenarios, the progress in strong emissions reductions sets in only after 2030 - when electric mobility comes into full swing, according to forecasts. Correspondingly, the 60-percent GHG reduction target will be achieved by the middle of the century in all scenarios, except the Reference 2016 one. In the short to mid-term, there is a serious lack of progress although carbon friendly transport solutions are at hand. The scenario calculations point to the urgency of action on reducing GHG emissions from transport.

The International Renewable Energy Agency (IRENA) makes different assumptions to the ones chosen by the European Commission. While the Commission assumes consumption of biofuels will stagnate or fall, IRENA sees strong growth potential for sustainably produced biofuels. According to a recently published paper, global biofuels use would quadruple from today's level of 129 billion litres to around 500 billion litres (or about 12 Exajoule) in 2030[10]. The analysis shows that there is significant potential to increase the share of renewables in all modes, between three and ten times today's shares. IRENA assumes that the number of four-wheel EVs can reach up to 160 million by 2030 which would make up around 10 percent of the total vehicle stock. "This estimate is close to what industry leaders have pledged to reach – a share of 15 percent by 2030. However, recent vehicle growth shows little sign of even starting to approach this high number", the report says.

5 THE PROMISE OF E-MOBILITY

In order to expand the use of renewables and to overcome the dominance of fossil fuels, a range of options is available. Looking at new technologies for road transport, e-mobility is in its early adoption stage: Year on year, sales of purely electric cars in the EU more than doubled in 2015 to some 146,000 cars that were registered[11]. Yet, this equaled only a share of 1.1 percent of all newly registered cars. Taking range extend-

ers and plug-in hybrids into the equation, new registrations amounted to 363,000 vehicles. In Germany, the EU's biggest car market, the government passed generous subsidies in 2016 to kickstart sales of electric cars. Other countries that have strong incentives for EVs in place, such as Norway and the Netherlands, ponder regulatory action to ban new combustion engines from roads in the mid to long term. The development of the EV market is driven by incipient consumer demand, government action as well as technological developments. Especially in countries like Germany that have a strong car manufacturing base, the issue of how to generate value added if the industry bids farewell to the combustion engine is a major issue. The question of where batteries for EVs will be produced is closely linked to this issue. Despite setbacks, German car manufacturer think about the establishment of domestic EV battery production as worries persist about losing value added in the wake of an EV boom.



Source: McKinsey

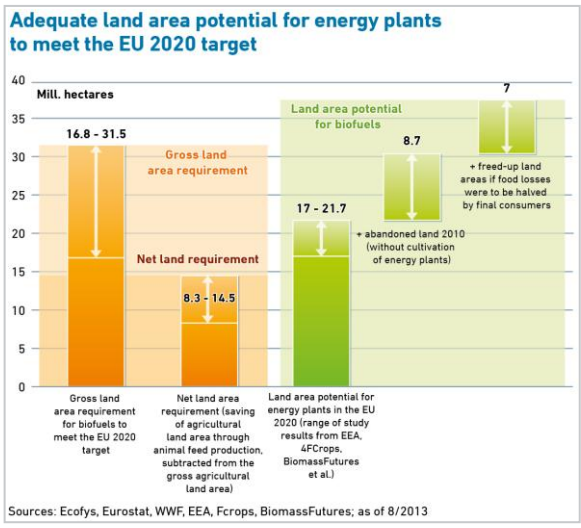
The growth of e-mobility is increasingly perceived as a race between established players such as traditional car manufacturers, on the one hand, and fast growing new companies, such as Tesla, as well as Asian countries like China on the other. In an "Electric Vehicle Index" published in July 2016 McKinsey came up with a country ranking of EV market uptake and industry developments[12]. According to that report, China has overtaken Japan as the world's leading manufacturer of EVs. Manufacturers and public authorities in China are working very systematically to make electric cars attractive for customers, according to McKinsey.

E-mobility offers solutions not just for the car industry, but also for two-wheelers. In the Netherlands, some 276,000 e-bikes were sold in 2015, according to a market analysis from BOVAG[13]. More than every fourth bicycle bought by the Dutch was electrically pedal-assisted. Pedelecs also offer great potential for freight services and, especially in urban areas, can be a viable alternative to cars. Freight capacity already reaches some 250 kg, while energy consumption of the pedelecs is as low as 0.5 l of fuel equivalent or 5 kWh for a distance of 100 km[14]. However, it should be kept in mind that the current EU power mix is still dominated by conventional energy technologies, depending on the national power mix of Member States. In the Netherlands, renewable electricity currently only claims a share of 10 percent in the power mix. E-mobility can only be a truly sustainable energy solution, when it draws on renewable power. Although EVs are quite efficient, the market expansion of E-mobility will also be a major task for renewable power generation. Assuming a power demand of some 20 kwh/100 km per EV and a yearly average mileage of 10,000 km, 100 million e-cars would have a demand of some 200 billion kilowatt hours. This roughly equals Germany's renewable power generation in 2015, which then contributed 30 percent to Germany's electricity mix.

6 THE UNTAPPED POTENTIAL OF BIOFUELS

Currently available biofuels either draw on the starch of plants to use their sugar for the production of ethanol or they use oil plants such as rapeseed for the production of vegetable oil that serves as the feedstock for biodiesel. Biomethane is another currently available option. For all those products, energy crops are an important raw material, while residues or co-products contribute by far the lesser part to current production. For the agriculture as well as for the energy sector, bioenergy has clearly gained importance, despite setbacks. Policy uncertainty has left its mark on the EU biofuel industry. Biofuel production took a dip and went slightly down in 2015 by 0.6 percent to 13.7 million tons of oil equivalent (m toe) in the Europe and Eurasia region, according to figures from BP[15]. Biofuel consumption in the EU declined by 1.7 percent to 14 m toe, EurObserv'ER says[16].

Although a sizeable share of EU biofuel demand is met by imports, the 10 percent renewables goal which the EU has set itself, could comfortably be met by using home grown grains and oilseeds. The land use requirement for reaching the 10 percent aim is estimated at circa 17.5 million (m) hectares (c. 10 percent of EU agricultural area)[17]. While scenarios for available EU bioenergy area hugely differ, several studies have



confirmed that the land area to cover those needs would be available. Besides, other renewable solutions such as e-mobility or biofuels from waste are to contribute to the 10 percent goal, too.

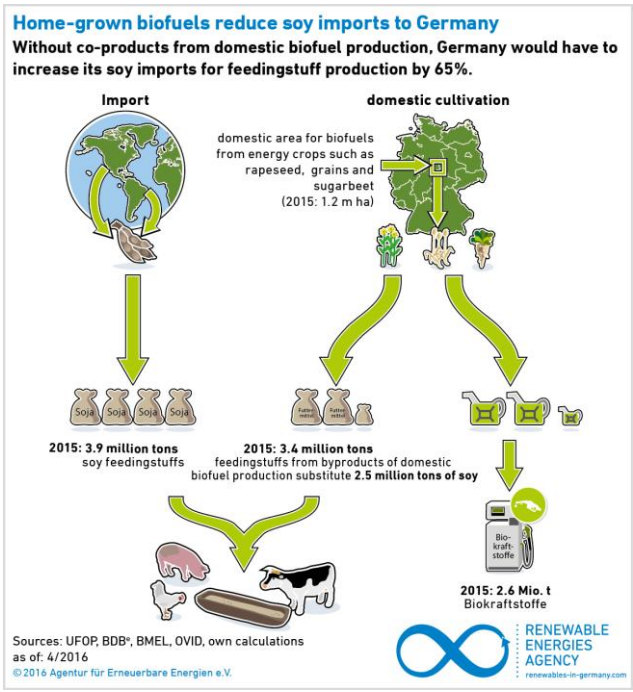
In terms of land availability for bioenergy, trends in agricultural yields and demographic changes play a crucial role as well as overarching economic developments. Depending on the given assumptions, results of model calculations on available land area differ widely. While some studies negate long term additional potential for energy crop cultivation, others are optimistic, even when taking into account conservation concerns. For example, a 2012 study from Hohenheim University in one scenario assumes that more than 31 m hectares will be available for energy crop cultivation in the EU in the long term[18].

Nowadays, biodiesel has gained centre stage in the public perception surrounding the ILUC debate (see chapter 10). However, when rapeseed is used as a raw material, biodiesel only claims some 40 percent of the seed. The remainder is used as a valuable feedingstuff. Those co-products help lessening the demand for agricultural land dedicated to food and feed production. Canola meal from plant oil extraction as well as Dried Distillers Grains (DDGS) from the destillation of starchy biomass are both important feedingstuffs. Hence, energy crops do not only deliver electricity, heat and fuels, but also supply fertilisers or feedingstuffs. For example, Germany imports more than 5 m tons of soybean products for the feed industry every year. The biofuel industry lessens those import requirements considerably. Because of the co-products from oil mills, above all canola meal from the extraction process, German farmers have an additional 2.5 m tons of feedingstuffs at their disposal.

7 FOOD AND FUEL – CONFLICTING OR COMPLEMENTARY?

Agricultural commodity supplies are ample. More than enough food calories are produced to feed the world. However, surplus production of food still fails to reach the world's needy. There is widespread consensus that it is not a shortage of basic food that lies at the root of hunger, but social factors such as an unfair distribution of a nation's wealth, conflicts and wars and poor governance.

Globally, harvests of the most important staple crops such as rice and wheat have been big in recent years. In 2016, another good harvest is expected. Consequently, prices for important food crops have come down markedly. At the same time, global biofuel production (in contrast to the development in the European Union) has increased and, from 2006 to 2015, almost tripled to 74.8 m tons oil eq.[19].



Despite strong increases in global biofuel production volume, the share of grains that goes into biofuel use has steadily remained at 6 percent in recent years. On global grain markets, production outstrips demand and stocks have grown considerably. The same holds true for oilseeds, the raw material for biodiesel. According to the most recent estimate from the United States Department of Agriculture (USDA) from August 2016, global oilseeds production will reach 544 m tons in the 2016/17 marketing year, an 8 percent increase on 2013/14 and a 39 percent rise on 2007/08[20].

Globally, FAO estimates indicate that in order to meet the projected food demand in 2050, agricultural production must grow by 60 percent above the level of 2005-07. There are signs for optimism: Over the last five decades (between 1961-63 and 2007-09) production has increased by a massive 170 percent, the FAO points out[21]. There is room for further sustainable increases, for instance in countries like Ukraine or Russia. Using the potential of degraded land for agriculture has huge potential, too. But food consumption patterns in developed nations need to change too, if we are serious about mitigating climate change.

Global oilseeds production past and present

	2007/08	2010/11	2013/14	2016/17
Rapeseed	48.6	60.6	71.7	67.2
Soybeans	221.0	264.3	282.5	330.4
Total	392.0	461.0	503.6	543.5

Source: USDA, August 2016; http://apps.fas.usda.gov/psdonline/circulars/oilseeds.pdf

8 BLUNTED PRICE SPIKES

As hunger and malnutrition are still prevalent in many developing countries and the world population rises, biofuels have been blamed to be responsible for price spikes on world agricultural markets. Scientists have come to hugely diverging assessments on the influence of biofuels on commodity markets. According to a study from the OECD, however, removing biofuel policies (mandates and budgetary support) would cause world prices for coarse grains, oilseeds and sugar to decline by only 0.8 percent, 2.2 percent and 0.6 percent respectively[22]. This is a negligible effect compared to the price fluctuations on world markets.

A study from Potsdam Institute for Climate Research Impact (PIK) warns that climate change impacts will have a far greater influence on agricultural prices than bioenergy. Agricultural prices could be about 25 percent higher in 2050 through direct climate impacts on crop yields in comparison to a reference scenario without climate change, according to PIK[23]. By way of contrast, high bioenergy demand as part of a scenario with ambitious mitigation appears to raise prices only by about 5 percent, PIK says regarding second generation bioenergy solutions.

Besides, higher prices also stimulate investment in agriculture that can lead to higher yields per hectare on the land. Such investments are also necessary to mitigate the impacts of climate change. Readily available sustainable bioenergy solutions contribute to fighting climate change. And, as a recent study points out, "biofuel projects can address food security concerns by applying best practices that reduce exposure to risks of food insecurity"[24].

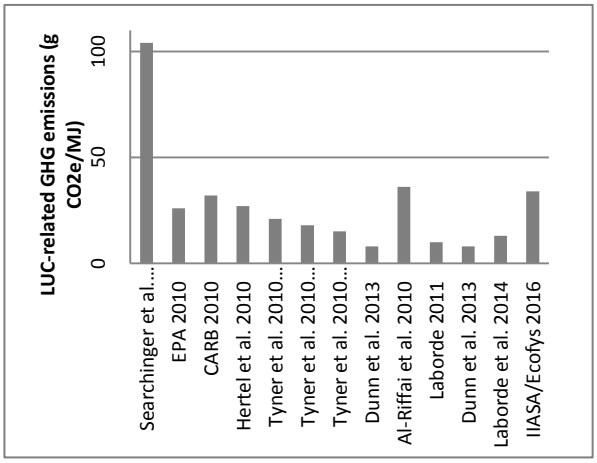
9 THE COMMITMENTS OF BIOFUELS

Sustainability has been a key term for the debate on biofuels in recent years. Counting biofuels for the 10 percent renewables goal of the EU has been conditional on adherence to sustainability criteria for several years now. The RED sets those sustainability standards for biofuels and the raw materials going into them. These standards are designed to prevent direct land use changes (for example the conversion of primary forests to arable land or plantations) and to protect precious habitats. Compulsory minimum GHG savings of 35 percent (measured against assumed fossil fuel emissions of 83.8 g CO_2 eq/MJ) apply to biofuels that contribute to the EU renewables quota. From 2018, this GHG savings requirement will rise to 50 percent. It should be kept in mind: So far, those mandatory sustainability standards only apply to biofuels, but not to other agricultural sectors. For a number of reasons, the 35 percent minimum GHG savings requirement for biofuels is usually outdone considerably: The EU Directive uses very conservative numbers to create an incentive for companies to calculate the GHG balance of their products on their own. In Germany, better GHG emission values have been turned into a competitive advantage: Since 1 January 2015, the national biofuel quota takes GHG savings as a benchmark, rather than the volume of biofuels put on the market. At the same time, the existing fossil fuel CO_2value of 83.8 g CO_2eq/MJ is rather advantageous for conventional petrol and diesel: According to the revised EU Fuel Quality Directive (FQD), the CO_2 emissions value for fossil fuels was fixed at 94.1 g CO_2eq/MJ in the FQD. Irrespective of that directive, even higher values have to be assumed for fossil fuels of unconventional origin. In a recent Ecofys study the authors come to the conclusion that the marginal greenhouse gas emissions avoided by the introduction of biofuel are approximately 115 g CO_2eq/MJ[25]. If this value would be applied as the basis for calculating GHG emissions reduction of biofuels, their contribution to climate protection would be a lot better nominally, too.

10 ILUC: FACT OR FICTION?

EU sustainability standards for biofuels address concerns about land needs for bioenergy. According to those sustainability standards no raw material from land with high biodiversity value is to be used for biofuels. As a deadline the EU Directive sets January 2008. In this way, direct land use changes are to be precluded. The political debate in recent years has focussed on ILUC. The ILUC theory assumes that even arable land use for bioenergy in the EU is to be made accountable for possible conversion of land overseas. According to that theory, an area expansion for a given energy crop, for example rapeseed, goes hand in hand with the expansion of oilseeds in other countries as import needs for food uses in Europe would rise. ILUC is contentious and based on models that have come up with so called ILUC factors, and results vary widely as shown below.

Estimate of ILUC related GHG emissions for corn ethanol (g CO2 eq./Megajoule)



Source: Utrecht University, www.geo.uu.nl/iluc, own calculations

The so called Globiom study, published in March 2016, was the latest paper in a series of studies on the issue. For rapeseed biodiesel it came up with an emission factor of 65 g CO_2 eq/MJ – only about a quarter below the fossil fuel emission factor used for calculating GHG savings.

Amongst the critics of global ILUC calculations is Prof. Uwe Lahl. He supports a regional approach to determine ILUC and suggests to tackle land use change directly in producer countries instead of using blanket ILUC factors[26].

The best way to prevent land use change that is detrimental to climate protection would be however, to extend sustainability criteria that currently just apply to biofuels in the EU, to all agricultural sectors and uses of agricultural raw materials. In this way, ILUC would be impossible as land use change would be prevented.

In reaction to the ILUC debate, scientists and civil society players have come up with suggestions on how to promote biofuels with an assumed low ILUC impact. Scientists from the University of Utrecht have analysed the situation in different Eastern European regions, but also in a part of Indonesia. They came up with evidence that large biofuel potentials with low risk of causing ILUC exist in all case studies[27]. In Eastern Europe, it is above all yield increases that contribute to those possibilities of expanding cultivation of energy crops.

So called advanced biofuels are often seen as another way out of the ILUC dilemma. In 2015, the EU set a separate 0.5 percent advanced biofuels quota which can be implemented on the national, Member State level. The definition of advanced biofuels in the relevant EU Directive is based on the feedstock. However, definitions of advanced biofuels vary. In a EU Commission Staff Working Document distinctions are drawn between technologies rather than feedstocks[28].

11 OPPORTUNITIES FOR A CHANGE IN CONSUMER BEHAVIOUR

The long awaited rise of renewables in the transport sector is not just a technological and a policy task. It also poses a challenge in terms of changing consumer behaviour. The "sharing" trend questions the concept of individual car ownership. Numerous car sharing firms offer EVs, but usually to a limited extent. In Germany, Deutsche Bahn spin off Flinkster has 700 e-cars in its portfolio, this equals a 20 percent share of its fleet. Similarly, DriveNow – a BMW and Sixt joint venture, has a 20 percent share of e-cars in their fleet. They have announced their intention to further increase that share[29]. The "sharing" trend in car use is not necessarily restricted to e-mobility, though. The car manufacturer Opel has launched the car sharing platform "CarUnity" successfully, and e-mobility is not a focus of that initiative.

Irrespective of the powertrain, the increase in car sharing could alter the "modal split" between different modes of transport in favor of rail and other alternatives that are more environmentally friendly than individual car trips.

Consumption trends also have their repercussions on bioenergy availability: According to an EU working document, some 1.6 m hectares in the EU were lost to soil sealing between 1990 and 2006[30]. If the latest available figures are applied to recent years, this adds up to a lost area of 2.4 m hectares since 1990. If only a third of that area would be cultivated with rapeseed as part of a sustainable crop rotation, some 2.5 m tons of rapeseed could be harvested, which would yield more than 1.1 m tons of biodiesel – about two thirds of France's annual production, which is the EU's second biggest producer. In consecutive years, wheat or rye could be grown as bioethanol crops.

Source: DriveNow

Modal split: Can car sharing better the balance for rail transport?

Apart from soil sealing, food losses impact on the availability of food and other biomass products in the European Union. A few million hectares in the EU are used for food that is afterwards wasted. In developing countries, high post-harvest-losses blemish good crop years. According to estimates from the United Nations, waste and post-harvest-losses diminish the global supply of oilseeds by 20 percent. Those two factors - post-harvest-losses and waste - diminish the grain supply by some 30 percent and the fruit and vegetable provisions by 40 to 50 percent. Translating this into absolute figures, this would equal an amount of 670 m tons of grain. By way of comparison, the World Food Programme (WFP) as the biggest humanitarian organisation purchases some 1.5 m tons of grain per year to help the hungry.

Living styles are an issue, too. If EU citizens would roughly follow official recommendations on alcohol consumption, they would lead healthier lives: While average per capita consumption in the EU is estimated at 10.8 l of pure alcohol, keeping to guidelines would limit it to some 5.9 l. If, theoretically, the surplus remainder would be guzzled by cars instead of throats this would free up more than 1.6 m tons of bioethanol which equals more than one million tons of fossil fuels. Converted

into wheat area, the demand covered by the surplus ethanol needs of thirsty EU citizens equals some 750,000 hectares. This is more than Denmark's or Italy's 2016 soft wheat area which reached 640,000 hectares and 580,000 hectares.

12 CONCLUSION

The transport sector of the European Union has so far been left largely untouched by the rise of renewables. This lack of progress questions the implementation of the EU's renewable and climate protection goals. Alternatives to fossil fuels are there for the taking. The promise of EVs holds solutions in store: E-mobility offers genuine alternatives to the internal combustine engine. It could also reign in the ever increasing growth in the number of cars on the globe. At the same time, such solutions do not yet have substantial market penetration. Supplying EVs with renewable power is a must to safeguard their GHG balance. The renewable energy power sector therefore needs to grow substantially. As a different option, crop based biofuels are available today to a great extent and can be used sustainably without endangering food supplies. In Europe, biofuels have been close to being competitive even under the current political framework, which does not take into account the external costs of fossil fuels. If one is serious about mitigating climate change, there will be areas where they are indispensable. For example there is no renewable alternative to biofuels in air traffic or for heavy-duty trucks for the foreseeable future. Apart from grasping the technological opportunities at hand, Europeans need to change their mobility patterns and get cars off the road to make transport more sustainable.

[1] Eurostat database on renewables, download from 15 August 2015, available at: http://ec.europa.eu/eurostat/web/energy/data/shares

[2] White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

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