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RENEWABLE ENERGIES AGENCY
renewables-in-germany.com

ISSUE 24
23/06/2015

RENEWABLES IN THE TRANSPORT SECTOR – WHICH ROUTES ARE OPEN?

BREAKTHROUGH FOR BIOFUELS AND OTHER OPTIONS STILL MISSING

In the EU's energy mix, transport plays a special role. It claims more than 30 percent of final energy demand in the EU. 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. Tough restrictions on food crops based biofuels are discussed in the EU, although harvests have been plentiful in recent years and are expected to be so again in 2015. Alleged risks of indirect land use change (ILUC) as well as the food versus fuel debate have left their mark. At the same time, alternatives to current biofuels have yet to gain market relevance. A modal shift towards more rail transport has not set in yet. This paper looks at the current state of play in the renewables sector for road transport with a special focus on biofuels.

AT A GLANCE

- At 5.4 percent, the share of renewables in the transport sector is by far the lowest in the EU (power: 25.4 percent, heat and cooling: 16.3 percent).
- Technologies for expanding renewables are available but face obstacles.
- Biofuels would have the potential to cover far more than their current market share.

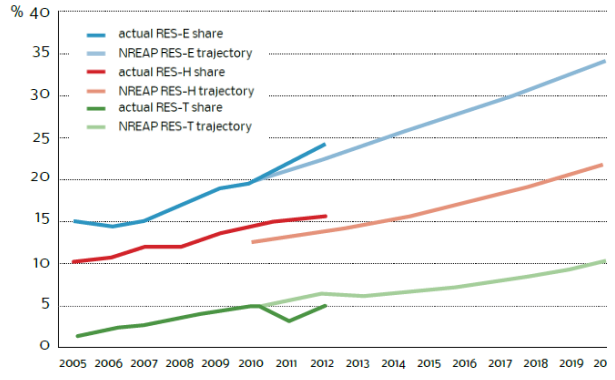
1 RENEWABLES IN THE EU TRANSPORT SECTOR - UNDERACHIEVING

In the transport sector, renewables are lagging behind. With a share in energy consumption of just 5.4 percent in 2013[1], their performance has been lacklustre. By contrast, the power and heating sectors saw a strong market expansion of renewables in 2013, with market shares reaching 25.4 and 16.3 percent respectively, according to EEA figures[2]. The EU therefore is off target to reach its 10 percent renewables goal set for 2020. It should also be kept in mind that renewables as a whole are to reach a share of 20 percent of EU gross energy consumption by 2020. The transport sector with its much lower 10 percent goal therefore is an underachiever by law, in a way.

The outlook to reach the 10 percent renewables goal in the transport sector is bleak. E-mobility is a promising option, but has yet to gain relevant market share. And food crops based biofuels look likely to be reigned in by new legislative measures. Doubts about their environmental performance have led to far-reaching proposals on limiting the contribution of food crops based biofuels to the 10 percent goal. If, on top of that, factors on indirect land use change (ILUC) were to be implemented, this could drive biofuels such as biodiesel out of the market. Second generation biofuel technologies are fledgling but products are not yet marketable. At the same time, a modal shift in mobility patterns away from road transport is not on the horizon yet. Infrastructure figures are an indication: The EU's motorways system has expanded to more than 71.000 km, an increase by 30 percent on 2000 figures. Simultanously, the EU's railway network has shrunk to 216.000 km, a decrease by 2 percent[3].

Meanwhile, the energy import dependence of the EU has con-

Actual EU renewable energy shares and trajectories according to national action plans (NREAPs)



Source: Keep on Track, EU Tracking Roadmap 2014

stantly increased this century. While the average dependency rate was 47 percent at the start of the millennium, it had risen to 53 percent in 2012. For petroleum and related products, energy imports now claim a share of 86 percent of consumption[4]. 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 has fallen to 4.8 percent, according to EU Commission figures[5]. At the same time, reform of energy taxation, which the EU Commission had endeavoured, has now been shelved. Such a reform should have geared taxation towards using the energy content of fuels as the basis for taxation. Instead, a common EU approach is still missing. Meanwhile EU transport GHG emissions (excluding international departures) still stood at 893 m tons in 2012, which equalled a 14 percent rise on 1990 figures. In the wake of the economic crisis, emissions have dropped in recent years though.

Against this backdrop, the future role of renewables in the transport sector is highly uncertain: According to the current EU Commission proposal for a 27 percent share of renewables to be attained by 2030, no sectoral targets will be set under this voluntary blanket goal.

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

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

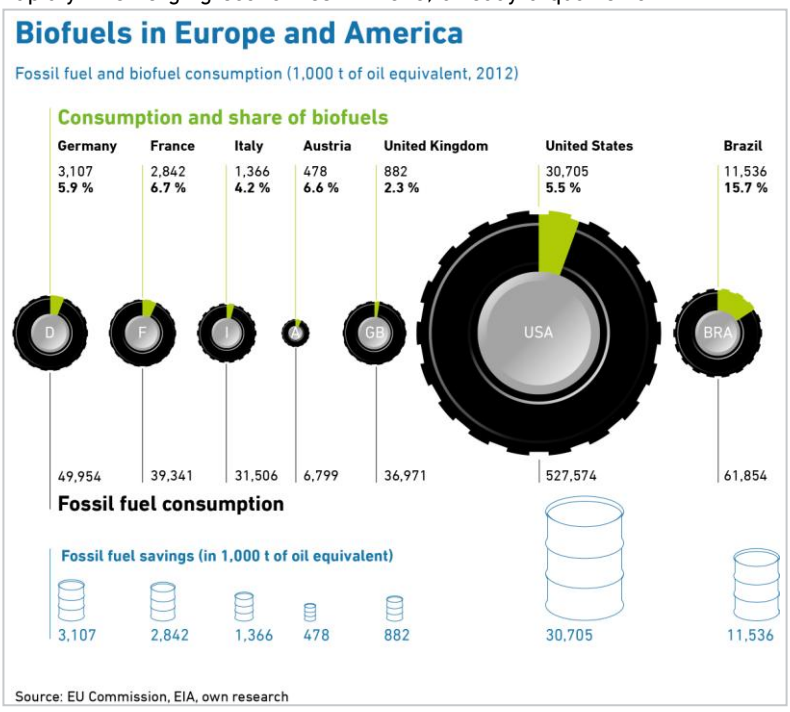
The attractiveness of individual road transport is increasing rapidly in emerging economies. In 2013, already a quarter of all vehicles were sold in China, while the EU and the US claimed shares of 19 and 17 percent respectively. A "peak car" of plateauing demand for automobiles is not yet foreseeable. The International Energy Agency (IEA) expects that global demand for oil in the transport sector will rise to 56.9 million barrels per day (mb/d) 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 16 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 30.7 m tons contributed just 5.5 percent to the country's fuel needs.

3 THE PROMISE OF E-MOBILITY

In order to expand the use of renewables and to overcome the dominance of fossil fuels in the transport sector, a range of options is available. Looking at new technologies for road transport, e-mobility holds promise: In 2014, sales of purely electric cars in the EU rose sharply to some 38.500, an on-year increase of 56 percent. Yet, this figure amounted to only around 0.3 percent of all new cars sold[8]. Taking range extenders and plug in hybrids into the equation, this share rose to 0.6 percent (and a total of some 75.000 electric vehicles sold). This shows that e-mobility is still in its early stages.

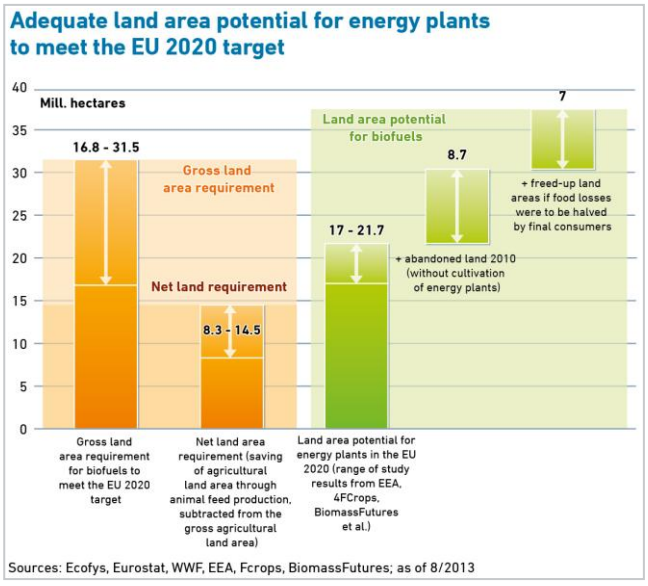
At the same time, e-mobility offers solutions not just for the car industry, but also for two-wheelers. This market develops very dynamically too. In the Netherlands, more than 220.000 e-bikes were sold in 2014, according to a market analysis from BOVAG[9]. Every fifth bicycle sold in the Netherlands was electrically pedal-assisted. Pedelecs also offer great potential for freight services and, depending on the circumstances, 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[10]. 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, renewables only claimed a share of 4.5 percent of gross final energy consumption. E-mobility can only be a truly sustainable energy solution when it draws on renewable power.



4 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.

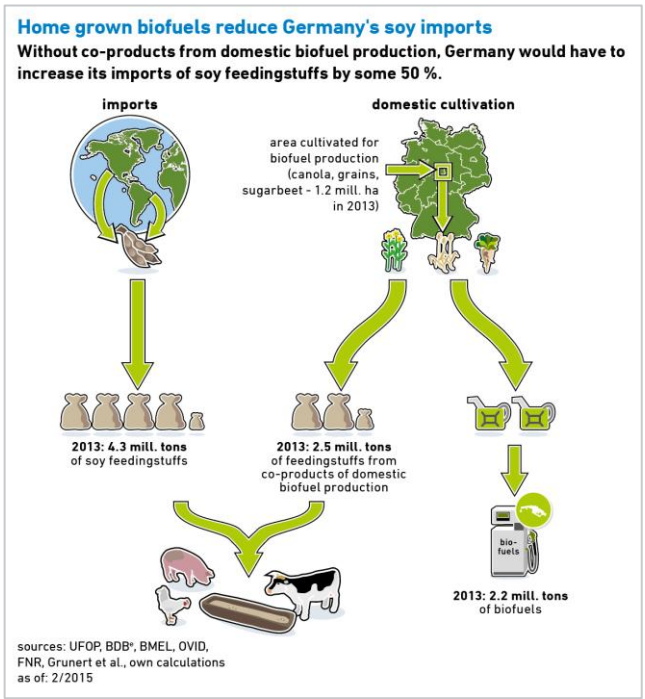
For the agricultural as well as for the energy sector, bioenergy has clearly gained importance. EU production of biodiesel reached some 9 m tons in 2013, while capacity stood at more than double that figure. Multinational companies are important market players, but so are traditional regionally rooted businesses. 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 threshold is estimated at circa 17.5 m hectares (circa 10 percent of EU agricultural area)[11]. While scenarios for available bioenergy area in the EU hugely differ, several studies have confirmed that the land area to cover those needs would be available. Besides, it should not be forgotten, that other renewable solutions such as e-mobility 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 any long term additional potential for energy crop cultivation, others are optimistic, also 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 in the long term be available for energy crop cultivation in the EU[12].

Regardless of diverging scientific assumptions it should be kept in mind that the biofuel production chain is an integral part of agricultural value creation. It often gets forgotten that the production of biofuels yields valuable co-products.

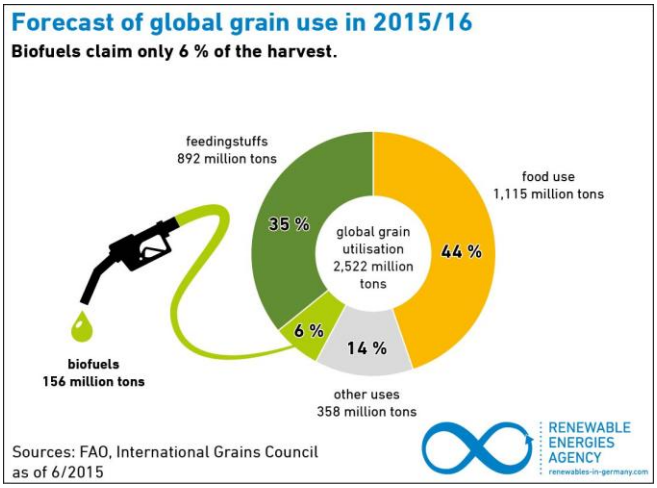
The origins of biodiesel date back to the 19th century when glycerin, used in the cosmetics industry and as a food additive, was the target product. Nowadays, biodiesel has gained centre stage in the public perception. However, when rapeseed is used as a raw material, biodiesel only claims some 40 percent of the seed. The remainder, the so called meal, is used as a valuable feedingstuff. Those co-products help lessening the demand for agricultural land dedicated to food and feed production. For example, the remainder from the biogas fermentation process, the so called digestate, can be used as a valuable natural fertiliser on farmers' fields. 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. The area needs of the bioenergy sector therefore have to be seen in perspective. This is important to keep in mind for the situation in the EU as well as for the global picture. 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 of oil mills, above all canola meal from the extraction process, German farmers have an additional 2.5 m tons of feedingstuffs at their disposal.



5 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. With over 805 million people going to bed hungry every night, the right to adequate food lacks implementation. The global curse of hunger is however much older than the advent of modern bioenergy solutions. For the 1990/92 period, the FAO estimated that the number of hungry people to have reached more than one billion. This number has come down in the 21st century, albeit slowly. 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 2015, another good harvest is expected. Consequently, prices for important food crops have come down markedly. In February 2015, the FAO food price index dipped to its lowest level since July 2010. At the same time, biofuel production globally (in contrast to the development in the European Union) has increased sizeably from 59.6 m tons in 2010 to 65.3 m tons in 2013.



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 June 2015, global oilseeds production will amount to 532 m tons in the 2015/16 marketing year, a 5 percent increase on 2013/14 and a 34 percent rise on 2008/09[13].

The comfortable supply situation is not restricted to grains and oilseeds. Already in 2012 the FAO talked about a "massive supply overhang" on rice markets[14]. Demand has since picked up, but ending stocks are even forecast to be above 2012/13 levels this year at 178 m tons. This goes to show: There is no lack of staple foods in the world, but they do not reach the needy.

Global oilseeds production past and present

	2007/08	2010/11	2013/14	2015/16
Rapeseed	48,6	60,6	71,2	68,5
Soybeans	221,0	264,3	283,7	317,6
Total	392,0	461,0	504,3	531,9

Source: USDA, June 2015 http://apps.fas.usda.gov/psdonline/circulars/oilseeds.pdf

Globally, the 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[15]. There is room for further sustainable. increases, for instance in countries like Ukraine or Russia. Using the potential of degraded land for agriculture as huge potential too. But consumption patterns in developed nations need to change too if we are serious about mitigating climate change.

6 BLUNTED PRICE SPIKES

As hunger and malnutrition are still prevalent in many developing countries and as 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 recent 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[16]. This is a negligible effect.

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[17]. 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.

7 THE COMMITMENTS OF BIOFUELS

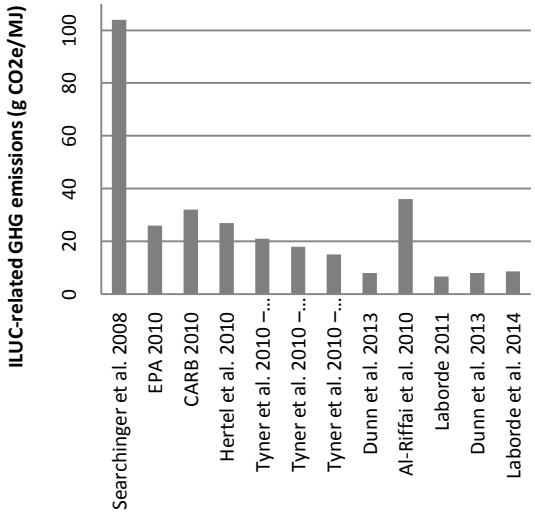
Sustainability has been a key term for the debate on first generation biofuels in recent years. Counting biofuels for the 10 percent renewables goal of the EU has been conditional on adherence to sustainability criteria for several years now. The EU Renewable Energy Directive (EU RED) sets those sustainability 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 CO2 eq/MJ) apply to biofuels that contribute to the EU renewables quota. In 2017, this GHG savings requirement rises 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 CO2 value of 83.8 g CO2 is rather advantageous for conventional petrol and diesel: According to the current state of play in the talks on the revision of the EU Fuel Qualitive Directive (FQD), the CO2 emissions value for fossil fuel looks set to be fixed at 94.1 g CO2/MJ (not 83.8 g) in that directive. Irrespective of that EU 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 CO2eq/MJ[18]. If this value or the new 94.1 g value under discussion for the FQD would be applied as the basis for calculating GHG emissions avoidance of biofuels, their contribution to climate protection would still be a lot better nominally too.

8 ILUC: FACT OR FICTION?

The sustainability standards for biofuels explained above 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. Direct land use changes are to be precluded in this way. The political debate now focuses on indirect land use changes (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 expansion of the area 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 highly contentious and based on models. Those models have come up with so called ILUC factors and results vary widely, as the following graph shows:

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



Source: Utrecht University; www.geo.uu.nl/iluc

Concrete proof for ILUC in agricultural practice is lacking. The results of model calculations remain speculative. Despite this uncertainty, ILUC factors would have to be added to the GHG emission balance of biofuels, according to a February 2015 vote in the European Parliament Environment Committee. Negotiations with the Council on a possible cap for first generation biofuels and on the treatment of alleged ILUC factors will be ongoing in spring 2015.

If ILUC factors were introduced, biodiesel from rapeseed as the mainstay of the European biofuel industry would disappear from the market as rapeseed biodiesel has so far usually been attributed very high ILUC factors. Instead of protecting the rainforest, ILUC factors would also run the risk of punishing responsible palm oil producers overseas.

Amongst the critics of global ILUC calculations is Prof. Uwe Lahl according to whom models that see iLUC as a global effect and define global factors are not sufficiently sound. 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[19]. 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 sec-

tors 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[20]. In Eastern Europe, it is above all yield increases that contribute to those possibilities of expanding cultivation of energy crops.

9 OPPORTUNITIES FOR CHANGE

It is not just by increases in yields and efficiency gains that agricultural production in the EU and beyond could be enhanced and more area be made available for alternative uses, either for energy use, conservation or other crop uses (such as use for bioplastics, for example). There are factors outside agriculture bound up with our modes of consumption, the political framework as well as infrastructure settings that go into the equation and that merit our attention.

According to an EU working document, some 1.6 million (m) hectares in the EU were lost to soil sealing between 1990 and 2006[21]. 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. Instead, those areas are lost for agricultural production as roads, buildings and other construction projects claim ever more soil.

Apart from soil sealing, food losses impact on the availability of food and other biomass products in the European Union. In industrialised countries, the problem of binning huge amounts of food in the distribution chain, in households as well as in the food service industry, slowly enters the public mind. 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, last year the World Food Programme (WFP) as the biggest humanitarian organisation purchased some 1.5 m tons of grain 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 to be 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 soft wheat area which reached 660.000 hectares and 600.000 hectares respectively in 2014.

10 THE RISE OF RENEWABLES STRENGTHENS RURAL AREAS

The rise of renewables can further prosperity in rural communities. This holds true for developing as well as industrialized countries. In Germany, the bioenergy sector (including power, fuel and heat production) now employs some 125.000 people, according to a study commissioned by the federal government. Decentralised supply and distribution structures have emerged that empower local citizens, for instance as members of local cooperatives that feed district bio-heat into a local grid or farmers who produce their own fuel such as biomethane or vegetable oil from rapeseed. Also car sharing of e-cars tentatively arrives in rural areas.

11 CONCLUSION

The transport sector of the European Union has so far been largely untouched by the rise of renewables which the power and heating sector of the EU have seen. 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 e-mobility holds solutions in store: E-mobility can offer genuine alternatives to the internal combustine engine. It could also reign in the ever increasing growth in the number of cars on the globe. E-mobility has therefore been dubbed a "Trojan horse". At the same time, such solutions do not yet have substantial market penetration. First generation sustainable biofuels, by contrast, are available today and they can be used 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. Given the difficult political climate, it remains to be seen in what way the sector will have the chance to profit from opportunities apart from the currently existing market possibilities.

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