UNION ZUR FÖRDERUNG VON OEL- UND PROTEINPFLANZEN E. V.

BIODIESEL & CO. 2022/2023

REPORT ON PROGRESS AND
FUTURE PROSPECTS – EXCERPT
FROM THE UFOP ANNUAL REPORT

ufop

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Editorial deadline: 01 September 2023

Published by:

UNION ZUR FÖRDERUNG VON
OEL- UND PROTEINPFLANZEN E. V. (UFOP)

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LIST OF FIGURES IN THE REPORT

Figures

1 World production of the most important vegetable oils estimated in 2022/23 and 2023/24 8

2 Production capacity of SAF in the EU 9

3 Drive types for HGVs – based on the example of an Iveco S-Way road tractor unit for semi-trailers ... 10

4 Biofuels are crucial for climate change mitigation in the transport sector – .....

emissionsreduction through biofuels 12

5 Approval of biodiesel for blending in diesel fuel 13

6 Elements of the EU's "Fit-for-55" package 14

7 Sales development and feedstock composition for biodiesel/HVO 15

8 Survey: The Majority favours keeping Biofuels 19

9 Use of Renewable Drive Power in Agriculture and Forestry 22

TABLE OF CONTENTS

Biodiesel & Co 7

Biofuels: A Bridging Technology 18

Fact Checking Mobility in Germany 20

How can Agriculture cut its Emissions? 22

Tabular annex 25

Biofuels (Tab. 1 – 13) 26

Biofuel mandates (Tab. 14 – 15) 39

Tables of the German Federal Office for Agriculture and Food (Tab. 16 – 22) 48

Biodiesel & Co.

Russia's war against Ukraine poses enormous challenges for the international community and its shared values, delaying measures for climate change mitigation in the southern hemisphere by years. Both sides are currently investing in missiles and tanks rather than in wind turbines and solar plants. Against the backdrop of new temperature records, forest fires and floods all over the world, that money would definitely be better invested in fighting against climate change to help secure humanity's future. Warmongering Russia has taken its leave of the international climate policy arena, relying as it does on revenue from fossil fuel exports to finance the war and its economic consequences.

Grain and oilseeds have become political bargaining chips in this conflict as exports from Ukraine traditionally provided reliable grain supplies to certain countries and regions in Africa, as well as supplying rapeseed and sunflower seeds to oil mills in Germany and other EU Member States. As the Russian President opted to discontinue the grain agreement in July 2023, the EU is again grappling with identifying and developing existing and alternative supply routes, including transport by road, rail and inland waterways to bring the harvest to market and ensure efficient transportation to the EU and especially to third countries. In recent months, this has posed major challenges, especially for EU Member States in eastern Europe, as well as squeezing producer prices due to large grain and oilseed shipments. Competition-driven international trade in agricultural commodities, combined with temporary regional support to transport agricultural produce from Ukraine to neighbouring EU countries, has proved its worth as a viable risk strategy to overcome regional supply bottlenecks, as Prof. Dr. Thomas Glauben, Director and Head of the Agricultural Markets Department at the Leibnitz Institute, Halle, noted in an interview (FAZ, 20.05.2023).

In January 2023 the price increases for oilseeds and cereals up to May/June 2022, initially triggered by Russia's attack on Ukraine, served as a pretext for German Environment Minister Steffi Lemke – backed by Agriculture Minister Cem Özdemir – to launch a renewed attempt to gradually exclude biofuels from cultivated biomass (see also UFOP Report 2021/22, p. 28), although at that point producer prices were plummeting. UFOP therefore expressly welcomed the unanimous decision by the Conference of Ministers of Economic Affairs on 21st/22nd June 2023, which urged the German government to abandon plans to reduce the upper limit for biofuels from cultivated biomass each year. The war has again highlighted how dependent German industry is on fossil fuel imports from Russia. Short-term substitution measures have once again sidelined climate change mitigation goals, particularly in the transport and heating sectors. Availability and above all affordability have become the key determining factors for acceptance of these measures, although admittedly a great deal has been achieved in recent months. Unfortunately, as a consequence of the decision to approve and construct new LNG terminals, the German government's previous plans for more frequent train connections between major German cities have been put on the back burner. Debate on the Building Energy Act (Gebäudeenergiegesetz), which could not be adopted before the parliamentary summer recess as initially planned, reveals a lack of communication when coordinating strategies with all crucial partners and, above all, with those affected. That is not the right way to achieve an approach to the energy transition and climate change mitigation that society embraces as "our shared strategy".

Time to adjust strategies – a complex challenge

As noted above, Russia has withdrawn from the international climate policy arena. Parties to the Paris Climate Agreement must therefore adopt more ambitious measures more rapidly to cut greenhouse gas (GHG) emissions. Against this backdrop, the European Commission has initiated the statutory consultation process on a proposal it has presented for an EU-wide interim climate target for 2040 to put the EU firmly on the path to climate neutrality in 2050, as stipulated in Article 4, European Climate Law. The European Commission has announced that a draft text with an impact assessment will be submitted in autumn 2023. In parallel, by 30th June 2024, Member States must submit their revised national energy and climate plans (NECP), which also contain national upper limits for biofuels from cultivated biomass. The draft versions were supposed to be submitted to the European Commission by 30th June 2023; the German government missed that deadline. The Paris Climate Agreement also provides for regular review and adjustment of the national commitments made by all signatory states.

Extending the renewable energy sector as rapidly as possible and using existing sustainable biomass potential as efficiently as possible is crucial to achieving the climate targets for 2030 and beyond. This applies in particular to boosting use of wind power; slow implementation coupled with an "authorisation backlog" at the level of the German federal states and local authorities dealing with site designation and approval procedures have put the brakes on this sector, despite provisions adopted by the German government to speed up the process, for example by stipulating that certain areas should be used for wind power facilities. Germany would need to build four to five wind turbines a day to hit the target of an 80-percent share of renewables in electricity consumption by 2030. The current construction rate is however only one or two turbines a day.

UFOP is convinced that tapping into the full potential of sustainable renewable energy will require us to steer a well-balanced course with carefully orchestrated measures. Sustainably produced biomass as well as residues and waste should be taken into account as versatile and storable energy sources when devising framework parameters for legal provisions and funding policy. Proper classification of cultivated biomass must be a top priority, reflecting its status as an energy source that, like rapeseed, has virtually no iLUC impact. UFOP believes that ecosystem and climate change mitigation services should be recognised and evaluated as part of an overall strategy, reflecting, for example, the contribution made to GHG reduction, by-products that secure protein supply and diminish reliance on imports, commodity chemicals (glycerine/bioethanol) produced, and new options for crop rotation with legumes, etc. Bearing these aspects in mind, arable farming strategy also needs to be finetuned and implemented within the framework of the "model farms" approach promoted by the German Ministry of Food and Agriculture (BMEL).

In the short to medium term, there should be a particular focus on the energy density of biofuels from cultivated biomass, which could serve a bridging function as part of the energy transition for applications that are difficult to electrify. As a general rule, biofuels can be used immediately in existing fleets without any need to invest in distribution infrastructure. That explains the growing interest from the transport industry generally, as well as forming the background to a welcome decision by Deutsche Bahn, the German national railway company, to switch from diesel for locomotives to HVO from waste oils and fats.

In April 2023, an agreement was reached in trilogue negotiations between the Commission, the Council and the European Parliament on binding requirements for use of sustainable aviation fuels (SAF). The ReFuelEU Regulation provides for a minimum share of SAF in kerosene for passenger aircraft taking off from the EU: initially 2% in 2025, the figure will rise to 6% in 2030, 20% in 2035, 34% in 2040 and 70% in 2050.

In this context, all certified sustainable biofuel options must be taken into account, as focusing solely on fuels from waste and residues considerably limits the volumes potentially available, particularly as these feedstocks are a statutory requirement in other sectors as a "crediting precondition" for GHG savings (biokerosene, marine fuels).

Assessing the potential of waste oils – the competition is heating up

UFOP welcomes the initiatives developed by transport industry associations to ensure appropriate support for sustainable biofuels through a compensation system for a certain percentage of road tolls or via a tax refund procedure. UFOP has repeatedly pointed out in discussions with industry associations that there is limited potential available globally. As Fig. 1 shows, record vegetable oil production of around 223 million tonnes is expected for the 2023/24 marketing year, with a corresponding increase in the potential volume of waste oils generated. If 5 % to 10 % of those waste oils could be collected and processed as biofuel feedstock, the total worldwide would be around 11 to 22 million tonnes. The world's largest HVO producer, Neste, with plants in locations such as the Netherlands, Finland and Singapore, estimates that globally the figure, including animal fats, is around 40 million tonnes.

A specific sub-target has been adopted for synthetic fuels from green hydrogen: at least 1.2% after 2030, 5% after 2035 and 35% by 2050. In addition, introduction of an EU eco-label from 2025 showing the CO_2 footprint of air travel will increase pressure. Revenues from fines for non-compliance with the new provisions are to be channelled into research and production of innovative SAF. These decisions are already triggering tangible investments to develop SAF production capacities in the EU and internationally (Fig. 2). In addition, HVO production capacity is being boosted (see Statistical Annex, Table 12). However, only the EU stipulates use of biokerosene and specifies the origins of feedstocks. In third countries, on the other hand, cultivated biomass will continue to play the most important role by far to fulfil future requirements for road and air transport. This also includes SAF production and alternative production pathways, for example based on starch or sugar (alcohol-to-jet). UFOP is concerned that this "feedstock policy" will trigger displacement effects, increasing demand for land elsewhere as, for example, domestic vegetable oil

Fig. 1: World production of the most important vegetable oils estimated in 2022/23 and 2023/24, in million t

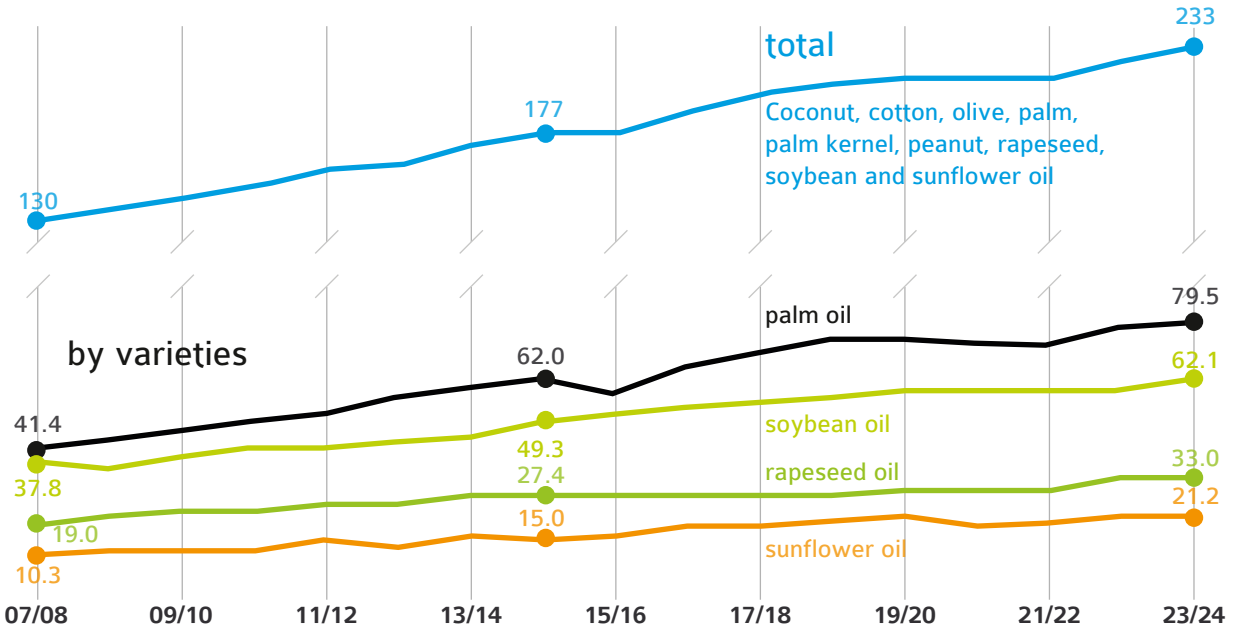
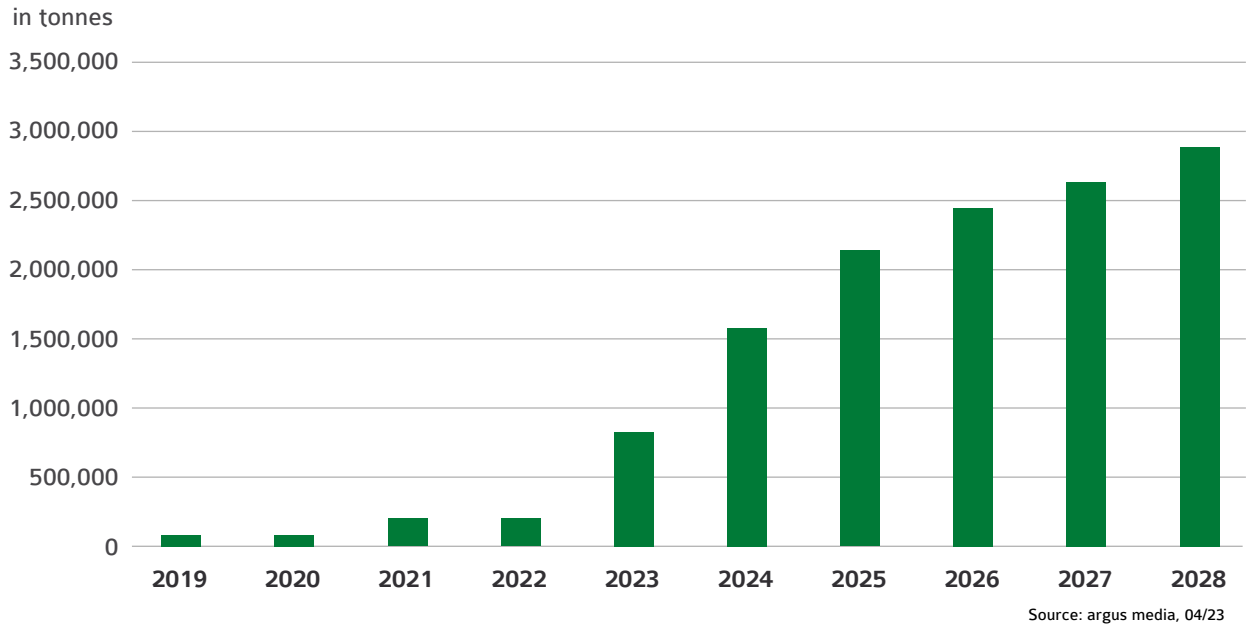


Figure: AMI | Source: USDA, July 2023

Fig. 2: Production capacity of SAF in the EU



Source: argus media, 04/23

production will have to compensate for exports of waste oils. A sustainable biofuel strategy also includes a balanced strategy to manage the potential of the cultivated biomass, wastes, and residues available, including a contribution to more efficient climate change mitigation. Rather than processing waste oils to produce SAF/ HVO, thought should be given to using them as a substitute for biodiesel (B100) for heavy-duty transport. This point has been made repeatedly by the Mittelstandsverband abfallbasierter Biokraftstoffe (German Waste-Based Fuels Association/MVaK) with reference to results from studies ("Conversion efficiencies of fuel pathways for Used Cooking Oil" *bit.ly/UCO_study*).

Avoidance costs drive competition and underpin the need for funding

Calculations by the Deutsches Biomasseforschungszentrum (German Biomass Research Centre/DBFZ) show that GHG avoidance costs (computed with reference to the additional costs and GHG savings compared with fossil fuels) are relatively low for biodiesel (FAME) compared to other alternative liquid fuels such as HVO or electricity for battery-driven electric propulsion: FAME 82 EUR/t CO_2, HVO/HEFA: 219 EUR/t CO_2, electricity: 638 EUR/t CO_2 (DBFZ – Monitoring renewable energies in transport 01/2023. *bit.ly/DBFZ_r44_EN*)

Switching to alternative and low-GHG fuels in existing vehicles is a comparatively accessible way to achieve transport sector decarbonisation, as existing infrastructure can be used. However, there is a significant price gap between biofuels and diesel. That backdrop is relevant when appraising the statement that an alliance of logistics industry associations issued in July 2023 ("Accelerating climate protection in road freight transport: creating tax incentives for use of advanced biofuels"). This text calls for use of advanced biofuels to be encouraged through tax relief (reimbursement procedure similar to agricultural diesel), in the spirit of the "bridging function" envisaged by UFOP. It also refers to the General Block Exemption Regulation that entered into force in June 2023 (2023/1315 – GBER) as a legal basis for national authorisation to amend the Energy Tax Act (Energiesteuergesetz); HVO 100, bio-LNG and bio-CNG are cited as fuel options. In UFOP's opinion, there is no mention of biodiesel as a pure fuel (B100) because comprehensive approvals for HVO 100 are available from commercial vehicle manufacturers, especially for existing vehicles, or will continue to be granted for new vehicles in the future. It is worth noting that no HVO plants are operated in Germany, which means the demands do not take account of the German commodity chain for biodiesel production. However, biomethane production for the fuel market would open up prospects for biogas plants subsidised under the Renewable Energies Act (Erneuerbare Energien Gesetz, EEG). Promising projects and concepts have already been presented at the "International Conference on Renewable Mobility – Fuels of the Future".

Political efforts to bring about disruptive changes as part of the energy transition also demand extraordinarily high funding levels, as the example of e-mobility demonstrates (purchasing vehicles and developing the charging station network). The German government's reply to a parliamentary query (BT Drucksache 20/3008) reveals 8.7 billion Euro funding for e-mobility from July 2016 to June 2022 (manufacturers share: 3.0 billion Euro; government share: 5.7 billion Euro). That does not include the increasingly pronounced shortfalls in energy tax revenue as the fleet grows.

UFOP criticises the decision adopted on 28th March 2023 by the governing coalition in Germany, addressing the "modernisation package for climate change mitigation and accelerated planning", which does not take account of the immediate

advantages offered by sustainable biofuels. UFOP can see no need to subsidise hydrogenated vegetable oils (HVO) in rail transport if pure fuels are authorised for diesel engines in commercial vehicles.

In addition, HVO as a key component can be added to diesel blends as desired and fuel suppliers can compensate for higher fuel prices thanks to GHG quota trading. The coalition's decision acknowledges that taxation should be based on climate impact and the need to create incentives for innovation and investment. Energy taxation only reflects the contribution to climate change mitigation made by e-fuels and what are known as "advanced" biofuels produced from residues and waste. UFOP criticises over-hasty discrimination of biofuels from cultivated biomass, which must undergo a comprehensive documentation procedure to demonstrate their sustainability credentials and the greenhouse gas reductions attained, particularly as use of these fuels is also limited by the 4.4% upper limit on final energy consumption for road and rail transport. In general, the higher costs involved in production and processing of biofuels compared to fossil fuels must be factored in. It is worth mentioning too that sustainable alternative fuels, including biofuels from cultivated biomass, are not subject to CO_2 pricing, as the emission factor for any CO_2 emissions is set at zero in accordance with the Fuel Emissions Trading Act (Brennstoffemissionshandelsgesetz, BEHG). However, the draft recast BEHG stipulated that application of the zero emission factor should be limited to biofuels below the 4.4% cap. Biofuel industry associations have criticised this vehemently, pointing in particular to the BEHG's provisions whereby pricing shall only apply to fossil CO_2. This restriction was ultimately withdrawn, which is hugely important, as rising price levels are also expected for the building and transport sectors with the introduction of emissions trading (ETS 2) from 2026. Germany is leading the way with the Fuel Emissions Trading Act and CO_2 pricing through taxation, which will not be applicable to biofuels (see UFOP Report 2020/21, p.25 / Fig. 8); it is set to rise gradually to around 17.2 cents per litre of diesel by 2026. Environmental economists have repeatedly called for higher prices as a prerequisite for a more rapid switch to renewable energies. This discussion arose in particular in the context of the draft Buildings Energy Act (Gebäude-Energie-Gesetz, GEG).

A future for combustion engines – with some restrictions

The position adopted by a slim majority in the European Parliament in mid-February 2023 does not quite mark the oft-cited demise of the internal combustion engine, as it stipulates a 55% reduction in CO_2 emissions compared to 2021 levels for new passenger cars and a 50% reduction for new vans from 2030 to 2034, as well as a 100% reduction in CO_2 emissions for new passenger cars and vans from 2035. The regulation includes a reference to e-fuels, stating that the Commission will, after consultation, present a proposal on registration of vehicles that run exclusively on CO_2-neutral fuels after 2035, in line with EU law, outside the scope of the CO_2 fleet standards and in keeping with the EU's climate neutrality objective. The competent Council of Ministers adopted these special provisions in late March 2023. German Minister of Transport, Dr Volker Wissing, managed to convince the European Commission and the Council with his arguments for openness to all technologies. However, from 2035 vehicle registration will be conditional on a guarantee from the vehicle manufacturer excluding use of other fuels, i.e. ensuring the vehicles in question cannot run on other fuels. This requires technical applications (sensor technology); a separate type class will be created for the approval process. In this context, the decisive parameter is not emissions during energy production but rather zero CO_2 emissions in exhaust gases. A battery-powered vehicle charged with electricity generated in a coal-fired power station would be considered climate-neutral as CO_2 emissions from electricity production are not relevant for the threshold stipulated in this system ("tank-to-wheel" rather than "well-to-tank"). The fundamental question that is still to be resolved is whether vehicle manufacturers will be prepared to continue engine development for this market segment; it is currently impossible to estimate how significant it will be, especially as requirements for emissions approval (type testing) will again become considerably more stringent when the Euro 7 standard is introduced. The European Commission also set a target to reduce CO_2 emissions from new heavy-duty vehicles by 90% by 2040, as this category accounts for 28% of CO_2 emissions from road traffic in the EU, despite making up only 2% of traffic. HGVs emitting CO_2 emissions from fossil fuels look likely to still be on the road in 2050 when GHG neutrality is to be achieved in the EU, given that HGVs have an average life span of 18 years. Biofuels and e-fuels could offer

Fig. 3: Drive types for HGVs – based on the example of an Iveco S-Way road tractor unit for semi-trailers

Energy source/drive	HP/kW	Capacity	Time needed to fill tank/charge	Tractor weight	Price in EUR (estimated)
Diesel/combustion engine	490 hp/360 kW	up to 1,320 litres	20 minutes	7.2 tonnes	100,000
LNG (gas)	460 hp/338 kW	up to 1,080 litres	12 minutes	7.4 tonnes	140,000
Battery	653 hp/480 kW	up to 738 kWh	120 minutes/350 kW	12.0 tonnes	350,000
Hydrogen combustion cell	653 hp/480 kW	70 kg	20 minutes	12.0 tonnes	475,000
Hydrogen with combustion generator	Currently not known	70 kg	20 minutes	approx. 10.0 tonnes	300,000

Source: Industry estimate

a solution for the existing fleet in this context too. The February 2023 draft proposes that CO_2 reduction targets should become more stringent every five years: 45% by 2030 (compared to 2019), 65% by 2035 and 90% by 2040. That would mean that the internal combustion engine would have a future even after 2040. The CO_2 reduction targets that vehicle manufacturers must comply with refer to the fleet as a whole and are based on the average performance of newly registered vehicles. There is thus good reason to expect that new vehicles will have to be powered predominantly by electricity or hydrogen in 2040, although it will still be possible to supply a small proportion of vehicles with combustion engines. The requirement to attain at least 90% GHG reduction will determine whether biofuels have a role to play a role here. An experience and evaluation report from the Federal Agency for Agriculture and Food (BLE) (*www.ufop.de/ble*, in German) notes that biofuels from residues and waste in particular, such as bio-CNG or LNG from biogas plants, can meet this requirement. Stricter targets are however, envisaged for city buses, which must be essentially emission-free by 2030 and will therefore have to be electrical vehicles. In a presentation on these proposals, European Commission Vice-President Frans Timmermanns expressed great confidence that electrification could be achieved successfully in this context too. UFOP however considers that this optimism fails to truly take account of issues such as the physics of energy transmission or storage, not to mention the cost of nationwide infrastructure for rapid charging stations (incl. power lines) and purchase of suitable vehicles (Fig. 3). The European Commission acknowledged the physics in the proposal it presented in July 2023 ("Greening Freight Package"). This allows vehicle manufacturers to compensate for the battery's additional weight without cutting back on payload by raising the permissible gross weight for zero-emission trucks by 4 t to 44 t. Furthermore, operation of longer heavy vehicles (gigaliners) with a total weight of 60 t is authorised for all EU Member States, but national regulations restrict onward travel. At present, a longer heavy vehicle would, for example, have to reload its freight onto two HGVs at the Danish border with Germany before continuing its journey. The marked increase in the share of e-buses in Germany is primarily due to the considerable public subsidies provided. These are based on the Clean Vehicle Procurement Act (Gesetz über die Beschaffung sauberer Fahrzeuge). Adopted in July 2021, this legislation establishes binding minimum targets for public procurement of low-emission and zero-emission cars and both light and heavy-duty commercial vehicles, especially buses for public transport. In the light of the decision taken by the governing coalition, this Act will be amended to stipulate that only renewable paraffinic fuels from waste oils or fats (HVO/biodiesel) or renewable electricity (e-fuels) may be utilised and to prohibit operation with biofuels from critical biogenic feedstocks (palm oil). UFOP notes an option in this context for marketing rapeseed methyl ester (RME biodiesel).

Germany's Ministry of Transport has presented a comprehensive funding programme for e-fuels to the tune of 1.5 billion Euro, which also includes investment funding to accelerate ramp-up of these technologies. Support will also be provided for innovative processes to produce advanced biofuels from waste and residues (RED II, Annex IX, Part A). Funding is dependent on the feedstock; this, conversely, signifies that processes that produce biofuels from cultivated biomass are not eligible for funding. There was a comprehensive presentation and discussion of this programme at the 20th Conference on Renewable Mobility, see conference review: *bit.ly/KSK23_Bericht* (in German)

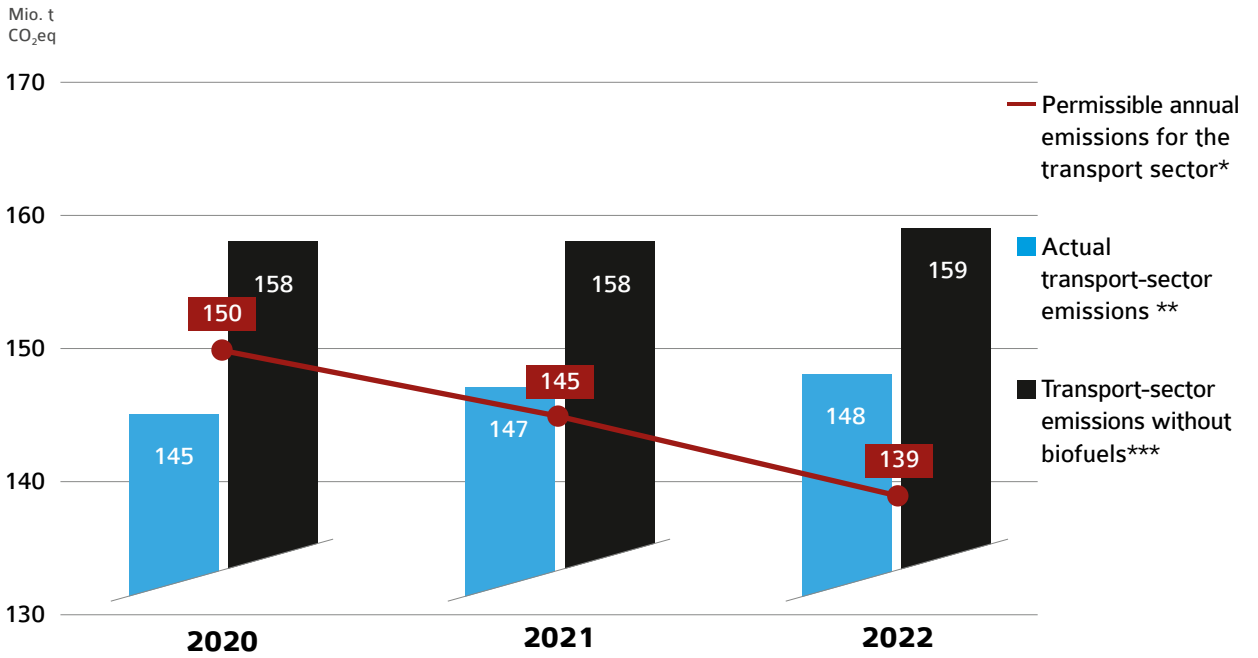
UFOP underlines that liquid fuels fulfil important safety functions in certain areas. That applies in particular to operational safety and durability for vehicles for specific dedicated purposes: fire-fighting vehicles, ambulances, vehicles used by the police, the civil protection services (THW), and the military, etc. The mineral oil industry welcomed this compromise as a prerequisite to start marketing paraffinic fuels with hydrogenated vegetable oil (HVO) as a "door opener". Speakers from the e-fuel Alliance and the Fuels & Energy industry association (en2x) provided information on the objectives, as well as on the general framework and funding conditions required for market ramp-up at the 9th BBE/UFOP seminar on sustainability of alternative fuels. (*www.bioenergie.de/fachseminare/bbe-ufop*, in German).

Transport sector misses the target again

Proof of target fulfilment as stipulated by the German Climate Change Act (Klimaschutzgesetz/ KSG) determines what climate change mitigation policy means in practice for the transport sector. As had been the case the previous year, the 2022 target

Dieter Bockey opening the 9th BBE-UFOP seminar

Fig. 4: Biofuels are crucial for climate change mitigation in the transport sector – emissions reduction through biofuels



*German Climate Change Act (Annex 2) | ** German Environment Agency (UBA) 03/2023 | *** CO_2 savings as per BLE evaluation report 01/2023, UFOP estimate for 2022

of a maximum of 139 million t CO2 eq was exceeded by 9 million t. UFOP emphasised in its assessment that the goal would have been missed by an additional 11 million t CO2 eq without credits due to biofuels. This once again underlines the bridging function of biofuels from certified sustainably cultivated biomass. Like biofuels from residues and waste (Fig. 4), these fuels could contribute even more to climate change mitigation if the upper limits for cultivated biomass and waste oils were adjusted. The German government has taken the first important step in this direction by authorising B10, as Germany exported about 2.3 million tonnes of biodiesel in 2022, potential that should be used domestically and credited towards climate change mitigation targets. It looks likely that other sectors will also fail to achieve the targets. That is why the draft second recast of the Climate Change Act approved by the cabinet envisages offsetting various sectors to compensate for the missed targets. Although the objectives remain unchanged, it will in future be up to the German government to decide in which sector(s) and with which measures the GHG reduction target is to be achieved by 2030. This will be conditional on the sector in question failing to attain the target for two years in a row. The recast is scheduled to enter into force at the end of 2023.

Implementation of Delegated Acts regulates market access for RFNBO and hydrogen

In the light of the April 2023 draft amendments proposed for the 37th Federal Immission Control Ordinance (Bundesimmissionsschutzverordnung/BImSchV), verification requirements for RFNBO (renewable fuels of non-biological origin) and hydrogen will be established as a prerequisite for market access, along with a GHG threshold of at least 70% emissions savings; a further condition that UFOP considers important will be co-processing of waste oils and fats in a refinery process. The feedstocks must correspond to the categories in Annex IX, Part A, RED II. Originally co-processing was only authorised until 2020 and will now be reintroduced. This provision will further intensify competition for raw materials that are in short supply both nationally and internationally and may give rise to crowding-out effects for companies that process feedstocks for biodiesel. At the same time, the introduction of "green" hydrogen creates a basis to add it to the crediting system in co-processing. This ordinance clearly points the way for market access, especially for windy locations in northern Germany that are investing in electrolysers for hydrogen production. However, very restrictive requirements apply for demonstration of the renewable credentials of the electricity used (clear identification); renewable electricity from biomass is not eligible.

Amending provisions on fuel quality – B10 / HVO 100 permitted at filling stations

The draft amendments to the "Fuel Quality Ordinance" (Kraftstoffqualitätsverordnung, 10th BImSchV) presented in June 2023 pave the way for nationwide rollout of HVO (DIN EN 15940) as a pure fuel at public filling stations. Unfortunately, this will not be implemented within Germany until 18 months after the new EU Fuel Quality Directive comes into force (Fig. 5). A higher proportion of biofuel was already permitted at public filling stations, as is still the case; up to 26 % HVO and 7 % biodiesel (outcome: "R 33") can be added to diesel while still remaining in compliance with the diesel standard (DIN EN 590). The draft also expands scope to include B10, as biodiesel manufacturers and their associations have repeatedly urged; B7 must be retained as what is known as a protective grade. Use of B10 calls for approvals to that effect from the vehicle manufacturers. UFOP assumes that this requirement, as well as the limited

Fig. 5: Approval of biodiesel for blending in diesel fuel

	To date		From 2025	
	EU	Germany	EU	Germany
B7	Placing on the market **must** be authorised by MS	Authorisation to place on the market	Placing on the market **must** be authorised by MS	Authorisation to place on the market
B10	Placing on the market **may** be authorised by MS	**No** authorisation to place on the market	Placing on the market **must** be authorised by MS	Authorisation to place on the market
B20/B30	Placing on the market **may** be authorised by MS	**No** authorisation to place on the market	Placing on the market **may** not be authorised by MS	**No** authorisation to place on the market

MS = Member States

number of fuel nozzles at filling stations, will limit demand for B10. Irrespective of these provisions, pure fuels can be marketed directly to fleet operators. Vehicle manufacturers are creating the preconditions for distribution via filling station networks thanks to multiple approvals for HVO. Widespread introduction of HVO consequently paves the way to build up supply of renewable synthetic paraffinic fuels (RFNBO/E-fuels) in the medium and long term. It remains to be seen whether vehicle owners will accept HVO with the anticipated price premium. Fleet operators may become more interested in this fuel alternative, due to mandatory reporting of GHG reductions under the aegis of corporate sustainability reporting requirements (Scope 3), for example in the manufacturing industry. The fuels used by transport companies play an important role, especially as goods are increasingly produced using renewable electricity (further information e.g. Stiftung Allianz für Entwicklung und Klima (Development and Climate Alliance Foundation): bit.ly/Scopes_GHG, in German). It remains to be seen whether logistics companies will be able to reflect this reporting obligation in their pricing; in this respect, B100 may also have good prospects as a cheaper alternative in this "competition for GHG efficiency". The stance adopted by the logistics industry associations on tax concessions for biofuels, as addressed above, should also be viewed in this context.

National Biomass Strategy – NABIS

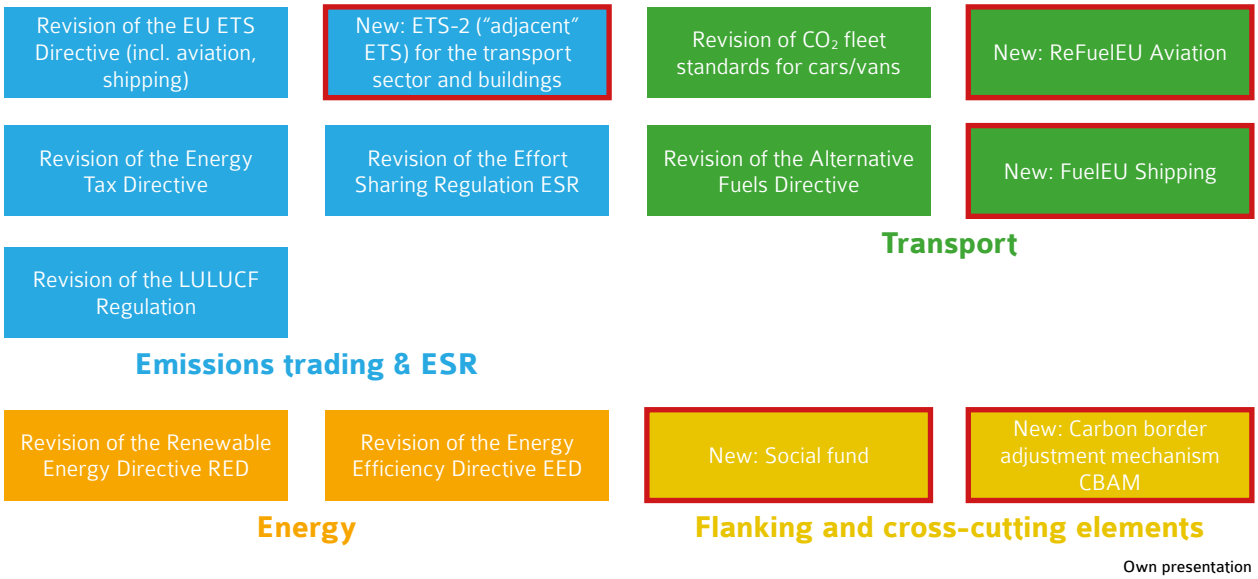
In its coalition agreement the governing coalition proclaimed that bioenergy should have a new future in Germany. The agreement further noted that the government will "develop a sustainable biomass strategy" with a view to achieving this goal. In late September 2022, the German inter-ministerial working group that brings together the Ministry of Economic Affairs and Climate Action (BMWK), the Ministry of Food and Agriculture (BMEL) and the Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) presented a paper with key points for consultation with industry associations. The priorities set out in the paper ("food first" and preference for material use over energy use) are key provisions that may influence how raw materials can be used in future. UFOP criticises the lack of any mention of the extensive existing statutory requirements for cultivation and use, as well as for sustainability certification. These requirements were therefore addressed in detail in a comprehensive statement from the member associations of the German Bioenergy Association (BBE) (bit.ly/42jBxZC, in German). A draft is to be presented to the Federal Cabinet for a decision at the end of 2023. UFOP has emphasised repeatedly the need for a holistic approach to developing a biomass strategy that reflects a "cultivation strategy" that takes due account of synergy effects, such as production of plant protein for animal and human nutrition from oilseed and protein crops. UFOP takes the view that moving away from evaluating specific

crops and instead appraising crop rotation and its effects would have a tangible effect (for example, as fewer imports would be needed), entirely in the spirit of considering the big picture for all ecological impacts, as presented in the paper on key issues.

Green Deal – "Fit for 55" package

In June 2021, the President of the European Commission, Dr. Ursula von der Leyen, presented the largest legislative package by far in the EU's history, setting in motion a transformation process for European industry on the pathway to climate neutrality. This affects all the EU's economic sectors and households. Fig. 6 shows just some of the over 50 proposals put forward by the European Commission. In June 2024, a new European Parliament will be elected and subsequently the the new Presidents and Commissioners will be appointed. Looking back, it is worth noting that the European Parliament and the Councils of Ministers involved have largely kept to the planned timetable. UFOP views the proposals to amend the Renewable Energy Directive as particularly important. The proposed

Fig. 6: Elements of the EU's "Fit-for-55" package



Own presentation

amendments to the Energy Tax Directive and related options for tax-relief for funding support for renewable fuels should be discussed and adopted as rapidly as possible in the forthcoming legislative period, although the need to reach unanimity between EU finance ministers in the Economic and Financial Affairs Council could prove a difficult hurdle to overcome.

RED III – Trilogue decision/EU Effort Sharing Regulation

At the end of March 2023, the Council of Ministers and the European Parliament agreed in a trilogue on amendment of the Renewable Energies Directive (RED III). The following decisions, which are binding for all Member States, are relevant for biofuels prospects (in the period up to 2030):

Overall target for share of renewable energies:

- Increase in the minimum share of renewable energies in gross energy consumption to 42.5%, plus 2.5% as an indicative (non-mandatory) target.

Transport sector:

- Sub-target: share of renewable energies to rise to at least 29% (previously 14%) – as an alternative: reduction of GHG intensity by 14.5% (Germany: GHG quota target: 25%)

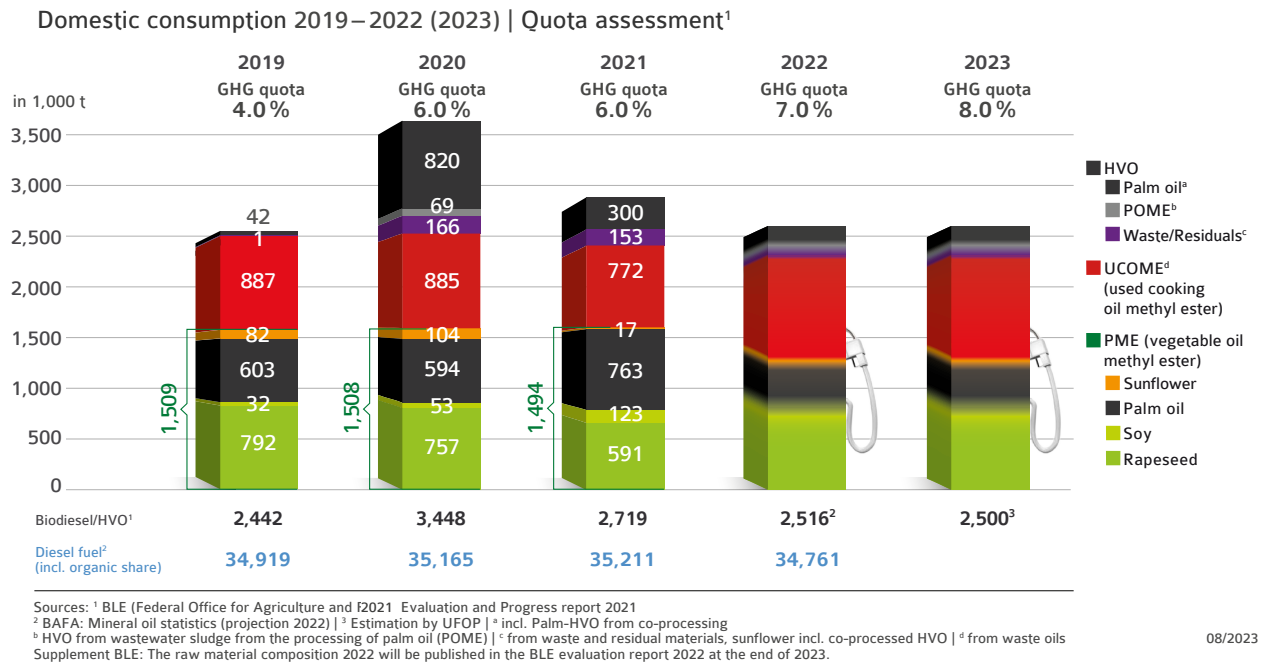
- Combined sub-quota: Biofuels from residues and wastes, Annex IX, Part A: by 2025 at least 1% / by 2030 at least 5.5%, of which at least 1% synthetic renewable fuels/green hydrogen (RFNBO)

- Upper limit for biofuels from cultivated biomass: max. 7 % of final energy consumption in road and rail transport; the previous restriction is maintained (market share in 2020 plus 1%).

RED III offers all Member States the option of introducing a GHG quota obligation, as is already the case in German legislation. Austria introduced provisions along these lines in March 2023 (GHG quota 25 %, penalty payment set at 600 Euro/t CO_2). Authorising Member States to apply multiple crediting for certain compliance options (for example e-mobility with factor 4) means that a commitment that goes beyond the stipulated 14.5 % minimum is required. Differences in penalty payments lead to pricing differentials in transfers of GHG quotas and consequently to displacement and import effects for those biofuels that can achieve the highest GHG reduction, as well as the option of double crediting (Annex, Part A). In UFOP's view it is crucial to introduce harmonised penalty payments. At the same time, additional physical quantities will be required to make a tangible contribution to the GHG reduction obligation in the transport sector, as the EU Effort Sharing Regulation, adopted in November 2022, stipulates stricter national reduction targets for the Member States. By 2030 average GHG emissions in the agriculture, transport, maritime and buildings sectors must be reduced by 40% compared to 2005. The level of mandatory reductions differs as a function of GDP, ranging from 10 % in Bulgaria to 50 % in Germany. The funding instruments and obligations that Member States plan to deploy to meet the reduction targets (e.g. requirement to include renewables in fuel blends) will be set out in the national energy and climate plans that are to be submitted to the European Commission by June 2024.Efficiency in cutting GHG determines feedstock composition/UCOME and the "China problem" – certification systems in the dock?

2021 confirmed once again that certified sustainable biofuels are currently by far the most important option in efforts to decarbonise the transport sector. The BLE evaluation and experience report (*bit.ly/BLE_Bericht_2021*, in German) reports consumption or crediting of over 3.9 million t of biofuels in 2021, with average GHG reduction of 84 %, compared to fossil fuel; approx. 2.72 million t of this total figure were biofuels replacing fossil diesel (biodiesel, HVO) (Fig. 7). Palm oil (biodiesel and HVO) topped the league table with a total of about 1.1 million t, followed by used cooking

Fig. 7: Sales development and feedstock composition for biodiesel/HVO



Sources: [1] BLE (Federal Office for Agriculture and f2021 Evaluation and Progress report 2021
[2] BAFA: Mineral oil statistics (projection 2022) | [3] Estimation by UFOP | [a] incl. Palm-HVO from co-processing
[b] HVO from wastewater sludge from the processing of palm oil (POME) | [c] from waste and residual materials, sunflower incl. co-processed HVO | [d] from waste oils
Supplement BLE: The raw material composition 2022 will be published in the BLE evaluation report 2022 at the end of 2023.

08/2023

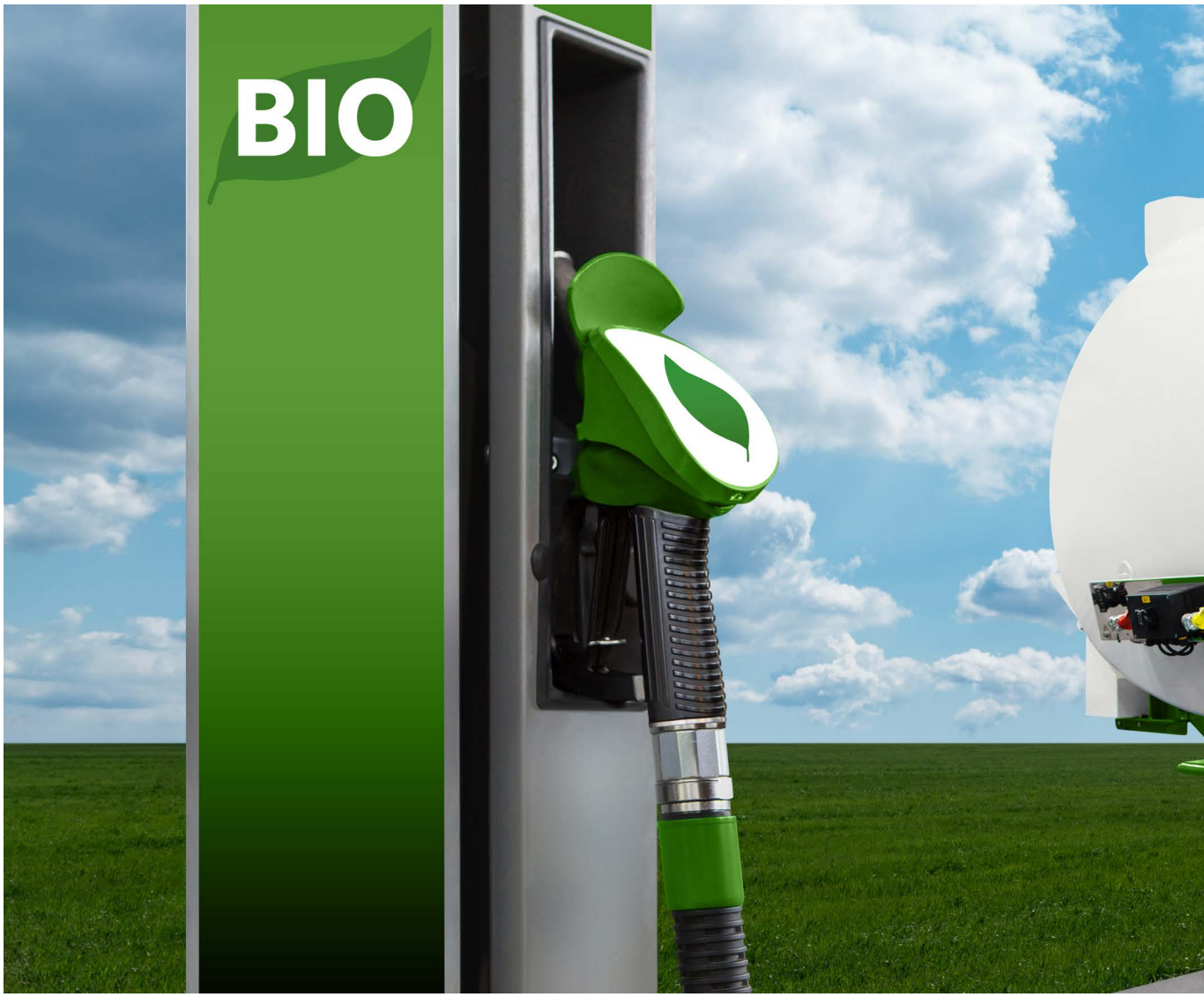
oils and fats at about 0.92 million t, with rapeseed oil accounting for about 0.6 million t. Compared to 2020, HVO from palm oil in particular made up a lower proportion of the total, falling by 0.52 to 0.3 million tonnes. As a general rule, HVO plays an important part in fulfilling the GHG reduction obligation as up to 26% HVO may be added to diesel blends without breaching the relevant standard. UFOP views the share of waste-based biofuels, which has risen to 34%, as particularly noteworthy. This is a significant development as biofuels from palm oil became ineligible for crediting towards quota obligations at the start of 2023. Palm oil has also been banned as a feedstock in other Member States. Alternatives will need to be found to make up for the ensuing shortfall of about 1 million tonnes of palm oil in Germany alone in 2023.

This shortfall may explain the marked increase since the end of 2022 in imports of waste-based biodiesel from China declared as "advanced" fuel. The incentive for these imports, in some cases linked to suspicions of fraud, arose from the possibility of double crediting, provided that the biofuel was demonstrably produced from waste as stipulated in Part A, Annex IX, RED. Depending on the source, data concerning the volume of additional imports varies by several 100.000 t. It is nevertheless not possible to explain the increased quantities allegedly produced with this feedstock. There is much uncertainty as to whether the capacities and plant technologies required to process such feedstocks are available on the spot in China. There are some suspicions concerning re-declaration, as it is impossible to prove the feedstock's characteristics/origin through analysis of the end product. As a result of such imports, GHG quota trading prices have been cut in half, falling from 400 EUR/t CO_2 to less than 200 EUR/t CO_2. As well as affecting producers and trading companies who work with liquid biofuels, this also has an impact on biogas plant operators who have converted to biomethane production or plan to invest in converting their facilities. Questions have also been raised in public concerning quality standards for sustainability certification and certification bodies. Biofuels certified as sustainable are, after all, "trust-based products" in terms of product characteristics. UFOP points out that this holds true as a general rule for all certification of feedstock or products that must be shown to have certain characteristics to obtain market access. During debate on these issues between industry associations and the world of politics, UFOP has contributed specific proposals to make on-the-spot certification more rigorous. Public discussion of the topic ultimately sparked what is known as a minor interpellation, a query that the CDU/CSU parliamentary group in the Bundestag addressed to the Federal Government (reply: Drucksache 20/7327, *bit.ly/7327*, in German). The European Commission is involved in the procedure, along with BLE as the competent authority. The Commission points out that the launch of the EU database means all companies in the commodity chain must register, thus improving transparency and traceability. UFOP is of the opinion that questions must be raised as to whether double crediting towards the GHG quota should be categorised as a form of excessive subsidy that would constitute an incentive to fraud. German legislation provides for double crediting, with no limit as to the quantity credited, for waste-based biofuels pursuant to Part A, Annex IX, if the legally prescribed minimum share of 0.3% is exceeded for 2023 as a quota year. UFOP is of the opinion that this threshold is far too low, even if it is set to rise gradually to 2.6% by 2030. A considerable degree of market impact has been observed, as would also be the case if the biodiesel imports from China were certified correctly.

The rapeseed market is likewise affected, as the leverage effect of double crediting leads to inappropriate value creation (excessive subsidy) and to a physical crowding-out effect for biofuels with a poorer GHG balance, e. g. those produced from rapeseed oil. It should be noted that the physical volumes are displaced by virtual volumes (double crediting) at the expense of any genuine contribution to climate protection. UFOP therefore calls for the abolition of double crediting for biofuels made from waste oils and fats. The funding category of "advanced" biofuels is intended to promote use of waste and residues that require extensive investment in technological innovations to enable processing.

Conclusion and outlook

The fundamental question is what kind of prospects rapeseed oil has as a feedstock for biofuel production against the background of this regulatory framework. Regulations at European and national level are constantly becoming broader in scope and addressing issues in greater depth. UFOP is committed to ensuring future prospects for rapeseed oil as an iLUC-free feedstock, in the light of the potential for sustainable cultivation. This potential forms part of a broader landscape of emerging alternatives; in terms of their actual contribution to GHG reduction, particularly given the gradual increase in the share of renewables in the electricity



That does not apply for waste oils and fats. Instead, double funding should be restricted to biofuels from agricultural residues and waste, e. g. straw, slurry (see Annex IX, Part A). As it is not worth transporting these feedstocks over long distances, the potential for value creation remains in the agricultural sector and thus in rural areas. Innovative technologies (c.f. bio-LNG) that require higher investment levels can boost the innovation potential of existing biogas plants for biomethane production (approx. 9,000 in Germany). Processing residues on farms helps safeguard the nutrient cycle and thus reduces demand for mineral fertiliser while also contributing to the humus balance.

mix, these options will only make an effective contribution (i.e. without crediting factors) to cutting GHG in the transport sector in the medium to long term. In the meantime, considerable public funding will need to go into developing innovative drive technologies (efficiency gains) and providing investment support for the first large-scale plants producing synthetic fuels (first movers). In this respect, the "Fit for 55" package has opened up myriad options on the regulatory front.

It is vital to factor in and acknowledge the potential for certified sustainable rapeseed oil to provide buffer volumes

and contribute to transport-sector decarbonisation. Given the immense challenge of substituting fossil fuels in transport, this is just one building block in efforts to attain greenhouse gas neutrality by 2050. As we move towards that objective, rapeseed oil will become increasingly important in food and as an input for material uses within the carbon cycle.

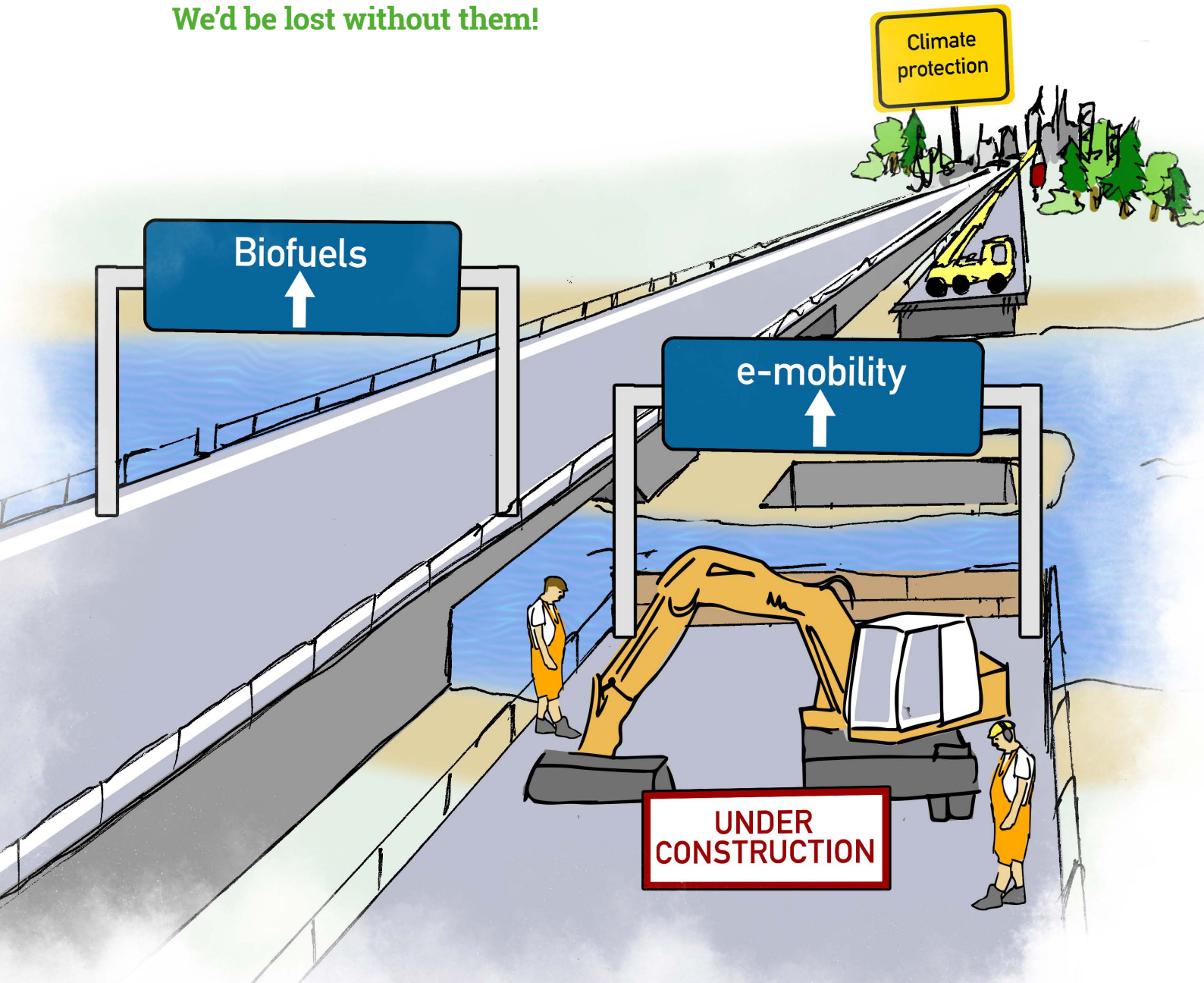
New regulations must respond to complex inter-related impacts, especially the pioneering role of biofuels in sustainability certification, which must also be implemented and monitored in third countries (to ensure a level playing field). In future, this should also include holistic appraisal of cultivation systems for feedstock production. As a general rule, sustainability certification does not vary as a function of the end use; it only becomes a statutory requirement if the product is marketed for a specific purpose. That means that by-products that arise in the commodity chain must be included in the GHG balance-sheet (substitution method).

To date, there has not been a holistic debate on how to ensure that ecosystem services in arable farming are economically sustainable, also in the light of shaping positive public opinions about agriculture. This is by no means a new issue: in 2016, the Technologie und Förderzentrum für nachwachsende Rohstoffe (Technology and Support Centre for Renewable Resources/TFZ), Straubing, Germany, noted in a report on ecosystem services in agriculture developed during the ExpRessBio project (bit.ly/ExpRessBio, in German): "As a result of the stipulated calculation methodologies, interactions between biomass, bioenergy and food production (cultivation of food crops, animal husbandry) are underestimated or are not taken into account at all (e.g. impact of crop rotation) in the EU. Further environmental, social and economic impact analyses are needed, along with studies on material flows and potential, in order to develop resource strategies".

The time has come to implement these approaches in farming practice, for agriculture in particular faces the challenge of reacting to the tangible consequences of climate change.

BIOFUELS: A BRIDGING TECHNOLOGY:

We'd be lost without them!



By 2030, Germany aims to cut its greenhouse gas emissions by at least 65 percent compared to 1990 levels. The transport sector has also adopted its own ambitious targets to slash greenhouse gas emissions.

Germany's Climate Change Act (Klimaschutzgesetz/KSG) stipulates that emissions must be reduced from the current 134 million tonnes to 85 million tonnes CO_2 eq. per annum.* That will call for a comprehensive strategic approach, combining an energy turn-around with a similar transformation in the transport sector: in other words, changing over to renewable energy sources (including biofuels) and renewable generation methods (electricity, electromobility), combined with switching to buses and trains as well as cutting down on flights. The problem is that none of these approaches will be enough on their own. Over the last two years, the transport sector has failed to achieve the greenhouse gas reduction target stipulated in the Climate Change Act (2021: 145 million t /2022: 139 million t CO_2 eq.): exceeding it in 2021 by 3 million t CO_2 eq., while already notching up a shortfall at the time of writing in 2022 of 9 million t CO_2 eq. Many experts are well aware that today's commercially available renewable fuels are already indispensable and will remain just as crucial in years to come. CO_2 reduction is already being put into practice when we fill our tanks, as biofuels are added to blends – as we can see whenever we're at a filling station (logos here for B7 / E5 /

E10). The proportion of biofuels could be increased immediately, for example by switching to B30 or B100 for heavy-duty transport, an option opened up by fuel-use approvals from vehicle manufacturers.

Positive impact: Biofuels can make use of existing infrastructure (e.g. filling stations, transport logistics), thus avoiding additional investment. Biofuels have long made a huge contribution to climate change mitigation, with standard-rate taxation to boot. In 2021 sustainable biofuels enabled savings of over 11 million t CO_2 eq. in road transport.**Those are official figures. By 2030, the total could rise to 175 million t CO_2 eq. Higher blend levels in diesel and petrol would further boost greenhouse gas savings. In the light of biomass potential available sustainably, there is always a natural limit to biofuels' contribution to climate change mitigation; however, as these fuels have already been launched, they play an important bridging function in electrification with renewable electricity. Tapping into the potential of wind power and photovoltaics with rapid expansion of these technologies is vital, in Germany and beyond. Despite substantial energy savings, Germany remains dependent on energy imports. That explains why the German government is pulling out all the stops to foster development of a wide range of synthetic fuels for a broad spectrum of applications (aviation and maritime transport). Increasing use of renewables in vehicles thanks to blends with a higher percentage of biofuels helps make headway on decarbonising the large fleet of older vehicles powered by internal combustion engines that will be with us for decades. That challenge will remain on the agenda although new registrations of combustion engine cars are be terminated in 2035.

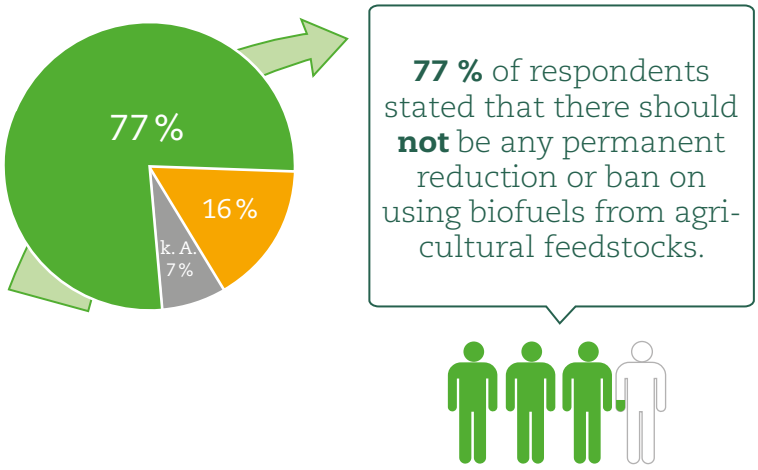
* CO_2 eq.= CO_2 equivalent = unit of measurement for comparison of greenhouse gas emissions
** Cf. Federal Office for Agriculture and Food (BLE) evaluation and experience report

Fig. 8: Survey: The Majority favours keeping Biofuels

A representative survey* asked the following question:

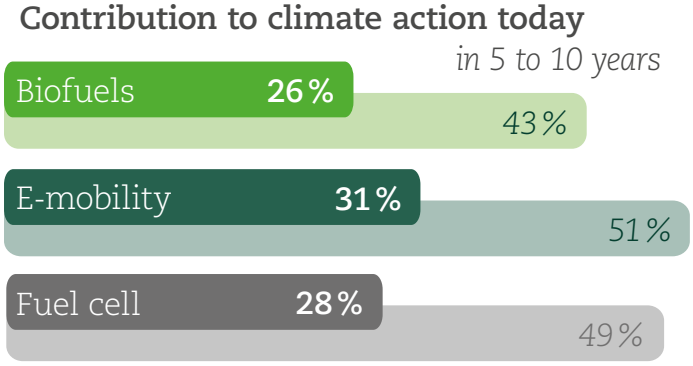
Biofuels reduce CO_2 emissions but agricultural feedstocks are in high demand due to the Ukraine crisis. How should policy-makers react?

Over three quarters of the general public are in favour of continuing to use biofuels in the transport sector on a permanent basis. That remains the case despite the war in Ukraine, which has sparked greater demand for agricultural feedstocks like vegetable oils and feed grains that are also used for biofuel production.



How much do you think the following drive concepts really contribute today to reducing gases that drive climate change and how will things look in 5 to 10 years?

Many consumers have long since realised that climate-friendly motorisation is only possible with a diverse and sustainable fuel mix. They predict that in five or ten years biofuels will make almost as significant a contribution to climate change mitigation as e-mobility and hydrogen technologies.



* via market research institute KANTAR (1,009 respondents), June 2022

FACT CHECKING MOBILITY IN GERMANY

How do biofuels relate to food security, energy imports, climate change mitigation and prices? This fact check also reveals why we need liquid fuels from rapeseed & co.

Spring 2022 saw considerable price rises on global agricultural markets, especially for grain, oilseeds, and vegetable oil. The market situation has since eased, as reflected in significantly lower prices. The market or rather trading companies in the European Union managed to make up for the shortfall in supply caused by Russia's war against Ukraine, switching from sunflower oil to rapeseed oil and shifting grain exports to rail and HGVs. There is currently an enormous grain surplus in Poland, Hungary, and Romania – grain prices have plummeted in those countries.

The tense supply situation in 2022 unsettled international markets and was instrumentalised in calls for gradual phasing-out of biofuels from grain, rapeseed, and other crops. The following six facts reveal why that would be the wrong decision and could even cause food shortages.

Fact 1:

Biofuels feed our livestock and reduce imports

During manufacture of certified sustainable biofuels from oilseeds and cereals, essential protein feedstuffs for animal nutrition are made as by-products. These feedstuffs play an important part in the entire food chain. In terms of yield per hectare, biofuel production predominantly supplies high-quality protein feedstuffs that have the advantage of being produced locally. 1.5 kilogrammes of readily digestible rapeseed meal

are generated for every litre of biodiesel. As high-quality feed for cows, pigs and poultry, it underpins production of dairy products, meat and sausages, and eggs. Rapeseed and cereals for biofuel manufacture improve supplies of fodder protein from domestic production; as a result, fewer soy imports are needed, diminishing demand for land to cultivate soy in exporting countries and turning the regional nutrient cycle into a closed-loop system.

Fact 2:

Biofuels support the market and food supplies

Reducing production of biofuels from agricultural commodities would run counter to efforts to safeguard stable feed and food supplies sourced largely within the country with secure regional supply chains. Agricultural products intended for biofuel production can be viewed as a strategic reserve that helps keep us prepared for crop failures or future shortages triggered by political tensions. As these products are available on the spot, they can be transferred to food markets at any time should the need arise. In spring 2022, rapeseed was not used to make biodiesel but bottled as cooking oil to compensate for shortages of sunflower oil; prices fell in parallel.

Fact 3:

Biofuels make us less dependent on energy imports

High prices and energy shortages make it crystal clear that Germany needs to drastically reduce its dependency on fossil gas and crude oil. 2.5 million tonnes of biodiesel made a noteworthy contribution to energy supply security for the German transport sector in 2022. It replaced fossil fuel imports from often unstable regions or autocratic countries. This volume of biodiesel corresponds to around eight "giant tankers".

Fact 4:

Biofuels are indispensable for immediate climate action in the transport sector

Biofuels provide an option to fulfil greenhouse gas reduction obligations, which will increase from 8% in 2023 to 25% in 2030. They can be found at filling stations in clearly labelled blends with diesel and petrol (B7, E5 / E10). Biofuels cut greenhouse gas emissions on average by 84.4% compared to fossil fuels and thus ensure savings of over 11 million t. CO_2 eq. per annum. In Germany, biofuels are currently the most important instrument for emissions reductions to make the transport sector more climate-friendly.

Fact 5:

Biofuels enable a new bioeconomy

Applications exist in many industrial sectors for substances found in biofuel feedstocks. Lecithin for example, which is produced when processing rapeseed or sunflower seeds, is used as a plant-based emulsifier for bread and other baked goods, in margarine, and in a host of further applications: in medicine, cosmetics, food supplements, and beverages. Glycerol is a sugar alcohol obtained when producing vegetable oil (transesterification), e.g. rapeseed or sunflower oil. It is widely used as a bio-based commodity chemical in pharmaceuticals, detergents, body care products, and cosmetics.

Fact 6:

Low demand for land for biofuels globally

Crops like cereals, oilseeds, sugar beet and sugar cane were grown on approximately 1.4 billion ha worldwide in 2021. A large proportion of the harvest was used for food, either directly or indirectly by feeding livestock. Only about 8 % of the cultivated area was used to supply feedstocks for biofuel production.

HOW CAN AGRICULTURE CUT ITS EMISSIONS?

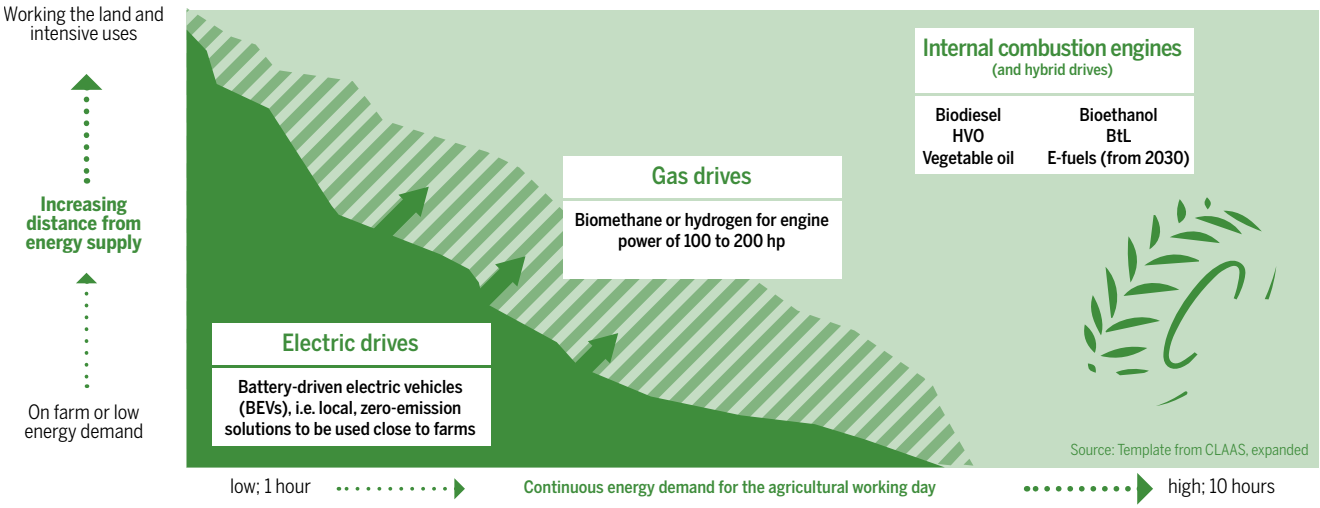
Agriculture and forestry belong to the primary sector, i.e. the part of the economy involved in primary production of raw materials.

The current challenges of energy supply security and climate protection underscore how urgent it is for our society and economy to make the switch from fossil fuels to renewable energies. Energy consumption in agriculture and forestry gives rise to around 6 million tonnes CO_2 emissions a year. Two thirds of emissions stem from use of fossil fuels in agricultural and forestry machinery.

Fossil-free drives

Despite ongoing development and increasing electrification of agricultural and forestry equipment, including machinery for smaller and lighter jobs, there is currently no prospect of switching to e-mobility for medium and high-load work. In this context, sustainable biofuels (biodiesel, vegetable oil, biomethane, etc.) and other renewable fuels offer viable solutions that have already proved their worth in practice for years. Existing vehicles can be converted. New models approved for non-fossil fuels are already on

Fig. 9: Use of Renewable Drive Power in Agriculture and Forestry



Mobility in agriculture is viable without mineral oil. More information on the website of the Plattform Erneuerbare Antriebsenergie für die Land- und Forstwirtschaft (Renewable Drive Energy Platform for Agriculture and Forestry): *www.erneuerbar-tanken.de* (in German)

A range of climate-friendly, low-emission drive systems is available to meet demand for varying distances, durations and operating power. E-tractors are a perfect match for short tasks close to farms, for fruit and vegetable cultivation or in viticulture. Biomethane tractor drives offer up to 200 hp engine power and are a good fit for normal, less intensive work in the fields. Heavy-duty tasks and longer periods working the land, for example ploughing or harvesting, demand high horsepower capacity. Tractors can run on liquid biofuels for that type of work. Existing tractors can also be converted. Fuel for tractors run on vegetable oil can be obtained from regional oil mills, ensuring the added value remains within the rural region.

the market – many manufacturers have further innovations in the pipeline. That offers scope to save up to 3 million tonnes of CO_2 annually. In addition, lubricants and hydraulic oils can also be replaced by bio-alternatives. Furthermore, biofuels, being bio-degradable, are either risk-free or very low risk for farmland and forest soils should there be an accident.

Self-sufficiency is feasible

Biofuels produced from rapeseed or bio-methane in biogas plants on farms in Germany can be used in farm vehicle fleets too. 90 % of the domestic rapeseed harvest (i.e. 1.9 million tonnes of rapeseed oil from 1.2 million hectares of rapeseed cultivation) would be enough to supply fuel to the entire German agricultural and forestry sector.

Three questions for Prof. Dr.-Ing. Peter Pickel

1. From 2035, new registrations of cars that run on petrol or diesel will not be permitted in the EU. But what will happen to agricultural tractors at that point?

"The ban on combustion engines from 2035 will not apply to agricultural tractors and harvesting machinery. We can only speculate as to whether that kind of restriction or ban will be introduced subsequently. Major tractor manufacturers are already developing alternative mobility concepts at present, using batteries, hydrogen or e-fuels, biomethane/biogas or biodiesel as energy sources. That is also a response to sector-specific emission reduction targets for agriculture; using climate-friendly vehicles on your farm can make it easier to achieve those goals."

2. How can farms already adopt a more climate-friendly approach with their current fleet? And how can they switch rapidly and successfully to renewable drive power?

"Sustainable biofuels produced in the agricultural sector such as vegetable oil or biodiesel could be used as fuels in that sector too. There are already feasible conversion options for engines in existing tractor fleets that demand little technological effort and farmers can continue to use existing supply logistics for fuel. However, subsidies still available for standard mineral diesel for agricultural purposes, along with high taxation of biofuels, may be obstacles to these options. Legislators need to take action and establish the right incentives."

3. Can farms in Germany actually be self-sufficient in energy and fuel?

"Tractors that can run on pure vegetable oil have been around for a while now. Developing fuel self-sufficiency as locally as possible or with a decentralised system makes agriculture less vulnerable to supply insecurity and to oil prices on the world market, while also providing local customers for decentralised oil mills. This creates a bioeconomy in rural areas that promotes regional value creation."

Prof. Dr.-Ing. Peter Pickel
Expert on renewable drive power
at John Deere

Tabular Annex

TABULAR ANNEX

Biofuels

Table 1: Germany: Development of biofuel consumption since 1990
Table 2: Germany: Domestic consumption of biofuels 2017 – 2022 in 1,000 t
Table 3: Germany: Monthly domestic consumption of biofuels 2017 – 2022 in 1,000 t
Table 4: Germany: Foreign trade in biodiesel 2017 – 2022 in t
Table 5: Germany: Export of biodiesel [FAME] (2017 – 2022) in t
Table 6: Germany: Import of biodiesel [FAME] (2017 – 2022) in t
Table 7: Preliminary statistical data on the fulfilment of the greenhouse gas quota 2016 – 2021
Table 8: Statistical data on the fulfilment of the progressive quota – quota year 2021
Table 9: (Bio-)fuel production capacities 2023 in Germany
Table 10: UCO imports by the EU in 2022 (mt)
Table 11: EU production of biodiesel and HVO 2015 – 2022 in 1,000 t
Table 12: Global biodiesel and HVO production 2015 – 2022 in 1,000 t
Table 13: Global biodiesel and HVO consumption 2015 – 2022 in 1,000 t

Biofuel mandates

Table 14: National biofuel mandates 2023
Table 15: Biofuel mandates in the EU for selected member states

Tables BLE Evaluation Report 2021

Table 16: Germany: Biofuel feedstocks in terajoules (TJ)
Table 17: Germany: Biofuel feedstocks in 1,000 t
Table 18: Germany: Biofuel feedstocks by origin in terajoules
Table 19: Germany: Biofuel feedstocks by origin in 1,000 t
Table 20: Germany: Total biofuel feedstocks
Table 21: Biofuels whose feedstock originates from Germany [TJ]
Table 22: Germany: Emissions and emission savings of biofuels

Legend/explanation of symbols in the tables:

–	nothing or less than one unit
.	no information available until editorial deadline
0	less than half of 1 in the final digit shown, but more than nothing
/	no information, since the numeric value is not reliable enough
()	Numeric value statistically relatively unreliable

Biofuels

Table 1: Germany: Development of biofuel consumption since 1990

Year	Biodiesel[1)]	Vegetable oil	Bioethanol	Total renewable Fuel supply
				Specification in 1,000 tonnes
1990	0	0	0	**0**
1995	35	5	0	**40**
2000	250	16	0	**266**
2001	350	20	0	**370**
2002	550	24	0	**574**
2003	800	28	0	**828**
2004	1,017	33	65	**1,115**
2005	1,800	196	238	**2,234**
2006	2,817	711	512	**4,040**
2007	3,318	838	460	**4,616**
2008	2,695	401	625	**3,721**
2009	2,431	100	892	**3,423**
2010	2,529	61	1,165	**3,755**
2011	2,426	20	1,233	**3,679**
2012	2,479	25	1,249	**3,753**
2013	2,213	1	1,208	**3,422**
2014	2,363	6	1,229	**3,598**
2015	2,149	2	1,173	**3,324**
2016	2,154	3	1,175	**3,332**
2017	2,216	0	1,156	**3,372**
2018	2,324	0	1,187	**3,511**
2019	2,348	0	1,161	**3,509**
2020	3,025	0	1,097	**4,122**
2021	2,560	0	1,153	**3,713**
2022	2,516	0	1,186	**3,702**

Sources: BAFA, BLE
[1)] ab 2012 inkl. HVO
Data 2022 prelimenary

Table 2: Germany: Domestic consumption of biofuels 2017–2022 in 1,000 t

	2017	2018	2019	2020	2021	2022
Biodiesel admixture	2,215.9	2,323.3	2,301.4	3,026.0	2,534.0	2,500.1
Biodiesel pure fuel	.	.	.	.	.	.
Total biodiesel	**2,215.9**	**2,323.3**	**2,301.4**	**3,025.3**	**2,534.0**	**2,500.1**
Vegetable oil	.	.	.	.	.	.
Total biodiesel & veg oil	**2,215.9**	**2,323.3**	**2,301.4**	**3,025.3**	**2,534.0**	**2,500.1**
Diesel fuel	36,486.7	35,151.7	35,546.8	32,139.4	32,677.3	32,035,.4
Share of admixture in %	5.7	6.2	6.1	8.6	7.2	7.2
Total fuels	**38,702.5**	**37,475.0**	**37,848.2**	**35,164.8**	**35,211.3**	**34,535.6**
Bioethanol ETBE	111.4	109.9	88.1	125.8	157.4	131.3
Bioethanol admixture	1,045.1	1,077.4	1,054.6	971.7	990.3	1,051.9
Bioethanol E 85	.	.	.	.	.	.
Total bioethanol	**1,156.5**	**1,187.4**	**1,142.7**	**1,097.5**	**1,147.7**	**1,183.2**
Petroleum fuels	17,139.5	16,649.7	16,823.2	15,120.4	15,366.9	15,776.1
Petroleum + bioethanol fuels	18,296.0	17,837.1	17,965.9	16,217.9	16,514.6	16,959.2
Share of bioethanol in %	6.3	6.7	6.4	6.8	6.9	7.0

Data 2022 prelimenary

Sources: German Federal Office of Economics and Export Control, AMI

Table 3: Germany: Monthly domestic consumption of biofuels 2017–2022 in 1,000 t

	2017	2018	2019	2020	2021	2022
Biodiesel blending						
January	160.22	182.81	182.62	221.72	172.19	180.41
February	134.45	176.12	145.13	212.69	157.71	206.67
March	206.45	203.28	172.67	221.96	182.48	235.94
April	174.91	196.00	180.57	194.34	211.29	214.41
May	178.44	204.94	185.78	242.25	204.73	206.48
June	190.17	197.08	191.11	227.75	210.05	195.00
July	205.92	225.16	220.98	288.80	232.45	200.81
August	207.11	212.19	214.37	282.56	266.71	212.96
September	200.18	190.39	204.33	303.29	260.45	200.22
October	189.94	184.91	198.19	271.76	248.84	214.93
November	193.99	173.29	204.24	229.77	197.61	217.48
December	174.14	177.17	201.44	209.55	186.54	214.83
Average	**184.66**	**193.61**	**191.79**	**242.20**	**210.92**	**208.34**
Total amount	**2,215.90**	**2,323.33**	**2,301.42**	**2,906.44**	**2,531.03**	**2,500.14**
Bioethanol						
January	88.22	104.92	95.26	102.21	101.78	94.47
February	77.26	87.45	81.95	95.53	95.42	83.64
March	90.33	98.15	82.28	84.99	84.84	98.46
April	99.86	95.30	89.45	60.84	60.80	112.33
May	105.50	106.85	103.94	89.23	89.21	94.09
June	95.47	103.01	100.48	93.68	93.60	90.91
July	106.32	104.91	99.77	112.67	112.45	102.73
August	102.98	109.72	94.37	105.04	104.84	105.35
September	96.11	92.64	96.81	92.12	92.14	99.44
October	102.59	95.94	101.45	100.67	100.69	97.03
November	91.55	93.70	100.66	86.26	86.22	105.12
December	100.33	94.75	96.28	75.84	75.84	99.60
Average	**96.38**	**98.95**	**95.22**	**91.59**	**91.49**	**98.60**
Total amount	**1,156.52**	**1,187.36**	**1,142.68**	**1,099.08**	**1,097.83**	**1,183.17**

Data 2022 prelimenary
Sources: German Federal Office of Economics and Export Control, AMI

Table 4: Germany: Foreign trade in biodiesel 2017–2022 in t

	2017	2018	2019	2020	2021	2022
Import of biodiesel						
January	43,930	85,583	97,340	118,498	52,484	102,306
February	45,251	78,473	71,163	103,546	45,214	89,925
March	58,354	115,706	86,856	93,790	53,510	99,415
April	67,174	116,581	122,073	119,514	84,349	184,858
May	69,232	138,737	124,686	143,256	105,065	131,082
June	57,016	130,556	107,161	186,604	92,248	164,804
July	78,880	121,159	159,543	159,334	107,870	115,982
August	80,471	92,421	126,501	170,039	99,627	218,193
September	75,286	127,237	155,319	122,840	139,342	135,985
October	82,373	79,313	112,635	87,584	110,481	96,935
November	70,296	55,765	111,581	91,980	85,252	104,318
December	59,883	75,638	130,722	86,543	133,541	97,954
total	**788,145**	**1,217,168**	**1,405,579**	**1,483,526**	**1,108,982**	**1,541,757**
Biodiesel export						
January	113,367	141,104	183,590	206,446	212,388	213,882
February	121,281	156,687	193,992	195,023	172,209	280,148
March	101,721	143,594	205,928	193,790	165,372	261,387
April	152,217	172,016	169,000	183,303	191,654	198,045
May	137,679	114,487	230,393	133,350	201,186	134,218
June	148,797	166,584	163,145	260,696	190,130	209,972
July	114,460	155,086	172,055	187,574	176,678	149,087
August	127,871	191,730	192,742	218,806	190,007	237,327
September	155,532	173,519	197,228	238,532	199,481	297,501
October	165,812	181,676	193,140	166,365	196,706	259,595
November	120,172	170,864	181,609	181,040	218,676	239,281
December	149,643	176,551	177,904	247,227	210,784	237,430
total	**1,608,550**	**1,943,897**	**2,260,727**	**2,412,153**	**2,325,268**	**2,717,871**

Note: Data for 2022 prelimenary
Sources: Federal Statistics Office of Germany, AMI

Table 5: Germany: Export of biodiesel [FAME] (2017–2022) in t

	2017	2018	2019	2020	2021	2022
Belgium	84,487	132,413	264,411	342,420	394,883	636,310
Bulgaria	1	1	1	1,200	5	1
Denmark	88,317	39,511	27,269	22,451	22,649	17,909
Estonia	24	.	.	1.890	786	337
Finland	12,734	9,156	2,626	525	790	635
France	76,339	64,945	53,701	68,473	76,455	55,485
Greece	2	3	1	.	.	.
Ireland	.	.	.	0	.	.
Italy	11,698	5,410	12,829	17,848	28,693	20,490
Croatia	.	.	500	100	1,013	2
Latvia	.	50	0	242	11,912	.
Lithuania	1.,198	660	977	1,920	17,720	1
Luxembourg	0	308	417	.	.	50
Malta	.	.	.	.	.	.
Netherlands	583,289	667,121	855,472	1,032,521	961,937	1,164,895
Austria	97,500	185,335	171,617	137,019	127,092	60,655
Poland	236,404	242,008	239,225	261,153	240,008	248,917
Portugal	9	8	8	4	5	8
Romania	-	-	-	3,935	22,214	4
Sweden	73,089	138,524	135,833	116,794	108,827	97,859
Slovakia	5,595	12,486	21,271	18,411	11,416	1,926
Slovenia	1,651	14,988	34,917	32,719	42,480	18,962
Spain	33,388	274	350	669	77	163
Czech republic	88,212	61,155	56,036	26,308	35,280	25,997
Hungary	3,488	4,902	315	7,072	531	778
Cyprus	.	.	.	.	.	
EU-27	**1,397,422**	**1,579,258**	**1,877,773**	**2,093,672**	**2,104,773**	**2,351,380**
USA	70,091	197,412	183,250	164,062	144,071	287,209
Switzerland	70,152	97,819	83,865	79,358	74,878	77,801
UK	40,016	50,581	107,902	67,004	964	634
Other countries	30,869	18,827	7,937	8,057	582	847
Insgesamt	**1,608,550**	**1,943,897**	**2,260,727**	**2,412,153**	**2,325,268**	**2,717,871**

Note: Data for 2022 provisional
Sources: Federal Statistics Office of Germany, AMI

Table 6: Germany: Import of biodiesel [FAME] (2017–2022) in t

	2017	2018	2019	2020	2021	2022
Belgium	136,199	236,150	293,449	296,691	229,363	334,418
Bulgaria	20,388	33,142	24,954	25,302	12,816	30,879
Denmark	3,599	532	1,001	785	76	121
Estonia	.	.	23	.	.	.
Finland	.	.	.	1,992	18,020	37,058
France	14,283	9,678	21,749	73,519	77,287	42,474
Greece	.	.	.	.	.	
Italy	3,003	827	33	177	1,017	732
Lithuania	.	536	.	.	.	.
Netherlands	300,959	618,523	713,134	701,379	519,418	758,521
Austria	92,837	90,538	80,537	84,274	31,452	88,318
Poland	70,498	88,955	94,316	138,690	116,362	86,771
Romania	.	.	25	3,440	8,213	2,287
Sweden	140	1	9	2	15	78
Slovakia	6,549	959	1,464	2,278	249	3,642
Slovenia	1,929	1,341	.	0	0	1
Spain	.	1,001	27	.	.	.
Czech republic	2,460	922	12,987	7,551	22,753	30,569
Hungary	193	.	.	.	114	23
Cyprus	.	.	.	.	.	.
EU-27	**653,038**	**1,083,104**	**1,243,706**	**1,336,081**	**1,037,153**	**1,416,167**
Malaysia	124,458	128,109	153,182	139,309	64,654	119,136
Philippines	2,989	2,988	1,517	263	1,255	1,877
Canada	.	.	.	968	1,152	1,415
Indonesia	3,309	718	44	239	2,244	1,106
United Kingdom	608	709	5,992	354	5	1
Other countries	3,743	1,540	1,138	6,312	2,519	2,055
Total	**788,145**	**1,217,168**	**1,405,579**	**1,483,526**	**1,108,982**	**1,541,757**

Note: Data for 2022 provisional
Sources: Federal Statistics Office of Germany, AMI

Table 7: Preliminary statistical data on the fulfilment of the greenhouse gas quota 2016 – 2021

	2016	2017	2018	2019	2020	2021
Quotas placed on the quantities placed on the market (Quantities in million litres)						
Diesel fuel	41,794	42,372	41,746	41,701	37,513	37,344
Petroleum fuels	23,126	22,935	23,105	23,432	20,981	20,583
For the fulfilment of the Greenhouse gas reduction quantity required in t CO_{2eq}						
Reference value	197,616,061	198,806,042	224,409,745	225,553,789	207,950,673	203,526,286
Target value	6,916,562 (-3,5%)	7,952,240 (-4,0%)	215,433,356 (-4%)	216,531,638 (-4%)	195,439,792 (-6%)	191,314,710 (-6%)
Actual emissions	-	-	214,592,554	215,545,804	195,305,575	188,910,680
Quantities for greenhouse gas mitigation eligible for consideration (in million litres)						
Replacing diesel fuel:						
Blending	2,474	2,458	2,659	2,778	4,059	3,138
Petroleum fuels complementary:						
Blending (incl. E85)	1,441	1,436	1,467	1,468	1,408	1,462
Pure fuels (FAME+PÖL+HVO)	3	4	4	3	11	17
Biogas in GWh (compressed and liquefied)	373	449	389	341	713	982
Natural gas (CNG+LNG+ synth. methane) in GWh	-	-	830	845	943	1,872
Liquefied petroleum gas (LPG+ Bio-LPG) in tons	-	-	423,473	397,025	339,552	359,855
Electricity in GWh	-	-	2	59	111	199
Hydrogen in tonnes	-	-	2	2	82	182
Achieved emission reduction of the fuels, in t CO_{2eq}						
Blending	7,206,150	7,552,170	9,329,327	9,485,954	12,763,118	10,654,212
Pure biofuels (incl. biomethane and bio LPG)	107,577	131,491	127,950	110,136	245,984	356,285
Liquefied petroleum gas (LPG)	-	-	399,335	374,394	321,608	339,344
Natural gas (NG, LNG and synth. methane)	-	-	73,571	71,517	70,515	134,909
Hydrogen	-	-	12	11	518	1,147
Power	-	-	197	5,730	13,636	25,013
Reductions from UER	-	-	-	-	784,852	1,825,783
Carried forward from the previous year	639,296	1,045,710	798,500	854,050	-	922,477
total	-	-	-	-	-	990,398
Gesamt	**7,953,023**	**8,729,371**	**-**	**10,901,792**	**14,200,231**	**15,249,568**

Continued on the next page.

	2016	2017	2018	2019	2020	2021
Quantities in t CO_{2eq}, eligible for the commitment year						
Overfulfilment	1,047,315	798,580	855,171	991,136	921,860	2,421,140
Obligation not fulfilled in the year						
Existing or legally established levy pursuant to § 37c para. 2 BImSchG in euros	648,000	10,081,000	6,594,000	2,425,000	552,000	59,537,000

The figures are rounded values. These statistics reflect the situation as of 01.06.2023. Changes may occur, for example, as a result of changes may occur, e. g. as a result of subsequent notifications or appeal proceedings. Since diesel and petrol fuels are included in the actual emissions with a value that deviates from the base value, the actual savings required may differ from the calculated savings.
Source: zoll.de

Table 8: Statistical data on the fulfilment of the progressive quota – quota year 2021*

Key figures of the 2021 advanced quota (FQ) in GJ (gigajoules)	
Total energy in the reference value from the GHG quota	2,065,264,695
Quota (0.05 % of the reference value energy)	2,065,265
Quantities considered for the calculation of the FQ in GJ	
Diesel fuel	-
Petroleum fuel	-
Biodiesel	2,103,118
HVO (incl. co processed HVO + biogenic oils)	4,200,327
Bioethanol and ETBE	38,891
Biomethanol and MTBE	498
Biomethane (compressed + liquefied)	2,633,748
Biogenic liquefied petroleum gas (Bio-LPG)	-
Hydrogen	-
Synthetic methane	-
Quota transfer from previous year	6,131,735
total	**15,108,317**
Quantities eligible for the commitment year 2022 in GJ	
Overachievement 2021	12,925,058
Obligation not fulfilled in 2021	
Existing or legally established levy pursuant to § 14 para. 3 of the 38th BImSchV in conjunction with § 37c para. § 37c para. 2 sentence 3 BImSchG in 1,000 euros	-

The figures are rounded values. These statistics reflect the current state of affairs and processing as of 01.06.2023.
Due to subsequent notifications and corrections, the figures may still change.
Source: zoll.de

Table 9: (Bio-)fuel production capacities 2023 in Germany

Operator/Plant	Location	Capacity (t/year)	
Biodiesel			
ADM Hamburg AG	Hamburg	not available	
ADM Mainz AG	Mainz	not available	
Bioeton Deutschland GmbH	Kyritz	80,000	
Biosyntec GmbH	Regensburg	50,000	
Biowerk Sohland GmbH	Sohland	100,000	
BKK Biodiesel GmbH	Rudolstadt	4,000	
Bunge Deutschland GmbH (ehemals MBF GmbH)	Mannheim	100,000	
Cargill Deutschland GmbH	Frankfurt am Main	350,000	
ecoMotion GmbH	Sternberg	100,000	
ecoMotion GmbH	Lünen	50,000	
ecoMotion GmbH	Malchin	12,000	
gbf german biofuels gmbh	Pritzwalk-Falkenhagen	132,000	
Gulf Biodiesel Halle GmbH	Halle (Saale)	80,000	
KFS Biodiesel GmbH & Co. KG	Cloppenburg	50,000	
KFS Biodiesel Kassel GmbH	Kaufungen	50,000	
KFS Biodiesel Köln GmbH	Niederkassel	120,000	
Louis Dreyfus Company Wittenberg GmbH	Lutherstadt Wittenberg	200,000	
MD-Biowerk GmbH	Tangermünde	33,000	
Mercuria Biofuels Brunsbüttel GmbH & Co. KG	Brunsbüttel	250,000	
Natural Energy West GmbH	Neuss	245,000	
PME BioLiquid GmbH & Co. Betriebs KG	Wittenberge	80,000	
REG Germany AG	Borken	80,000	
REG Germany AG	Emden	100,000	
Tecosol GmbH	Ochsenfurt	90,000	
VERBIO Bitterfeld GmbH	Bitterfeld	195,000	
VERBIO SchwedtGmbH	Schwedt/Oder	250,000	
VITERRA Magdeburg GmbH	Magdeburg	250,000	
VITERRA Rostock GmbH	Rostock	200,000	
Total		**3,251,000**	

Operator/Plant	Location	Capacity (t/year)
Bioethanol		
Anklam Bioethanol GmbH	Anklam	55,000
Baltic Distillery GmbH	Dettmannsdorf	16,000
Cargill Deutschland GmbH	Barby	40,000
Clariant Produkte GmbH (Demonstrationsanlage)	Straubing	1,000
CropEnergies Bioethanol GmbH	Zeitz	315,000
eal Euro-Alkohol	Lüdinghausen	16,000
Ethatec GmbH	Weselberg	4,000
Nordbrand Nordhausen GmbH	Nordhausen	16,000
Nordzucker AG	Wanzleben-Börde	100,000
Sachsenmilch Leppersdorf GmbH	Leppersdorf	8,000
VERBIO Schwedt GmbH	Schwedt	200,000
VERBIO Zörbig GmbH	Zörbig	60,000
Total		**831,000**
Biomethan		
VERBIO Biomethan Zörbig	Zörbig	19,000
VERBIO Biomethan Schwedt	Schwedt	36,000
VERBIO Biomethan Pinnow	Pinnow	5,000
Total		**60,000**
Mineral oil		
Bayernoil Raffineriegesellschaft mbH	Ingolstadt/Vohburg	10,300,000
BP Lingen	Lingen (Ems)	4,700,000
Gunvor Raffinerie Ingolstadt GmbH	Ingolstadt	5,000,000
H & R Chemisch-Pharmazeutische Spezialitäten GmbH	Salzbergen	220,000
H & R Oelwerke Schindler	Hamburg	240,000
Holborn Europa Raffinerie GmbH	Hamburg	5,150,000
MiRO Mineralölraffinerie Oberrhein GmbH & Co. KG	Karlsruhe	14,900,000
Mitteldeutsches Bitumenwerk GmbH	Webau	195,000
Nynas GmbH und Co. KG	Hamburg	1,825,000
OMV Deutschland GmbH	Burghausen	3,700,000
PCK Raffinerie GmbH Schwedt	Schwedt	11,480,000
Raffinerie Heide GmbH	Heide/Holstein	4,200,000
Ruhr Oel GmbH	Gelsenkirchen	12,800,000
Shell Energy and Chemicals Park Rheinland	Wesseling	7,300,000
Shell Rheinland Raffinerie Werk Köln-Godorf	Köln	9,300,000
TotalEnergies Raffinerie Mitteldeutschland GmbH	Spergau/Leuna	12,000,000
TotalEnergies Bitumen Deutschland GmbH & Co.	Brunsbüttel-Ostermoor	570,000
Total		**103,880,000**

Note: = AGQM-Member;
Sources: VDB (with information via UFOP, FNR, AGQM, names partly abbreviated).
DBV and UFOP recommend purchasing biodiesel from the members of the Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e. V. (AGQM).

Table 10: UCO imports by the EU in 2022 (mt)

	2020	2021	2022
China	276,202.66	619,869.90	934.810,88
UK	154,828.39	150,654.84	237.871,81
Malaysia	312,630.73	231,729.75	227.830,22
Indonesia	114,684.03	190,829.08	157.878,38
Saudi Arabia	65,037.48	66,880.55	81.106,76
Russia	99,584.11	87,535.85	80.976,06
Chile	35,058.25	70,054.80	62.121,29
Viet Nam	8,971.08	6,377.73	59.575,03
United States	104,451.26	32,435.82	31.204,77
Japan	44,893.83	31,624.00	24.844,29
South Africa	16,073.03	433.61	23.528,89
Belarus	22,723.53	21,349.18	21.033,66
Switzerland	13,105.95	13,904.73	15.321,66
UAE	9,975.36	20,292.28	13.828,26
Iran	185.09	3,627.98	11.709,02
Norway	7,792.87	6,061.15	11.012,80
Peru	6,908.86	10,819.51	9.860,71
Colombia	7,782.94	5,777.88	8.719,22
Kuwait	5,613.93	6,849.34	8.187,27
Thailand	0.11	0.05	7.271,82
Morocco	4,307.94	5,577.02	7.046,52
Israel	157.73	1,518.02	6.631,25
Turkey	970.92	1,571.34	5.730,43
Serbia	5,600.26	5,452.91	4.929,67
Panama	2,791.63	2,790.52	3.627,24
Egypt	21,175.10	1,430.07	3.350,80
Iraq	1,020.50	2,760.90	3.342,89
Hong Kong	6,352.11	2,479.62	3.255,74
Ukraine	1,427.12	2,788.63	3.057,66
Argentina	32,964.38	24,053.10	3.053,31
Lebanon	3,410.77	1,780.90	2.895,72
Singapore	7,372.16	5,291.61	2.420,23
India	1,868.17	3,025.42	2.194,36
Uruguay	226.69	1,337.83	2.109,25
Mexico	208.78	2,194.89	2.094,92
Philippines	700.10	2,631.72	1.996,18
Jordan	2,902.77	6,130.10	1.747,00
Qatar	1,758.13	1,143.34	1.659,07
Australia	115.69	4,175.37	1.594,21
Kanada	1,176.23	1,636.36	1.463,10
Others/undefined	308,026.41	88,055.62	18.363,79
Total	**1,711,325.41**	**1,744,935.40**	**2,115,599.70**
Intra-EU27	**1,772,819.23**	**2,168,530.41**	**2,866,898.69**

Source: Eurostat

Table 11: EU production of biodiesel and HVO 2015–2022 in 1,000 t

	2015	2016	2017	2018	2019	2020	2021	2022
Belgium	248	235	290	252	254	213	192	242
Denmark	140	140	120	130	130	125	120	115
Germany	3,085	3,119	3,208	3,344	3,584	3,127	3,378	3,200
France	2,386	2,224	2,250	2,560	2,497	2,274	1,808	1,300
Italy	765	774	918	990	1,164	1,237	111	1,275
Netherlands	1,629	1,462	1,929	1,839	1,902	1,939	1,973	1,603
Austria	340	307	295	287	299	293	275	300
Poland	759	871	904	881	966	955	991	1,001
Portugal	363	337	356	363	292	262	238	256
Sweden	264	258	209	258	322	312	393	500
Slovakia	125	110	109	110	109	117	117	115
Spain	1,175	1,486	1,878	2,143	2,040	1,845	1,769	1,600
Czech republic	168	149	157	197	251	262	246	213
EU other	1,214	1,216	1,502	1,618	1,754	1,570	2,933	1,508
EU-27	**12,661**	**12,688**	**14,125**	**14,972**	**15,564**	**14,531**	**14,544**	**13,228**
UK	149	342	467	476	510	500	500	500

Source: S&P Global, May 2023

Table 12: Global biodiesel and HVO production 2015–2022 in 1,000 t

Biodiesel production	2015	2016	2017	2018	2019	2020	2021	2022
EU	10,531	10,495	11,337	12,122	12,301	11,212	11,101	9,946
Canada	260	352	350	270	350	355	315	245
USA	4,108	5,222	5,315	6,186	5,744	6,044	5,458	5,396
Argentinia	1,811	2,659	2,871	2,429	2,147	1,157	1,724	1,910
Brazil	3,465	3,345	3,776	4,708	5,193	5,660	5,954	5,523
Colombo	513	448	510	555	530	530	580	625
Peru	1	0	33	99	135	164	183	183
China, Mainland	693	800	918	734	826	1,250	1,725	2,200
India	119	123	132	163	210	190	155	160
Indonesia	1,425	3,217	3,006	5,428	7,391	7,560	8,400	9,800
Malaysia	654	512	900	968	1,400	1,225	1,000	1,450
Philippines	180	199	194	199	213	165	165	189
Thailand	1,089	1,084	1,256	1,392	1,624	1,622	1,459	1,224
Rest of the world	1,102	1,266	1,439	1,625	1,799	1,784	1,790	1,768
TOTAL	**25,951**	**29,722**	**32,038**	**36,878**	**39,864**	**38,919**	**40,009**	**40,619**

Renewable Diesel/HVO	2015	2016	2017	2018	2019	2020	2021	2022
EU	2,100	2,161	2,752	2,733	3,187	3,215	3,295	3,282
USA	522	713	763	902	1,453	1,575	2,406	4,379
Other	1,002	1,047	1,011	900	1,259	1,526	1,682	1,809
TOTAL	**3,624**	**3,921**	**4,526**	**4,535**	**5,899**	**6,316**	**7,383**	**9,470**

Source: S&P Global, May 2023

Table 13: Global biodiesel and HVO consumption 2015–2022 in 1,000 t

Biodiesel consumption	2015	2016	2017	2018	2019	2020	2021	2022
EU-27	10,205	10,031	10,634	12,405	12,585	11,639	12,074	11,716
Canada	385	270	370	365	345	435	325	370
USA	4,977	6,946	6,613	6,341	6,038	6,250	5,485	5,309
Argentinia	1,014	1,033	1,173	1,099	1,071	477	438	712
Brazil	3,368	3,333	3,753	4,678	5,167	5,045	5,993	5,486
Colombo	523	506	513	552	532	502	629	620
Peru	278	294	290	291	293	251	317	325
China, Mainland	208	240	275	361	378	220	229	243
India	35	45	65	75	88	45	9	35
Indonesia	585	2,306	1,999	2,900	5,510	7,300	6,990	7,650
Malaysia	453	449	456	471	656	585	634	1,000
Philippines	177	192	180	181	192	142	168	190
Thailand	1,135	1,025	1,255	1,422	1,449	1,420	1,111	839
Rest of the world	1,735	1,743	1,790	2,596	2,885	2,484	2,176	2,294
TOTAL	**25,077**	**28,413**	**29,366**	**33,737**	**37,189**	**36,795**	**36,578**	**36,789**

HVO consumption*	2015	2016	2017	2018	2019	2020	2021	2022
EU-27	1,996	2,034	2,189	1,993	2,406	3,376	3,241	3,551
Canada	151	168	251	268	337	306	350	375
USA	1,017	1,181	1,207	1,081	1,995	2,195	3,157	4,222
Rest of the world	141	186	386	229	313	287	367	480
TOTAL	**3,305**	**3,569**	**4,033**	**3,571**	**5,051**	**6,164**	**7,115**	**8,628**

Total Biodiesel/ HVO consumption worldwide (all sectors)	**29,766**	**34,023**	**35,518**	**40,459**	**45,975**	**45,643**	**47,631**	**50,915**

* HVO = Hydrogenated Vegetable Oil; all data for road transport.
Source: F.O: Licht/S&P Global, May 2023

Biofuel mandates

Table 14: National biofuel mandates 2023

	Type	minimum Total biofuel (%)	Progressive Biofuels* (%)	Biofuel in petrol (%)	Biofuel in diesel (%)	Reduction of the GHG intensity of fuels (%)
Austria	Energy	-	0.2	3.4	6.3	-6
Belgium	Energy	10.2	0.11[2]	6.5	6.5	-
Bulgaria	Volume	-	1 (in Diesel)	9	6	-
	Energy	-	0.05	-	-	
Croatia	Energy	-	0.2	-	-	-6
Cyprus	Energy	-	0.2	-	-	-6
Czech Republic	Volume	-	0.22	-	-	-6
Denmark	Energy	-	-	-	-	-3.4
Estonia	Energy	7.5[3]	0.5	-	-	-
Finland	Energy	13.5[4]	2	-	-	-
France	Energy	-	1.2 (in petrol) 0.4 (in Diesel)	9.5	8.6	-10
Germany	Energy	-	0.3	-	-	-8[5]
Greece	Energy	-	-	3.3	-	-
	Volume	-	0.2	-	7	
Hungary[6]	Energy	8.4	0.2	6.1 (ROZ 95)	0.2	-
Irland[7]	Energy	16.985	0.3 (in energy)	-	-	-6
Italy[8]	Energy	-	3	0.5	-	-6
Latvia	Volume	-	0.2	9.5 (ROZ 95)	6.5[9]	-
Lithuania	Energy	7.2	0.4	6.6	6.2	-
Luxembourg	Energy	7.7[10]	-	-	-	-6
Malta	Energy	-	0.2	-	-	-
Netherlands[11]	Energy	18.9	2.4	-	-	-6
Poland	Energy	8.9	0.1	3.2	5.2	-
Portugal	Volume	11	0.5	-	-	-
Romania	Volume	-	-	8	6.5	-
Slovakia	Energy	8.6	0.5 (double counting)	-	-	-6
	Volume	-	-	9	6.9	
Slovenia	Energy	10.3[12]	0.2	-	-	-6
Spain	Energy	10.5[13]	0.3	-	-	-6
Sweden		-	-	-	-	-7.8 for petrol -30.5 for Diesel

* The Czech Republic suspended the biofuel blending obligation from July 2022 in connection with the increase in fuel prices. Latvia suspended the biofuel blending obligation from 1 July 2022 to 31 December 2023.

* Some Member States excluded biofuels from high-ILUC feedstocks, such as: Austria (palm), Denmark (palm and derivatives, soy), France (palm and derivatives, soy), Sweden (palm).

1 After double counting.
2 Double counting at 0.95%.
3 Plant-based biofuels are limited to 4.5%.
4 Plant-based biofuels are limited to 2.6%.
5 Ceilings (in e/e): crop-based biofuels at 4.4%; high ILUC risk biofuels at 0.9%; Annex IX-B at 1.9%.
6 Annex IX-B biofuels capped at 4 % after double counting.
7 Plant-based biofuels capped at 2 %.
8 Italy has a mandate of 300kt/year for HVO.
9 In the period from 1 April to 31 October.
10 9.7% with multipliers. Can be reduced to 6%. Advanced biofuels must make up at least 50% of the biofuel blend after double counting. Plant-based biofuels are limited to 5%.
11 Plant-based biofuels are limited to 1.4%. UER cannot count towards the 6% GHG intensity target.
12 Renewable transport obligation to be achieved through the use of biofuels, renewable electricity, RCFs and RFNBOs.
13 Plant biofuels are capped at 7%. Upper limit for biofuels with high ILUC risk (including palm oil, fresh fruit bunches of oil palm, PFAD, palm kernel oil and palm kernel shell oil) at 3.1 %

Source: www.ePure.org (retrieved: 16.06.23)

Table 15: Biofuel mandates in the EU for selected member states

a) Austria

	Overall Percentage (energy content, % cal)	Biodiesel (% cal)	Bioethanol (% cal)	Advanced Biofuels (% cal)	GHG Emission Reduction (%) [1]	Cap on crop-based biofuel (% cal)	Multiple Counting
2021	5.75			0.5[2]	6		
2022	5.75			0.5[2]	6		
2023				**0.2**	**6**		
2024				0.2	7		
2025		**6.3**	**3.4**	1	7.5	7[3]	**No**
2026	**None**			1	8		
2027				1	9		
2028				1	10		
2029				1	11		
2030				3.5	13		

Source: FAS Vienna based on Austrian Fuels Order 2012, (with its 2014, 2017, 2018, 2020, and 2022 amendments)

To reach the GHG reduction target the following may be taken into account:

- Emission credits from upstream emission reduction (UER) projects (in 2023 only and up to amaximum of 1 percent).
- electric power from renewable energy sources used for electrically powered motor vehicles may alsobe taken into account (multiple counting x4 for renewable electricity in road transport).

Penalties
Failing to meet the mandates is sanctioned with the following penalties:

Mandate	Penalty
Energetic	43 Euro per GJ under supplied
GHG reduction 2023	600 Euro per MT CO_2 eq for the first 5 percent and 15 Euro per MT CO_2 eq for the last percent of unmet GHG reduction target
GHG reduction 2024 and onwards	600 Euro per MT CO_2 eq of unmet GHG reduction target

b) Belgium

	Overall Percentage (% cal)	Biodiesel (% cal)	Bioethanol (% cal)	Double Counting
Since January 1, 2023	**10.5**	**5.7**	**5.7**	**Max 0.95%**

Source: FAS USEU based on Law of July 7, 2013; Law of July 21, 2017; Law of May 4, 2018; Law of December 27, 2021

Penalties

Failing to meet the mandates is sanctioned with the following penalties:

Mandate: Energy
Penalty: € 1,400 per 34 GJ undersupplied.

Source: ePure

Table 15: Biofuel mandates in the EU for selected member states – continued

c) Czech Republic

	Renewable energy in transport (% cal)	Advanced biofuels biome-thane bioLPG (% cal)	Minimum GHG emissi-on reduction (%)	Biodiesel (% vol)	Bioethanol (% vol)	Double counting [1]
2021	-	-	6	-	-	Yes applies only to shares of advanced biofuels raw material IX.A, to biofuels raw material IX.B and to advanced biomethane and bioLPG
2022–2024	-	0.22	6			
2025	-	1.07	6			
2030	9.5	1.07	6			

Source: FAS Prague
1) According to the Act on Supported Energy Sources and Amendments to Certain Other Acts No. 382 Coll., with effect fromSeptember 15, 2021.

d) Denmark

	Overall Percentage (% cal)	GHG emission reduction (%)	Cap on crop-based biofuels (% vol)	Advanced Biofuels[2] (Annex IX-A) (% cal)	Multiple Counting
2021	7.6			0.9	
2022–2024		3.4	Biofuels based on palm oil and soy phased out by 2022[1]	0.2	x 2 for advanced biofuels; x 4 for renewable electricity in road, x 1.5 in train; x 1.2 for aviation and maritime fuels
2025–2027		5.2	All High-ILUC-risk biofuels phased out by 2025	1	
2028–2029		6		1	
2030		7		3.5	

Source: FAS The Hague based on ePure
1) Unless certified low-ILUC-risk.
2) The use of biofuels produced from Annex IX-B feedstock is capped at 1.7 percent.

Crop-based biofuels:

All high-ILUC-risk biofuels should be phased out no later than 2025. Biofuels based on palm oil (and its by-products, incl. PFAD) and soy are excluded from 2022, unless certified low-ILUC-risk.

Source for Table 15 (pages 40 – 46) and further information:
GAIN Report Biofuel Mandates in the EU by Member State and United Kingdom – 2023
(Nr. E42023-0023, published 06.07.2023, Author: Sabine Lieberz), see also bit.ly/GAIN_Report2023

Table 15: Biofuel mandates in the EU for selected member states – continued

e) Finland

	Overall Percentage (% cal)	Advanced biofuel	Cap on crop-based biofuel[1)] (% cal)	Multiple Counting
2022	12	2		
2023	**13.5**	**2**		
2024	28	4		
2025	29	4	**2.6**	
2026	29	6	**High ILUC: 0**	**No**
2027	30	6		
2028	31	8		
2029	32	9		
from 2030	34	10		

Source: FAS The Hague based on ePure
1) Applicable since July 1, 2021. Biofuels produced from Annex IX- B feedstock are not capped.

f) France

	Bioethanol (% cal)	Advanced Bioethanol (% cal)	Biodiesel (% cal)	Advanced Biodiesel (% cal)	Double Counting [1]
2021–2023	8.6	-	8	-	Yes
2023–2027	8.6	1.2	8	0.4	Yes
2028 and onwards	**8.6**	**3.8**	**8**	**2.8**	**Yes**

Source: FAS Paris
1) Double counting for cellulosic biofuels and waste biofuels produced from the feedstocks listed in Annex IX of Directive2009/28/EC except tall oil and tall oil pitch.

Cap on certain feedstocks

From 2019, the share of energy that can be taken into account is limited to a maximum of:

- 7 percent for conventional biofuels including biofuels produced from palm oil fatty acid distillates
- 0.9 percent for used cooking oil and animal fats
- 0.6 percent for tall oil and tall oil pitch
- 0.2 percent for sugar plant residues and starch residues extracted from starch-rich plants (0.4percent from 2020)
- Palm oil is excluded since January 1, 2020
- Soybean oil is excluded since January 1, 2022

[1] **Source for Table 15 (pages 40 – 46) and further information:**
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Table 15: Biofuel mandates in the EU for selected member states – continued

g) Germany

	GHG Emission Reduction[1] (%)	Advanced Biofuels[2] (% cal)	Cap on crop-based biofuel[2] (% cal)	Cap on UCO- and animal fat-based biofuels[2] (% cal)	Cap on feeds-tocks with high ILUC risk[2], [5] (% cal)	Multiple counting	Sustainable Aviation Fuel [1][6] % Cal
2022	7	0.2[3]			0.9		
2023	8	0.3[4]					-
2024	9.25	0.4 [4]					
2025	10.5	0.7					
2026	12	1	4.4	1.9	0	See table below	0,5
2027	14.5	1					0,5
2028	17.5	1.7					1
2029	21	1.7					1
2030	25	2.6					2

Sources: FAS Berlin based on Federal Act on Protection against Air Pollution and 38th Implementation Ordinance on the Federal Act on Protection against Air Pollution (both in German language)

1) Federal Act on Protection against Air Pollution Until 2026, emission credits from upstream emission reduction (UER) projects may be taken into account to comply with the GHG reduction mandate.
2) 38th Implementation Ordinance on the Federal Act on Protection against Air Pollution
3) Companies that put on the market 10 PJ or less of biofuels in the previous year are exempted
4) Companies that put on the market 2 PJ or less of biofuels in the previous year are exempted
5) Effectively, this means that starting in 2023, biofuels based on palm oil feedstock no longer count against the mandates.
6) Only non-biomass-derived sustainable aviation fuel (SAF) is eligible for counting against this mandate.

Multiple counting

Compliance Option	Conditions	Factor
Advanced biofuels [1]	Volumes that exceed the mandate	2
Hydrogen and PtX fuels [2]	If not derived from biomass	2
Electricity	For road e-vehicles	3

Sources: FAS Berlin based on
1) 38th Implementation Ordinance on the Federal Act on Protection against Air Pollution
2) Federal Act on Protection against Air Pollution

Penalties

Failing to meet the mandates is sanctioned with the following penalties:

Mandate	Year	Penalty
Energetic	2009–2014:	Biodiesel: 19 Euro per GJ under allocated Bioethanol: 43 Euro per GJ under allocated
GHG reduction	2015–2021	0.47 Euro per kg CO_2 eq under allocated reduction
	Since 2022	0.60 Euro per kg CO_2 eq under allocated reduction
SAF	Since 2022	70 Euro per GJ under allocated

Source: FAS Berlin based on Federal Act on Protection against Air Pollution

Table 15: Biofuel mandates in the EU for selected member states – continued

h) Hungary

	Renewable energy in transport (% cal)	Biodiesel (% vol)	Bioethanol (% vol)	Advanced Biofuels (% cal)	Double counting [1)]
2022–2023		**8.4**	**6.1**	**0.2**	**Biofuels derived from feedstock listed in Annex 2 of the Government Decree No. 821/2021 (in Hungarian)**

Source: FAS Budapest

i) Ireland

	Overall Percentage (% vol)	Annex IX biofuels (% cal)	Multiple Counting
2022	15		
2023	**17**	**0.3**	**x2 for Annex IX biofuels; x4 for renewable electricity in road, x1.5 in train; x1.2 for aviation and maritime fuels**
2024	21	0.3	
2025	25	1	
2026	29	1	
2027	34	1	
2028	39	1	
2029	44	1	
2030	49	3.5	

Source: FAS London and ePure

j) Italy

	Overall (%)	Advanced Biofuels (%)	Bioethanol (%)	Advanced Biomethane (%)
2023	**10**	**3.4**	**0.5**	**2.3**
2024	10.8	4.2	1	2.9
2025	11.7	4.9	3	3.5
2026	12.6	5.5	3.4	3.9
2027	13.4	6.1	3.8	4.3
2028	14.3	6.7	4.2	4.8
2029	15.2	7.4	4.6	5.2
2030	16	8	5	5.7

Source: FAS Rome, based on a decree dated March 16, 2023, issued by Italy's Ministry of Environment and Energy Security

Source for Table 15 (pages 40 – 46) and further information:
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Table 15: Biofuel mandates in the EU for selected member states – continued

k) The Netherlands

	Overall Percentage (% cal)	Of which advanced Annex IX-A biofuels (% cal)	Cap on conventional crop-based biofuel (% cal)	Multiple counting
2021	17.5	1.26	1.4 0 for Biofuels made from palm and soy, except for certified low-ILUC-risk feedstock	Annex IX A and B: x 1.6 Electricity: x 4 Gaseous fuels: x 2 Maritime: x 0.8 Aviation: x 1.2
2022	17.9	1.8		
2023	**18.9**	**2.4**		
2024	19.9	2.9		
2025	21	3.6		
2026	22.3	4.2		
2027	23.6	4.9		
2028	25	5.6		
2029	26.5	6.3		
2030	28	7		

Source: FAS The Hague based on ePURE

l) Portugal

	Overall Percentage (% cal)	Biodiesel (% cal)	Bioethanol/ ETBE (% cal)	Advanced Biofuels (% cal)	Cap on conventional crop-based biofuel (% cal)	Double counting
2021	11	-	-	0.5	7[1)]	Yes
2022	11			0.2		
2023	**11.5**			**0.7**		
2024	11.5			0.7		
2025–2026	13			2		
2027–2028	14			4		
2029–2030	16			7		

Sources: FAS Madrid based on Consumption mandates: Decree-Law 117/2010, Decree-Law 69/2016, Law 42/2016, Budget Law for 2018 and 2019 and Decree-Law 8/2021 as amended by Rectification Declaration 9-A/2021, and Decree-Law 84/2022 Double counting: Decree-Law 117/2010 and Annex III in Implementing Order 8/2012

1) Food-based biofuels are capped at 2020 levels up to one percent higher, but with a maximum cap of seven percent for each MS.

m) Polen

	Overall Percentage (% cal)	Biodiesel (% cal)	Bioethanol (% cal)	Double counting
2023	**8.9**	**5.2**	**3.2**	Yes
2024	9.1	6.2	3.2	

Source: FAS Warsaw based on the Polish Act on Bio-components and Liquid Biofuels as amended by the Polish Parliament in October 2022.

Table 15: Biofuel mandates in the EU for selected member states – continued

n) Spain

	Overall Percentage (% cal)	Biodiesel (% cal)	Bioethanol (% cal)	Advanced Biofuels (% cal)	Cap on crop-based biofuels (% cal)	Double counting
2021	9.5	-	-	0.1		
2022	10	-	-	0.2	7	
2023	**10.5**	**-**	**-**	**0.3**	**3.5**	
2024	11	-	-	0.5	3.1	**Yes**
2025	11.5	-	-	1	2.6	
2026–2029	12	-	-	1.25	2.6	
2030	14	-	-	3.5	2.6	

Source: FAS Madrid

Penalties
Those failing to meet the mandates are sanctioned with the following penalties:

Year	Penalty
Since 2022	1,623 Euros per missing certificate (each certificate equals one Ktoe.)

Source: FAS Madrid based on Resolution of 17 of December of 2021 by the Ministry for Ecological Transition and Demographic Challenge.

o) Sweden

	GHG Reduction Target	
	Gasoline (%)	Diesel (%)
2022	7.8	30.5
2023	**7.8**	**30.5**
2024	12.5	40
2025	15.5	45
2026	19	50
2027	22	54
2028	24	58
2029	26	62
2030	28	66

Source: FAS The Hague based on ePURE

Attempts to relax GHG reduction targets: In 2022, the government agreed to freeze annual increases to the emissions reduction targets in 2023 to cope with fuel price inflation. Additionally, the government is discussing lowering the GHG reduction targets for 2024-2026.

Source for Table 15 (pages 40 – 46) and further information:
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Tables BLE Evaluation Report 2021

Table 16: Germany: Biofuel feedstocks in terajoules (TJ) [1]

Fuel type	Bioethanol			Biodiesel (FAME)		
Quota year	2019	2020	2021	2019	2020	2021
Feedstock						
Waste/Residual	698	1,661	1,748	33,139	32,975	28,881
Ethiopian mustard				98	73	51
Cereal whole plant						
Fodder beets						
Grass/arable grass						
Barley	424	1,034	977			
Maize	19,623	17,367	14,721			
Palm oil				22,523	22,216	28,520
Rapeseed				29,600	28,274	22,084
Rye	1,148	2,111	4,077			
Silage maize						
Soy				1,215	1,994	4,612
Sunflowers				3,073	3,897	629
Triticale	1,493	1,301	1,401			
Wheat	5,394	3,562	3,890			
Sugar cane	1,426	2,062	2,967			
Sugar beet	603	429	877			
Total	30,808	29,528	30,656	89,646	89,429	84,776

Source: BLE (report online at *www.ufop.de/ble*)
[1] Differences in totals are due to rounding

Table 17: Germany: Biofuel feedstocks in 1,000 t[1,2]

Fuel type	Bioethanol			Biodiesel (FAME)		
Quota year	2018	2019	2020	2018	2019	2020
Feedstock						
Waste/Residual	26	63	66	887	882	772
Ethiopian mustard				3	2	1
Cereal whole plant						
Fodder beets						
Grass/arable grass						
Barley	16	39	37			
Maize	741	656	556			
Palm oil				603	594	763
Rapeseed				792	757	591
Rye	43	80	154			
Silage maize						
Soy				32	53	123
Sunflowers				82	104	17
Triticale	56	49	53			
Wheat	204	135	147			
Sugar cane	54	78	112			
Sugar beet	23	16	33			
Total	1,164	1,116	1,158	2,399	2,393	2,267

Source: BLE (report online at *www.ufop.de/ble*)
[1] Differences in totals are due to rounding
[2] The conversion into tonnage was made on the basis of the quantity data

Biomethan			HVO			Vegetable oil			
2019	2020	2021	2019	2020	2021	2019	2020	2021	Quota year
									Feedstock
736	1,885	2,750	24	9,230	6,659				Waste/Residual
									Ethiopian mustard
	10	45							Cereal whole plant
	2	1							Fodder beets
	10	14							Grass/arable grass
									Barley
		610							Maize
			1,877	36,065	13,066	19	28	8	Palm oil
				10		18	26	30	Rapeseed
		26							Rye
491	643								Silage maize
									Soy
				694					Sunflowers
									Triticale
									Wheat
									Sugar cane
	27	32							Sugar beet
1,227	**2,577**	**3,477**	**1,901**	**45,999**	**19,725**	**37**	**54**	**38**	**Total**

Biomethan			HVO			Vegetable oil			
2018	2019	2020	2018	2019	2020	2018	2019	2020	Quota year
									Feedstock
15	38	55	1	212	153				Waste/Residual
									Ethiopian mustard
	0.2	1							Cereal whole plant
	0.04	0.01							Fodder beets
	0.2	0.3							Grass/arable grass
									Barley
		12							Maize
			43	827	300	1	0.8	0.2	Palm oil
						0.5	0.7	1	Rapeseed
		1							Rye
10	13								Silage maize
									Soy
				16					Sunflowers
									Triticale
									Wheat
									Sugar cane
	1	1							Sugar beet
25	**52**	**70**	**44**	**1,055**	**453**	**1**	**1**	**1**	**Total**

Table 18: Germany: Biofuel feedstocks by origin in terajoules[1]

Region	Africa			Asia			Australia		
Quota year	2019	2020	2021	2019	2020	2021	2019	2020	2021
Feedstock									
Waste/Residual	174	648	644	13,122	17,842	15,428	18	14	30
Ethiopian mustard									
Cereal whole plant									
Fodder beets									
Grass/arable grass									
Barley									
Maize									
Palm oil				21,409	52,975	38,936			
Rapeseed				71	110	11	5,014	4,214	3,115
Rye									
Silage maize									
Soy									
Sunflowers								2	
Triticale									
Wheat									
Sugar cane									
Sugar beet									
Total	174	648	644	34,603	70,927	54,376	5,031	4,229	3,144

Source: BLE (report online at *www.ufop.de/ble*)
[1] Differences in totals are due to rounding

Table 19: Germany: Biofuel feedstocks by origin in 1,000 t[1,2]

Region	Africa			Asia			Australia		
Quota year	2019	2020	2021	2019	2020	2021	2019	2020	2021
Feedstock									
Waste/Residual	5	17	17	351	451	393	0.5	0.4	1
Ethiopian mustard									
Cereal whole plant									
Fodder beets									
Grass/arable grass									
Barley									
Maize									
Palm oil				566	1,285	992			
Rapeseed				2	3	0.3	134	113	83
Rye									
Silage maize									
Soy									
Sunflowers								0.04	
Triticale									
Wheat									
Sugar cane									
Sugar beet									
Total	5	17	17	919	1,739	1,385	135	113	84

Source: BLE (report online at *www.ufop.de/ble*)
[1] Differences in totals are due to rounding
[2] The conversion into tonnage was made on the basis of the quantities stated in the certificates

Europe			Central America			North America			South America			
2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021	Quota year
												Feedstock
19,924	24,812	22,271	11	15	28	969	1,681	777	379	749	924	Waste/Residual
						9	27	1	89	46	50	Eth. mustard
424	1,034	977										Cereal wh. plant
	10	45										Fodder beets
	2	1										(arable) grass
	10	14										Barley
19,607	17,364	15,200				15	0,4	54		2	76	Maize
			2,970	4,842	2,571				39	492	87	Palm oil
24,533	22,160	17,255					1,827	1,604			129	Rapeseed
1,148	2,111	4,103										Rye
491	643											Silage maize
27	70	299		2					1,188	1,922	4,313	Soy
3,073	4,589	629						0,1				Sunflowers
1,493	1,301	1,401										Triticale
5,394	3,562	3,890										Wheat
			350	688	539				1,076	1,375	2,428	Sugar cane
603	456	908										Sugar beet
76,716	**78,126**	**66,992**	**3,331**	**5,547**	**3,138**	**993**	**3,535**	**2,436**	**2,771**	**4,586**	**8,007**	**Total**

Europe			Central America			North America			South America			
2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021	Quota year
												Feedstock
536	665	590		0.4	1	26	41	20	10	20	25	Waste/Residual
						0.2	1	0.01	2	1	1	Eth. mustard
16	39	37										Cereal wh. plant
	0.2	1										Fodder beets
	0.04	0.01										(arable) grass
	0.2	0.3										Barley
741	656	564				1	0.01	2		0.1	3	Maize
			79	125	69				1	13	2	Palm oil
656	593	462					49	43			3	Rapeseed
43	80	135										Rye
10	13											Silage maize
1	2	8		0.04					32	51	115	Soy
82	120	17						0.002				Sunflowers
56	49	53										Triticale
204	135	147										Wheat
			13	26	20				41	52	92	Sugar cane
23	17	34										Sugar beet
2,368	**2,368**	**2,067**	**93**	**152**	**90**	**27**	**91**	**65**	**86**	**137**	**242**	**Total**

Table 20: Germany: Total biofuel feedstocks[1]

	[TJ]			[kt]		
	2019	2020	2021	2019	2020	2021
Feedstock						
Waste/Residual	34,598	45,761	40,102	928	1,195	1,047
Ethiopian mustard	98	73	51	3	2	2
Barley	424	1,034	977	16	39	37
Cereal whole plant		10	45		0.2	1
Fodder beets		2	1		0.04	0.01
Grass/arable grass		10	14		0.2	0.3
Maize	19,623	17,367	15,331	741	656	568
Palm oil	24,418	58,308	41,594	646	1,423	1,063
Rapeseed	29,618	28,310	22,113	793	757	592
Rye	1,148	2,111	4,103	43	80	155
Silage maize	491	643		10	13	
Soy	1,215	1,994	4,612	32	53	123
Sunflowers	3,073	4,591	629	82	120	17
Triticale	1,493	1,301	1,401	56	49	53
Wheat	5,394	3,562	3,890	204	135	147
Sugar cane	1,426	2,062	2,967	54	78	112
Sugar beet	603	456	908	23	17	34
Total	**123,619**	**167,597**	**138,737**	**3,632**	**4,617**	**3,950**

Source: BLE (report online at *www.ufop.de/ble*)
[1] Differences in totals are due to rounding

Table 21: Biofuels whose feedstock originates from Germany [TJ]*

Biofuel type	Bioethanol			Bio-LNG	Biomethan			CP-HVO
Quota year	2019	2020	2021	2021	2019	2020	2021	2020
Feedstock								
Waste/Residual	220	303	305	48	736	1,858	2,484	
Barley	367	884	856					
Cereal whole plant						10	44	
Fodder beet						2	1	
Grass/arable grass								
Maize	264	109	119				610	
Rapeseed								4
Rye	470	537	1,348				26	
Silage maize/whole plant					491	643		
Sunflowers								
Triticale	271	145	237					
Wheat	392	117	449					
Sugar beet	468	392	771			27	32	
Total	**2,452**	**2,487**	**4,086**	**48**	**1,227**	**2,540**	**3,196**	**4**

Source: BLE (report online at *www.ufop.de/ble*)
* Differences in totals are due to rounding

Table 22: Germany: Emissions and emission savings of biofuels[1]

	Emissions [t CO_{2eq} / TJ]			Savings [%][2]		
	2019	2020	2021	2019	2020	2021
Biofuel type						
Bioethanol	11.04	7.44	9.18	88.16	92.02	90.21
Bio-LNG		13.70	6.79		85.44	92.78
Biomethan	10.12	8.94	5.86	89.24	90.50	93.77
Biomethanol		33.50	33.50		64.09	64.09
Btl-FTD			20.07			78.49
FAME	18.37	17.97	16.86	80.68	81.11	82.33
HVO	19.45	19.82	16.02	79.55	79.15	83.15
CP-HVO	20.43	17.69		78.52	81.40	
Vegetable oil	25.90	31.60	31.73	72.77	66.78	66.70
Weighted average of all biofuels	**16.48**	**16.46**	**14.77**	**82.59**	**82.63**	**84.45**

Source: BLE (report online at *www.ufop.de/ble*)
[1] Differences in totals are due to rounding
[2] Savings compared to fossil fuel benchmark 94.1 g CO_{2eq}/MJ

Biodiesel (FAME)			HVO	Plant oil			Total			Biofuel type
2019	2020	2021	2021	2019	2020	2021	2019	2020	2021	Quota year
										Feedstock
6,275	7,759	7,683	10				7,231	9,920	10,531	Waste/Residual
							367	884	856	Barley
								10	44	Cereal whole plant
								2	1	Fodder beet
										Grass/arable grass
							264	109	729	Maize
13,812	11,396	9,380		18	26	30	13,830	11,426	9,409	Rapeseed
							470	537	1,374	Rye
							491	643		Silage maize/whole plant
		2							2	Sunflowers
							271	145	237	Triticale
							392	117	449	Wheat
							468	419	803	Sugar beet
20,087	**19,155**	**17,065**	**10**	**18**	**26**	**30**	**23,784**	**24,212**	**24,435**	**Total**

Published by:

UNION ZUR FÖRDERUNG VON
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