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10. Background data

Table 1: Biofuel types by raw material [TJ]

Raw material	Bioethanol			Bio-LNG			Biomethane			Biomethanol			Organic naphtha		FAME			HVO			CP-HVO	Vegetable oil		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2021	2022	2020	2021	2022	2020	2021	2022	2020	2020	2021	2022
Waste and residues	1,661	1,748	1,230	1	62	110	1,885	2,750	4,678	10	<0.5	514	1	20	32,975	28,881	41,162	9,228	6,659	16,801	2			
Brassica carinata															73	51	147							
Fodder beet							2	1																
Barley	1,034	977	655																					
Cereal - Whole plant							10	45	21															
Grass/ arable grass							10	14	4															
Maize	17,367	14,721	16,526				643	610	82															
Palm oil													24		22,216	28,520	9,267	34,665	13,066	4,049	1,400	28	8	1
Rapeseed															28,274	22,084	22,259				10	26	30	34
Rye	2,111	4,077	1,001					26																
Soy															1,994	4,612	8,679							
Sunflowers															3,897	629	1,138			142	694			3
Triticale	1,301	1,401	2,532																					
Wheat	3,562	3,890	4,456																					
Sugar cane	2,062	2,967	4,131																					
Sugar beet	429	877	423				27	32	<0.5															
Total	29,528	30,656	30,954	1	62	110	2,577	3,477	4,786	10	<0.5	514	1	44	89,429	84,776	82,652	43,893	19,725	20,991	2,106	54	38	38

Table 2: Biofuel types by raw material [kt]

Raw material	Bioethanol			Bio-LNG			Biomethane			Biomethanol			Organic naphtha		FAME			HVO			CP-HVO	Vegetable oil		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2021	2022	2020	2021	2022	2020	2021	2022	2020	2020	2021	2022
Waste and residues	63	66	46	<0.5	1	2	38	55	94	<0.5	<0.5	26	<0.5	1	882	772	1,101	212	153	385	<0.5			
Brassica carinata															2	1	4							
Fodder beet							<0.5	<0.5																
Barley	39	37	25																					
Cereal - Whole plant							<0.5	1	<0.5															
Grass/ arable grass							<0.5	<0.5	<0.5															
Maize	656	556	624				13	12	2															
Palm oil														1	594	763	248	795	300	93	32	1	<0.5	<0.5
Rapeseed															757	591	596				<0.5	1	1	1
Rye	80	154	38					1																
Soy															53	123	232							
Sunflowers															104	17	30			3	16			<0.5
Triticale	49	53	96																					
Wheat	135	147	168																					
Sugar cane	78	112	156																					
Sugar beet	16	33	16				1	1	<0.5															
Total	1,116	1,158	1,170	<0.5	1	2	52	70	96	<0.5	<0.5	26	<0.5	1	2,393	2,267	2,212	1,007	453	482	48	1	1	1

Table 3: Biofuels by origin of raw material [TJ]

Raw material	Africa			Asia			Australia			Europe			Central America			North America			South America		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Waste and residues	648	644	864	17,842	15,428	30,485	14	30	122	24,812	22,271	30,175	15	28	26	1,681	777	1,239	749	924	1,605
Brassica carinata																27	1	6	46	50	141
Fodder beet										2	1										
Barley										1,034	977	655									
Cereal - Whole plant										10	45	21									
Grass/ arable grass										10	14	4									
Maize									1	18,007	15,200	15,772				<0.5	54	53	2	76	782
Palm oil				52,975	38,936	12,667	4,214	3,115					4,842	2,571	550				492	87	123
Rapeseed				110	11	11	2		6,173	22,160	17,255	15,905				1,827	1,604	182		129	23
Rye										2,111	4,103	1,001									
Soy									<0.5	70	299	331	2					4	1,922	4,313	8,343
Sunflowers										4,589	629	1,284					<0.5				
Triticale										1,301	1,401	2,532									
Wheat										3,562	3,890	4,456									
Sugar cane													688	539	1,641				1,375	2,428	2,491
Sugar beet										456	908	423									
Total	648	644	864	70,927	54,376	43,163	4,229	3,144	6,297	78,126	66,992	72,559	5,547	3,138	2,217	3,535	2,436	1,483	4,586	8,007	13,508

Table 4: Biofuels by origin of raw material [kt]

Raw material	Africa			Asia			Australia			Europe			Central America			North America			South America		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Waste and residues	17	17	23	451	393	764	<0.5	1	3	665	590	775	<0.5	1	1	41	20	44	20	25	46
Brassica carinata																1	<0.5	<0.5	1	1	4
Fodder beet										<0.5	<0.5										
Barley										39	37	25									
Cereal - Whole plant										<0.5	1	<0.5									
Grass/ arable grass										<0.5	<0.5	<0.5									
Maize									<0.5	669	564	595				<0.5	2.06	2	<0.5	3	30
Palm oil				1,285	992	323	113	83					125	69	15				13	2	3
Rapeseed				3	<0.5	<0.5	<0.5		165	593	462	426				49	43	5		3	1
Rye										80	155	38									
Soy									<0.5	2	8	9	<0.5					<0.5	51	115	223
Sunflowers										120	17	34					<0.5				
Triticale										49	53	96									
Wheat										135	147	168									
Sugar cane													26	20	62				52	92	94
Sugar beet										17	34	16									
Total	17	17	23	1,739	1,385	1,087	113	84	168	2,368	2,067	2,181	152	90	77	91	65	51	137	242	400

Table 5: Biofuels 2022 by place of production [TJ]

Raw material	Africa	Asia	Europe	Central America	North America	South America	Total
Waste and residues	36	16,916	46,695		514	355	64,516
Brassica carinata			147				147
Fodder beet							
Barley			655				655
Cereal - Whole plant			21				21
Grass/ arable grass			4				4
Maize			16,493		53	63	16,608
Palm oil		1,871	11,469				13,340
Rapeseed			22,293				22,293
Rye			1,001				1,001
Soy			4,214			4,465	8,679
Sunflowers			1,284				1,284
Triticale			2,532				2,532
Wheat			4,456				4,456
Sugar cane				1,641		2,491	4,131
Sugar beet			423				423
Total	36	18,786	111,687	1,641	567	7,373	140,090

Table 6: Biofuels 2022 by place of production [kt]

Raw material	Africa	Asia	Europe	Central America	North America	South America	Total
Waste and residues	1	428	1,188		26	12	1,655
Brassica carinata			4				4
Fodder beet							
Barley			25				25
Cereal - Whole plant			<0.5				<0.5
Grass/ arable grass			<0.5				<0.5
Maize			622		2	2	626
Palm oil		50	292				341
Rapeseed			597				597
Rye			38				38
Soy			113			119	232
Sunflowers			34				34
Triticale			96				96
Wheat			168				168
Sugar cane				62		94	156
Sugar beet			16				16
Total	1	478	3,192	62	28	228	3,988

Table 7: Biofuels by raw material

Raw material	Year 2020	Year 2021	Year 2022	Year 2020	Year 2021	Year 2022
	[TJ]	[TJ]	[TJ]	[kt]	[kt]	[kt]
Waste and residues	45,761	40,102	64,516	1,195	1,047	1,655
Brassica carinata	73	51	147	2	1	4
Fodder beet	2	1		<0.5	<0.5	
Barley	1,034	977	655	39	37	25
Cereal - Whole plant	10	45	21	<0.5	1	<0.5
Grass/ arable grass	10	14	4	<0.5	<0.5	<0.5
Maize	18,010	15,331	16,608	669	568	626
Palm oil	58,308	41,594	13,340	1,423	1,063	341
Rapeseed	28,310	22,113	22,293	757	592	597
Rye	2,111	4,103	1,001	80	155	38
Soy	1,994	4,612	8,679	53	123	232
Sunflowers	4,591	629	1,284	120	17	34
Triticale	1,301	1,401	2,532	49	53	96
Wheat	3,562	3,890	4,456	135	147	168
Sugar cane	2,062	2,967	4,131	78	112	156
Sugar beet	456	908	423	17	34	16
Total	167,597	138,737	140,090	4,617	3,950	3,988

Table 8: Biofuels, raw material from Germany [TJ]

Raw material	Bioethanol			Bio-LNG		Biomethane			CP-HVO	FAME			HVO		Vegetable oil			Total		
	2020	2021	2022	2021	2022	2020	2021	2022	2020	2020	2021	2022	2021	2022	2020	2021	2022	2020	2021	2022
Waste and residues	303	305	31	48	16	1,858	2,484	4,249		7,759	7,683	8,711	10	11				9,920	10,531	13,017
Fodder beet						2	1											2	1	
Barley	884	856	568															884	856	568
Cereal - Whole plant						10	44	21										10	44	21
Grass/ arable grass								2												2
Maize	109	119	216			643	610	82										752	729	298
Rapeseed									4	11,396	9,380	5,036			26	30	28	11,426	9,409	5,065
Rye	537	1,348	488				26											537	1,374	488
Soy											2	8							2	8
Sunflowers											<0.5								<0.5	
Triticale	145	237	441															145	237	441
Wheat	117	449	723															117	449	723
Sugar beet	392	771	419			27	32	<0.5										419	803	419
Total	2,487	4,086	2,886	48	16	2,540	3,196	4,354	4	19,155	17,065	13,755	10	11	26	30	28	24,212	24,435	21,050

Table 9: Biofuels from waste and residues [TJ]

advanced biofuels according to the 38th BImSchV Annex 1 No.	Year 2020	Year 2021	Year 2022
2 (biomass share of mixed municipal waste)	<0.5	37	120
3 (biowaste from private households)	94	59	645
4 (biomass share of mixed municipal waste)	1,112	3,463	7,310
5 (straw)	129	302	371
6 (liquid manure and sewage sludge)	184	228	1,886
7 (wastewater from palm oil mills and empty palm fruit bunches)	3,290	2,835	12,878
8 (tall oil pitch)			38
9 (crude glycerine)	47	697	1,277
10 (bagasse)			234
11 (grape marc and lees)	<0.5		25
15 (biomass shares of waste and residues from forestry)	1,433	1,495	3,431
16 (other non-food cellulosic material)		4	18
Subtotal advanced biofuels	6,288	9,119	28,235
used vegetable oils	29,286	24,249 ¹	30,010
Other	10,188	6,733 ⁶	6,271
Subtotal non-advanced biofuels	39,473	30,982	36,281
Total waste and residues	45,761	40,102	64,516

¹ corrected value

Table 10: Biofuels 2022 from waste and residues by origin of raw material [TJ]

advanced biofuels according to the 38th BImSchV Annex 1 No.	Africa	Asia	Australia	Europe	Central America	North America	South America	Total
2 (biomass share of mixed municipal waste)				120				120
3 (biowaste from private households)				169		476		645
4 (biomass share of mixed municipal waste)		1,664		5,569		69	9	7,310
5 (straw)				371				371
6 (liquid manure and sewage sludge)				1,848		39		1,886
7 (wastewater from palm oil mills and empty palm fruit bunches)	31	12,847					<0.5	12,878
8 (tall oil pitch)				17		21		38
9 (crude glycerine)	12			1,265				1,277
10 (bagasse)							234	234
11 (grape marc and lees)				25				25
15 (biomass shares of waste and residues from forestry)		529		2,771		132		3,431
16 (other non-food cellulosic material)				18				18
Subtotal advanced biofuels	43	15,039		12,173		736	243	28,235
used vegetable oils	730	14,883	120	13,026	26	387	838	30,010
Other	91	563	2	4,976		116	524	6,271
Subtotal non-advanced biofuels	821	15,446	122	18,002	26	503	1,362	36,281
Total waste and residues	864	30,485	122	30,175	26	1,239	1,605	64,516

Table 11: Biofuels 2022 from waste and residues by origin of raw material [TJ]

advanced biofuels according to the 38th BImSchV Annex 1 No.	Africa	Asia	Australia	Europe	Central America	North America	South America	Total
2 (biomass share of mixed municipal waste)				120				120
3 (biowaste from private households)				169		476		645
4 (biomass share of mixed municipal waste)		1,604		5,697			9	7,310
5 (straw)				371				371
6 (liquid manure and sewage sludge)				1,848		39		1,886
7 (wastewater from palm oil mills and empty palm fruit bunches)		6,871		6,007				12,878
8 (tall oil pitch)				38				38
9 (crude glycerine)	12			1,265				1,277
10 (bagasse)							234	234
11 (grape marc and lees)				25				25
15 (biomass shares of waste and residues from forestry)				3,431				3,431
16 (other non-food cellulosic material)				18				18
Subtotal advanced biofuels	12	8,475		18,990		514	243	28,235
used vegetable oils	24	7,984		22,002				30,010
Other		456		5,703			112	6,271
Subtotal non-advanced biofuels	24	8,440		27,705			112	36,281
Total waste and residues	36	16,916		46,695		514	355	64,516

Table 12: Biofuels, emissions and emission savings

Biofuel type	Emissions 2020	Emissions 2021	Emissions 2022	Savings 2020	Savings 2021	Savings 2022
	[t CO ₂ eq/TJ]	[t CO ₂ eq/TJ]	[t CO ₂ eq/TJ]	[%]	[%]	[%]
Bioethanol	7.44	9.18	9.39	92.02	90.21	89.94
Bio-LNG	13.70	6.79	-7.33	85.44	92.78	107.79
Biomethane	8.94	5.86	-25.47	90.50	93.77	127.07
Biomethanol	33.50	33.50	33.48	64.09	64.09	64.12
Bionaphtha		20.07	19.14		78.49	79.49
FAME	17.97	16.86	14.93	81.11	82.33	84.31
HVO	19.82	16.02	12.24	79.15	83.15	87.13
CP-HVO	17.69			81.40		
Vegetable oil	31.60	31.73	33.06	66.78	66.70	65.24
weighted average of all biofuels	16.46	14.77	11.98	82.63	84.45	87.35

Table 13: Types of combustible biofuels [TJ]

Types of combustible biofuels	2020	2021	2022
from pulp industry	24,955	24,192	23,493
Bionaphtha	1		
FAME	1,276	975	825
HVO	26	600	927
Vegetable oil	4,415	2,162	865
Total	30,673	27,929	26,111

Table 14: Biofuels from vegetable oil by raw product [TJ]

Raw material	2020	2021	2022
Palm oil	3,237	1,665	450
Rapeseed	1,169	351	279
Shea	9	146	136
Total	4,415	2,162	865

Table 15: Biofuels from palm oil by raw material [TJ]

Source	2020	2021	2022
Guatemala	165	87	32
Honduras	254	5	93
Indonesia	1,198	823	151
Columbia	99	184	43
Malaysia	1,521	567	131
Total	3,237	1,666	450

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Table 16: Biofuels, emissions and emission savings

Types of combustible biofuels	Emissions 2020	Savings 2021	Savings 2022	Savings 2020	Savings 2021	Savings 2022
	[t CO ₂ eq/TJ]	[t CO ₂ eq/TJ]	[t CO ₂ eq/TJ]	[%]	[%]	[%]
from pulp industry	2.43	1.94	3.17	97.33	97.86	96.52
Bionaphtha	9.57			89.49		
FAME	33.81	33.28	33.02	62.85	63.43	65.27
HVO	8.48	8.32	7.42	90.68	90.86	92.19
Vegetable oil	31.07	30.23	34.23	65.86	66.78	64.01
weighted average of all combustible biofuels	7.86	5.36	5.29	91.36	94.11	94.21