										Carbon fiber reinforced plastic part (CFRP)															
				Precursor production		Carbon fiber production				CFRP production															
										Material properties				CFRP production processes											
No		Name	Treatment, standards, routes	Raw material	Electricity for precursor production	Electricity for carbon fiber production	Thermal energy for carbon fiber production	Type of energy use	Fiber Type	Polymer type	Matrix material	Fiber volume content	Electricity for processing	Bindered non-crimp fabric (NCF)	Press forming	Braiding	Resin transfer molding (RTM)	Pultrusion	Fabric production	Organo sheet production	Thermoplastic forming	machining	Recycling
47	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; low preform cuttings (20%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	50%	Electricity grid mix Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	Low preform cuttings (20%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
48	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; low preform cuttings (20%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	50%	Electricity from windpower Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	Low preform cuttings (20%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
49	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; low preform cuttings (20%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	50%	Electricity grid mix Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	Low preform cuttings (20%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
50	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; low preform cuttings (20%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	50%	Electricity from windpower Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	Low preform cuttings (20%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
51	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; average preform cuttings (40%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	50%	Electricity grid mix Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	Average preform cuttings (40%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
52	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; average preform cuttings (40%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	50%	Electricity from windpower Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	Average preform cuttings (40%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
53	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; average preform cuttings (40%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	50%	Electricity grid mix Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	Average preform cuttings (40%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
54	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; average preform cuttings (40%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	50%	Electricity from windpower Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	Average preform cuttings (40%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
55	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; high preform cuttings (60%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	50%	Electricity grid mix Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	High preform cuttings (60%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
56	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; high preform cuttings (60%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	50%	Electricity from windpower Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	High preform cuttings (60%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
57	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; high preform cuttings (60%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	50%	Electricity grid mix Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	High preform cuttings (60%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
58	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: bindered non-crimp fabric (NCF), press forming, resin transfer molding RTM, machining; high preform cuttings (60%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	50%	Electricity from windpower Germany	Fiber areal weight: 250 g/m². Bindered material contains 5% epoxy binder (12g/m²)and 1.6% polyester yarn (4g/m²).	High preform cuttings (60%). Mean process parameters from industry data for part size (~1m²).	-	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part geometry (~1m²) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
59	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: braiding, resin transfer molding RTM, machining; low preform cuttings (5%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	50%	Electricity grid mix Germany	-	-	24k-Roving. Mean process parameters from industry data for deposition rate in dependance on fiber angle (45-75°), core diameter (30-150mm) and with and w/o application of filler yarn.	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part diameter (30-150mm) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
60	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: braiding, resin transfer molding RTM, machining; low preform cuttings (5%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	50%	Electricity from windpower Germany	-	-	24k-Roving. Mean process parameters from industry data for deposition rate in dependance on fiber angle (45-75°), core diameter (30-150mm) and with and w/o application of filler yarn.	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part diameter (30-150mm) and thickness (~2mm).	-	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.

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No		Name	Treatment, standards, routes	Raw material	Electricity for precursor production	Electricity for carbon fiber production	Thermal energy for carbon fiber production	Type of energy use	Fiber Type	Polymer type	Matrix material	Fiber volume content	Electricity for processing	Bindered non-crimp fabric (NCF)	Press forming	Braiding	Resin transfer molding (RTM)	Pultrusion	Fabric production	Organo sheet production	Thermoplastic forming	machining	Recycling
61	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: braiding, resin transfer molding RTM, machining; low preform cuttings (5%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	50%	Electricity grid mix Germany	-	-	24k-Roving. Mean process parameters from industry data for deposition rate in dependance on fiber angle (45-75°), core diameter (30-150mm) and with and w/o application of filler yarn	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part diameter (30-150mm) and thickness (~2mm).		-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
62	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: braiding, resin transfer molding RTM, machining; low preform cuttings (5%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	50%	Electricity from windpower Germany	-	-	24k-Roving. Mean process parameters from industry data for deposition rate in dependance on fiber angle (45-75°), core diameter (30-150mm) and with and w/o application of filler yarn	Includes injection of resin, heating of tools, hydraulic press and vacuum pump. Process temperature: 120°C. Process time: 10 min. Mean process parameters from industry data for part diameter (30-150mm) and thickness (~2mm).		-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
63	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: pultrusion, machining; low carbonfiber remainings on the bobbins (5%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	60%	Electricity grid mix Germany	-	-	-	-	Open pultrusion. cut-offs matrix: 7.5%. Carbon fiber remaining on the bobbins: 5%. Mean process parameters from industry data for fiber volume content (60%).	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
64	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: pultrusion, machining; low carbonfiber remainings on the bobbins (5%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	EP	60%	Electricity from windpower Germany	-	-	-	-	Open pultrusion. cut-offs matrix: 7.5%. Carbon fiber remaining on the bobbins: 5%. Mean process parameters from industry data for fiber volume content (60%).	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
65	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: pultrusion, machining; low carbonfiber remainings on the bobbins (5%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	60%	Electricity grid mix Germany	-	-	-	-	Open pultrusion. cut-offs matrix: 7.5%. Carbon fiber remaining on the bobbins: 5%. Mean process parameters from industry data for fiber volume content (60%).	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
66	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix EP. Fiber: CF. Fiber volume content 50%. Production processes: pultrusion, machining; low carbonfiber remainings on the bobbins (5%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	EP	60%	Electricity from windpower Germany	-	-	-	-	Open pultrusion. cut-offs matrix: 7.5%. Carbon fiber remaining on the bobbins: 5%. Mean process parameters from industry data for fiber volume content (60%).	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
67	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO, P: DE)	Thermosetting polymer. Matrix PU. Fiber: CF. Fiber volume content 50%. Production processes: pultrusion, machining; low carbonfiber remainings on the bobbins (5%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	PU	60%	Electricity grid mix Germany	-	-	-	-	Open pultrusion. cut-offs matrix: 7.5%. Carbon fiber remaining on the bobbins: 5%. Mean process parameters from industry data for fiber volume content (60%).	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
68	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix PU. Fiber: CF. Fiber volume content 50%. Production processes: pultrusion, machining; low carbonfiber remainings on the bobbins (5%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermosetting polymer	PU	60%	Electricity from windpower Germany	-	-	-	-	Open pultrusion. cut-offs matrix: 7.5%. Carbon fiber remaining on the bobbins: 5%. Mean process parameters from industry data for fiber volume content (60%).	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
69	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermosetting polymer. Matrix PU. Fiber: CF. Fiber volume content 50%. Production processes: pultrusion, machining; low carbonfiber remainings on the bobbins (5%)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	PU	60%	Electricity grid mix Germany	-	-	-	-	Open pultrusion. cut-offs matrix: 7.5%. Carbon fiber remaining on the bobbins: 5%. Mean process parameters from industry data for fiber volume content (60%).	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
70	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermosetting polymer. Matrix PU. Fiber: CF. Fiber volume content 50%. Production processes: pultrusion, machining; low carbonfiber remainings on the bobbins (5%)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermosetting polymer	PU	60%	Electricity from windpower Germany	-	-	-	-	Open pultrusion. cut-offs matrix: 7.5%. Carbon fiber remaining on the bobbins: 5%. Mean process parameters from industry data for fiber volume content (60%).	-	-	-	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
71	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO, P: DE)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; low organo sheet cuttings (20 %)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity grid mix Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. Low organo sheet cuttings (20%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
72	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; low organo sheet cuttings (20 %)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity from windpower Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. Low organo sheet cuttings (20%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
73	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; low organo sheet cuttings (20 %)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity grid mix Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. Low organo sheet cuttings (20%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
74	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; low organo sheet cuttings (20 %)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity from windpower Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. Low organo sheet cuttings (20%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.

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				Precursor production		Carbon fiber production				CFRP production													
										Material properties				CFRP production processes									
No		Name	Treatment, standards, routes	Raw material	Electricity for precursor production	Electricity for carbon fiber production	Thermal energy for carbon fiber production	Type of energy use	Fiber Type	Polymer type	Matrix material	Fiber volume content	Electricity for processing	Bindered non-crimp fabric (NCF)	Press forming	Braiding	Resin transfer molding (RTM)	Pultrusion	Fabric production	Organo sheet production	Thermoplastic forming	machining	Recycling
75	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO, P: DE)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; average organo sheet cuttings (40 %)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity grid mix Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. Medium organo sheet cuttings (40%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
76	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; average organo sheet cuttings (40 %)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity from windpower Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. Medium organo sheet cuttings (40%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
77	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; average organo sheet cuttings (40 %)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity grid mix Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. Medium organo sheet cuttings (40%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
78	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; average organo sheet cuttings (40 %)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity from windpower Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. Medium organo sheet cuttings (40%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
79	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO, P: DE)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; high organo sheet cuttings (60 %)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity grid mix Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. High organo sheet cuttings (60%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
80	DE	Carbon fiber reinforced plastic part (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; average organo sheet cuttings (40 %)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity from windpower Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. High organo sheet cuttings (60%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
81	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; average organo sheet cuttings (40 %)	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity grid mix Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. High organo sheet cuttings (60%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
82	DE	Carbon fiber reinforced plastic part (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production, thermoplastic forming, machining; average organo sheet cuttings (40 %)	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity from windpower Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. High organo sheet cuttings (60%). Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	Infrared heater at 300°C for 1.5min.; Hydraulic press; tooling temperature: 80°C; cristallization time: 1.5min. Mean process parameters from industry data for part size (~1m²) and thickness (2mm).	10% cut-offs.	Only waste water treatment is included. No CFRP recycling.
83	DE	Carbon fiber reinforced organo sheet (CFRP. CF: GLO, P: DE)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production; no cut-offs	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity grid mix Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. No sheet cuttings. Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	-	-	Only waste water treatment is included. No CFRP recycling.
84	DE	Carbon fiber reinforced organo sheet (CFRP. CF: GLO-Hydro, P: DE-Wind)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production; no cut-offs	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Regular energy used	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity from windpower Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. No sheet cuttings. Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	-	-	Only waste water treatment is included. No CFRP recycling.
85	DE	Carbon fiber reinforced organo sheet (CFRP. Optimized energy use, CF: GLO, P: DE)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production; no cut-offs	Acrylonitrile	Electricity grid mix Japan	Carbon fiber production capacity world mix	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity grid mix Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. No sheet cuttings. Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	-	-	Only waste water treatment is included. No CFRP recycling.
86	DE	Carbon fiber reinforced organo sheet (CFRP. Optimized energy use, CF: GLO-Hydro, P: DE-Wind)	Thermoplastic polymer. Matrix PA6. Fiber: CF. Fiber volume content 50%. Production processes: fabric production, organo sheet production; no cut-offs	Acrylonitrile	Electricity from hydropower Japan	Electricity from hydropower US	Electricity grid mix Europe (EU27)	Optimized energy use	High tensity fiber	Thermoplastic polymer	PA6	50%	Electricity from windpower Germany	-	-	-	-	-	Fiber areal weight: 250 g/m².	Eletric-heated heating press. No sheet cuttings. Mean process parameters from industry data for fiber volume content (50%). Temperature zones of a.) 280°C and b.) 80°C, pressure for zone 1bar (a) and 40bar (b), process time for each of both zones ~10min (a,b).	-	-	Only waste water treatment is included. No CFRP recycling.

Legend: CFRP = carbon fiber reinforced plastic part, CF = carbon fiber, HT = high tensity, US = United States of America, DE = Germany or DE electricity grid mix, EU27 = European Union, JP = Japan, EP = epoxy, PU = polyurethane, PA6 = polyamid, P = processing, GLO = carbon fiber production capacity world mix 2016 and precursor production JP electricity grid mix, GLO-Hydro = carbon fiber production US electricity from hydropower and precursor production from JP electricity from hydropower, DE-Wind = DE electricity from windpower