<u>**Supplementary material**</u>

Economic and ecological impacts on the integration of biomass-based SNG and FT diesel in the Austrian energy system

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Assumptions and references for process simulation to calculate mass and energy balances for biomass-based SNG and FT route

Table S1. Assumptions for the units of the gasification, gas cooling & cleaning section

Parameter	Unit	Value/Assumption	Reference
Biomass dryer			**[65, 66]**
Water content incoming biomass	wt.-%	40	
Water content exiting biomass	wt.-%	20	
Temperature drying air inlet	°C	90	
Relative humidity drying air inlet	%	80	
Relative humidity drying air outlet	%	80	
DFB gasification reactor			**[66-68]**
Operating temperature	°C	820	
Steam to fuel ratio	$kg_{H2O}/kg_{fuel,daf}$	0.6	
Heat loss (related to thermal fuel power)	%	1	
Temperature steam	°C	400	
DFB combustion reactor			**[66-68]**
Lambda	kg/kg	1.25	
CO slip	mol CO/mol CO_2	0.05	
Heat loss (related to thermal fuel power)	%	1	
PG filter			**[69]**
Separation efficiency dust	%	99.9	
Separation efficiency char	%	99.9	
Separation efficiency tar	%	30	
RME scrubber			**[19, 70, 71]**
Circulating solvent to gas ratio	kg_{RME}/kg_{gas}	20	
Tar concentration outlet	g/Nm^3	1.5	
Temperature exiting gas	°C	40	
Temperature incoming RME	°C	37	
Separation efficiency ammonia (inclusive downstream units)	%	99.9	
Massflow fresh RME make-up	kg/h	110	[19]
AC adsorber			**[38, 45]**
Separation efficiency tar	%	100	
Separation efficiency sulfur	%	100	
Adsorption capacity AC	wt.-%	20	
Steam regeneration temperature	°C	250	[38]
Steam amount for regeneration	kg/kg_{BTX}	9.2	[38]

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Auxiliary and pressure drop			
Steam pre-evaporation (related to amount of water phase from RME scrubber)	wt.-%	5	assumed
Total pressure drop product gas route	mbar	345	assumed
Total pressure drop flue gas route	mbar	345	assumed
Blowers			**[66, 72]**
Efficiency of drive system (all units)	%	95	
Mechanical efficiency of blowers (all units)	%	98	
Isentropic efficiencies			
Drying air blower	%	80	
PG blower	%	50	
PG recycle blower	%	50	
FG blower	%	75	
FG recycle blower	%	75	
Combustion air blower 1	%	65	
Combustion air blower 2	%	45	

Table S2. Assumptions for the units of the SNG synthesis and upgrading section

Parameter	Unit	Value/Assumption	Reference
Compressor			**[73]**
Efficiency of drive system	%	95	
Mechanical efficiency of compressor	%	98	
Isentropic efficiency	%	85	
Guard reactor (ZnO)			
GHSV	h^{-1}	3800	[74]
Fluidized bed methanation reactor			
Reaction temperature	°C	320	[75]
Reaction pressure	bar	10	assumed
WHSV	Nm^3/kg_{cat} h	1.5	[75]
Steam content inlet	vol.-%	15	assumed
Pressure drop	mbar	150	assumed
Catalyst type	-	Ni/Al_2O_3	[75]
CO_2 scrubber			
Gas inlet temperature	°C	40	[76]
Gas outlet temperature	°C	60	assumed
Separation efficiency CO_2	%	97.5	assumed
Reboiler duty	$MJ/kgCO_2$	0.8	[38]
Absorption capacity	kg CO_2/kg amine	0.36	[77]
Amine make-up stream	kg/t_{CO2}	1.5	[76]
Glycol dryer			
Gas inlet temperature	°C	30	[78]
Gas outlet temperature	°C	31	[78]
Glycol regeneration temperature	°C	190	[78]
Glycol make-up stream	kg/h	0.1	[79]

Table S3. Assumptions for the units of the FT synthesis and upgrading section

Parameter	Unit	Value/Assumption	Reference
Compressor			**[73]**
Efficiency of drive system	%	95	
Mechanical efficiency of compressor	%	98	
Isentropic efficiency	%	85	
CO_2 scrubber			
Gas inlet temperature	°C	40	[76]
Gas outlet temperature	°C	60	assumed
Separation efficiency CO_2	%	80	assumed[2]
Reboiler duty	MJ/kgCO_2	0.8	[38]
Absorption capacity	kg CO_2/kg amine	0.36	[77]
Amine make-up stream	kg/t_{CO2}	1.5	[76]
Guard reactor (ZnO)			
GHSV	h^{-1}	3800	[74]
FT slurry reactor			
Reaction temperature	°C	230	[40]
Reaction pressure	bar	21	[40]
CO-Conversion	mol.-%	50	[40]
CO_2-Conversion (WGS activity)	mol.-%	0	[40]
α_1 (eASF distribution parameter)	-	0.78	[40]
α_2 (eASF distribution parameter)	-	0.9	[40]
β (eASF distribution parameter)	-	0.75	[40]
γ (eASF distribution parameter)	-	0.48	[40]
μ (eASF distribution parameter)	-	0.95	[40]
Naphtha compounds in liquid phase	mass.-%	0	assumed[3]
Middle distillate compounds in liquid phase	mass.-%	0.05	assumed[3]
Naphtha compounds in liquid phase	mass.-%	0.75	assumed[3]
Recirculation ratio tailgas	vol.-%	85	assumed[4]
WHSV	Nm^3/kg_{cat} h	2.0	[80]
Pressure drop	mbar	300	assumed
Catalyst type	-	Co/Al_2O_3	[81]
Quench column			
Temperature (top)	°C	70	[81]
Steam Reformer			
Reaction temperature	°C	850	[82]
Reaction pressure	bar	10	[82]
CH_4-Conversion	vol.-%	90	[82]
C_2H_4-Conversion	vol.-%	90	[82]
C_2H_6-Conversion	vol.-%	95	[82]
C_3H_8-Conversion	vol.-%	99	[82]
Steam/Carbon ratio	-	2.5	[83]
WHSV	Nm^3/kg_{cat} h	2.5	assumed
Pressure drop	mbar	300	assumed
Catalyst type	-	$NiO/CaAl_{12}O_{19}$	[84]

[2] Separation efficiency was set to adjust balance in Steam Reformer in favor of H_2/CO ratio of tailgas
[3] Liquid and gas phase distribution of FT products assumed according to phase equilibrium at process conditions
[4] Recirculation ratio assumed according to heat demand of steam reformer (15% of tailgas combusted = purge gas)

Hydrocracker			
Reaction temperature	°C	360	[81, 85, 86]
Reaction pressure	bar	40	[81, 85, 86]
Wax conversion	%	70	[86, 87]
Outlet concentration C_1-C_3	wt.-% (without wax)	5	[81]
Outlet concentration C_4-C_9	wt.-% (without wax)	20	[81]
Outlet concentration C_{10}-C_{20}	wt.-% (without wax)	75	[81]
LHSV	Nm^3_{wax}/Nm^3_{cat} h	1	[81, 85, 86]
Hydrogen make-up stream	wt.-$\%_{H2}$ /wt.-$\%_{wax}$	1	[81]
Catalyst type	-	Pt/SiO_2-Al_2O_3	[87, 88]
Hydrotreater			
Reaction temperature	°C	350	[86, 89]
Reaction pressure	bar	40	[86, 89]
LHSV	Nm^3_{MD}/Nm^3_{cat} h	2	[86, 89]
Hydrogen make-up stream	wt.-$\%_{H2}$ /wt.-$\%_{MD}$	0.3	[86]
Catalyst type	-	Ni-MoS_2/Al_2O_3	[85 ,90]

Table S4. Assumptions as well as results for biomass and gas compositions

Parameter	Unit	Value/Assumption	Reference
Biomass composition			**[5]**
Water content	wt.-%	40	
Ash content	wt.-$\%_{db}$	1	
Carbon	wt.-$\%_{db}$	50.7	
Hydrogen	wt.-$\%_{db}$	5.9	
Nitrogen	wt.-$\%_{db}$	0.21	
Sulfur	wt.-$\%_{db}$	0.01	
Product gas composition			**[91]**
Hydrogen	vol.-$\%_{db}$	45	
Carbon dioxide	vol.-$\%_{db}$	21.15	
Carbon monoxide	vol.-$\%_{db}$	23	
Methane	vol.-$\%_{db}$	9.7	
Ethylene	vol.-$\%_{db}$	1	
Ethane	vol.-$\%_{db}$	0.1	
Water content	vol.-%	30	
Ammonia	$ppm_{v,db}$	950	
Nitrogen	$ppm_{v,db}$	350	
Dust	g/Nm^3	10	
Char	g/Nm^3	10	
Tar	g/Nm^3	5	
SNG composition			**result**
Methane	vol.-%	94.62	
Hydrogen	vol.-%	2.82	
Carbon dioxide	vol.-%	2.34	
Nitrogen	vol.-%	0.12	
Carbon monoxide	vol.-%	0.093	

Relative density	-	0.564	
Wobbe index	MJ/Nm^3	50.55	
Higher heating value	MJ/Nm^3	37.95	
FT product composition (excluding C_1-C_3)			**result**
FT naphtha (C_4-C_9)	wt.-%$_{db}$	23.67	
FT middle distillate (C_{10}-C_{19})	wt.-%$_{db}$	37.25	
FT wax (C_{20+})	wt.-%$_{db}$	39.08	

Assumptions and references for techno-economic assessment to calculate production costs for biomass-based SNG and FT route

Table S5. Assumptions for cost rates

Parameter	Unit	Value/Assumption	Reference
General plant parameters			**[11, 92]**
Plant lifetime	a	20	
Number of employees	-	7	
Personnel costs per employee 2022	€/a	65000	
Personnel costs per employee 2019	€/a	62500	
Operating hours plant	h/a	7500	
Operating hours district heat	h/a	5800	
Maintenance costs	%$_{CAPEX}$/a	2.0	
Insurance, administration and other costs	%$_{CAPEX}$/a	1.5	
Interest rate	%	6	
Consumption-related parameters			
Natural gas household price 2022	€/MWh	150	[93, 94]
Natural gas household price 2019	€/MWh	69.7	[93]
Natural gas industry price 2022	€/MWh	88.9	[93]
Natural gas industry price 2019	€/MWh	29.9	[93]
Fossil diesel price petrol station 2022	€/l	1.939 (incl. taxes)	[95]
Fossil diesel price petrol station 2019	€/l	1.236 (incl. taxes)	[95]
Fossil diesel price stock market 2022	€/l	1.595 (incl. taxes)	[96]
Fossil diesel price stock market 2019	€/l	0.934 (incl. taxes)	[96]
Wood chips price 2022	€/t$_{atro}$	95	[11]
Wood chips price 2019	€/t$_{atro}$	75	[11]
Fresh scrubber solvent (RME)[5]	€/kg$_{2013}$	0.96	[66]
Fresh amine (MEA)[5]	€/kg$_{2013}$	1.40	[98]
Fresh glycol (TEG)[5]	€/kg$_{2016}$	2.0	[99]
Activated carbon[5] (lifetime 1 year)	€/kg$_{2019}$	2.21	[11]
Zinc oxide[5] (lifetime 3 years)	€/kg$_{2013}$	20	[100]
Olivine[5]	€/t$_{2013}$	190	[66]
Limestone[5]	€/t$_{2013}$	35	[92]
Nickel catalyst[5] (lifetime 3 years)	€/kg$_{2011}$	50	[29]
Cobalt catalyst[5] (lifetime 5 years)	€/kg$_{2013}$	24	[29]
Platin catalyst[5] (lifetime 3 years)	€/kg$_{2014}$	1504	[29]
Disposal costs ash[5]	€/t$_{2013}$	90	[66]
Disposal costs waste water[5]	€/m$^3_{2019}$	2.5	[11]

[5] Cost rates from literature inflation-adjusted with EPI [97] from literature base to reference years 2019 and 2022

CO_2 emission allowances 2022	€/t_{CO2}	69.6	[101]
CO_2 emission allowances 2019	€/t_{CO2}	24.9	[101]
Electricity costs (industry) 2022	€/kWh_{el}	0.21	[102]
Electricity costs (industry) 2019	€/kWh_{el}	0.095	[102]
Hydrogen costs 2022	€/kg	4.5	[103]
Hydrogen costs 2019	€/kg	4.0	[103]
Revenues FT naphtha[5]	€/l_{2017}	0.78	[104]
Revenues district heat[5]	€/$MWh_{th,2016}$	30.0	[92]

Table S6. Assumptions for determination of total capital investment costs for the biomass-based SNG route

Equipment	Base scale	Base cost	Scale factor	Desired scale	Equipment costs 2022[6]	Equipment costs 2019[6]	Ref.
Resource supply + Gasification + Raw gas cleaning + Flue gas cleaning					**114 431 228 €**	**83 522 433 €**	
(biomass dryer, gasification reactor, combustion reactor, PG cyclone, PG cooler, PG filter, RME scrubber incl regeneration, PG blower, steam generation, pre-evaporator, FG cyclone, post combustion chamber, steam superheater, FG cooler, FG filter, FG blower, stack)							
DFB gasification system + gas cooling and cleaning (total capital investment costs)	15 MW_{th}	21 697 500 $€_{2020}$	0.7	100 MW_{th}	114 431 228 €	83 522 433 €	[11]
Fine gas cleaning + Syngas compression and cooling					**6 206 640 €**	**4 505 289 €**	
Activated carbon adsorber (TSA)	32 MW_{th}	945 180 $€_{2018}$	0.7	100 MW_{th}	3 043 368 €	2 221 330 €	[28]
Product gas compressor 1	224 kW_{el}	120 498 $€_{1994}$	0.84	1303 kW_{el}	1 256 400 €	917 036 €	[105]
Intermediate cooler	448 MW_{th}	4 258 200 $€_{2007}$	0.7	1.66 MW_{th}	140 785 €	102 758 €	[106]
Product gas compressor 2	224 kW_{el}	120 498 $€_{1994}$	0.84	1442 kW_{el}	1 368 204 €	998 641 €	[105]
Syngas preheater	93 m^2	19 660 $€_{1994}$	0.59	65 m^2	36 015 €	26 287 €	[105]
ZnO guard reactor	175 $MW_{SNG,HHV}$	450 000 $€_{2012}$	0.7	72 $MW_{SNG,HHV}$	361 778 €	239 237 €	[107]
Methanation					**3 713 954 €**	**2 710 785 €**	
Fluidized bed methanation	25 560 Nm^3/h	2 235 200 $€_{2010}$	0.6	27 044 Nm^3/h	3 670 316 €	2 678 934 €	[108]
Steam generator methanation	93 m^2	19 660 $€_{1994}$	0.59	90 m^2	43 638 €	31 851 €	[105]
SNG Upgrading					**5 099 018 €**	**3 721 731 €**	
Raw-SNG cooler	93 m^2	19 660 $€_{1994}$	0.59	600 m^2	133 651 €	97 551 €	[105]
Raw-SNG condenser	448 MW_{th}	4 258 200 $€_{2007}$	0.7	4.29 MW_{th}	274 085 €	200 052 €	[106]
CO_2 scrubber (MEA) incl. regeneration	54 000 Nm^3/h	6 700 000 $€_{2012}$	0.6	13 185 Nm^3/h	4 298 880 €	3 137 718 €	[109]
CO_2 recycle blower	16 992 Nm^3/h	60 702 $€_{1994}$	0.6	6 246 Nm^3/h	75 353 €	54 999 €	[105]
CO_2 recycle motor	7.5 kW_{el}	11 144 $€_{1994}$	0.56	8.9 kW_{el}	29 189 €	21 304 €	[105]
SNG cooler	93 m^2	19 660 $€_{1994}$	0.59	65 m^2	36 015 €	26 287 €	[105]
Glycol dryer incl. regeneration	41664 Nm^3/h	457 507 $€_{2016}$	0.6	6938 Nm^3/h	251 845 €	183 820 €	[78]
Total equipment costs SNG route (without DFB)					**15 019 612 €**	**10 937 805 €**	
Total capital investment costs SNG route (Lang factor = 4.87 [54])					**187 576 738 €**	**136 789 544 €**	

[6] Calculated according to equation 3 from main text in chapter 2.3

Table S7. Assumptions for determination of total capital investment costs for the biomass-based FT route

Equipment	Base scale	Base cost	Scale factor	Desired scale	Equipment costs 2022[7]	Equipment costs 2019[7]	Ref.
Resource supply + Gasification + Raw gas cleaning + Flue gas cleaning					**114 431 228 €**	**83 522 433 €**	
(biomass dryer, gasification reactor, combustion reactor, PG cyclone, PG cooler, PG filter, RME scrubber incl regeneration, PG blower, steam generation, pre-evaporator, FG cyclone, post combustion chamber, steam superheater, FG cooler, FG filter, FG blower, stack)							
DFB gasification system + gas cooling and cleaning (total capital investment costs)	15 MW_{th}	21 697 500 $€_{2020}$	0.7	100 MW_{th}	114 431 228 €	83 522 433 €	[11]
Fine gas cleaning + Syngas compression and cooling					**14 213 796 €**	**10 331 845 €**	
Activated carbon adsorber (TSA)	32 MW_{th}	945 180 $€_{2018}$	0.7	100 MW_{th}	3 043 368 €	2 221 330 €	[28]
Product gas compressor 1	224 kW_{el}	120 498 $€_{1994}$	0.84	1303 kW_{el}	1 256 400 €	917 036 €	[105]
Product gas compressor 2	224 kW_{el}	120 498 $€_{1994}$	0.84	1450 kW_{el}	1 374 800 €	1 003 455 €	[105]
CO_2 scrubber (MEA) incl. regeneration	54 000 Nm^3/h	6 700 000 $€_{2012}$	0.6	23 171 Nm^3/h	6 029 535 €	4 400 909 €	[109]
CO_2 recycle blower	16 992 Nm^3/h	60 702 $€_{1994}$	0.6	3 890 Nm^3/h	56 716 €	41 397 €	[105]
CO_2 recycle motor	7.5 kW_{el}	11 144 $€_{1994}$	0.56	5 kW_{el}	21 100 €	15 401 €	[105]
Product gas compressor 3	224 kW_{el}	120 498 $€_{1994}$	0.84	1926 kW_{el}	1 744 670 €	1 273 421 €	[105]
Syngas preheater	93 m^2	19 660 $€_{1994}$	0.59	177 m^2	64 991 €	47 436 €	[105]
ZnO guard reactor	24 925 Nm^3/h	361 778 $€_{2022}$	0.7	50 442 Nm^3/h	622 216 €	411 460 €	SNG route
Fischer-Tropsch synthesis + Tailgas recycling					**14 296 262 €**	**10 434 726 €**	
Fischer-Tropsch slurry reactor	2 420 000 kW	223 156 860 $€_{2011}$	0.75	54 124 kW	4 664 232 €	3 404 386 €	[110]
Quench column incl. separation	12.1 t/h	497 000 $€_{2011}$	0.7	29.1 t/h	1 369 811 €	999 814 €	[29]
Tail gas heater	93 m^2	19 660 $€_{1994}$	0.59	1011 m^2	181 781 €	132 680 €	[105]
Steam reformer	1 390 kmol/h	9 400 000 $€_{2007}$	0.65	1 617 kmol/h	4 182 820 €	3 053 007 €	[29]
Combustion chamber	Calculation tool (Reformer furnace)			14 815 kW	2 848 772 €	2 079 296 €	[46]
Steam generator (reformer)	36 000 kg/h	1 317 000 $€_{2011}$	0.6	6 080 kg/h	644 012 €	470 059 €	[29]
Tail gas cooler	93 m^2	19 660 $€_{1994}$	0.59	1175 m^2	198 652 €	144 994 €	[105]
Tail gas condenser	448 MW_{th}	4 258 200 $€_{2007}$	0.7	2.86 MW_{th}	206 182 €	150 490 €	[106]

Table S7. Assumptions for determination of total capital investment costs for the biomass-based FT route (continuous)

[7] Calculated according to equation 3 from main text in chapter 2.3

Equipment	Base scale	Base cost	Scale factor	Desired scale	Equipment costs 2022[8]	Equipment costs 2019[8]	Ref.
Fischer-Tropsch products upgrading					**13 500 621 €**	**9 853 995 €**	
Wax heater	93 m^2	19 660 $€_{1994}$	0.59	14 m^2	14 348 €	10 473 €	[105]
Hydrocracker	4 100 kg/h	6 018 429 $€_{2007}$	0.55	1 728 kg/h	6 233 141 €	4 549 519 €	[110]
Middle distillate (MD) heater	93 m^2	19 660 $€_{1994}$	0.59	22 m^2	19 092 €	13 935 €	[105]
Distillation	3190 MW	67 179 900 $€_{1993}$	0.65	54.1 MW	2 799 167 €	2 043 090 €	[110]
Hydrotreater	1 300 kg/h	1 611 386 $€_{2007}$	0.6	3 001 kg/h	4 434 873 €	3 236 978 €	[110]
Total equipment costs FT route (without DFB)					**42 010 679 €**	**30 620 566 €**	
Total capital investment costs FT route (Lang factor = 4.87 [54])					**319 023 235 €**	**232 644 589 €**	

[8] Calculated according to equation 3 from main text in chapter 2.3

Assumptions and references for ecological assessment to calculate CO_2 footprint for biomass-based SNG and FT route

Table S8. Assumptions for CO_2e emission factors

Parameter	Unit	Value	Reference
Consumption-related emission factors			
Biomass (wood chips)	$kg_{CO2e}/kg_{wood\ chips}$	0.049	[49]
Bed material (olivine / limestone)	$kg_{CO2e}/kg_{quartz\ sand}$	0.024	[111]
Bed material transport	$kg_{CO2e}/km/t_{sand}$	0.057	[112]
RME scrubber solvent (rapeseed methyl ester)	kg_{CO2e}/kg_{RME}	1.912	[49, 113]
Activated carbon (AC)	kg_{CO2e}/kg_{AC}	14.133	[114]
Zinc oxide (only raw material)	kg_{CO2e}/kg_{Zinc}	3.260	[115]
Nickel catalyst (only raw materials) (20% Ni and 80% Al_2O_3) ➔ for methanation and hydrotreater assumed	$kg_{CO2e}/kg_{catalyst}$	1.902	[116, 117]
Nickel catalyst (only raw materials) (14% Ni and 86% Al_2O_3) ➔ for steam reformer assumed	$kg_{CO2e}/kg_{catalyst}$	1.679	[116, 117]
Cobalt catalyst (only raw materials) (20% Co and 80% Al_2O_3) ➔ for FT slurry reactor assumed	$kg_{CO2e}/kg_{catalyst}$	2.472	[117, 118]
Platin catalyst (only raw materials) (1% Pt and 99% SiO_2) ➔ for hydrocracker assumed	$kg_{CO2e}/kg_{catalyst}$	266	[119, 120]
Amine (monoethanolamine)	kg_{CO2e}/kg_{Amine}	2.361	[121]
Glycol (Polyethylene glycol assumed)	kg_{CO2e}/kg_{PEG}	2.240	[122]
Electricity (green electricity)	kg_{CO2e}/kWh_{el}	0.014	[49]
Hydrogen (calculated via electricity consumption)	kWh_{el}/kg_{H2}	48	[123]
Construction-related emission factors			
Steel for construction and equipment	kg_{CO2e}/t_{steel}	1446	[124, 125]
Concrete for brickwork and fundament	$kg_{CO2e}/t_{concrete}$	107	[126]
Emission factors of fossil counterparts			
Fossil natural gas	kg_{CO2e}/kWh_{NG}	0.268	[49]
Fossil diesel	kg_{CO2e}/l_{Diesel}	3.134	[49]

Assumptions and references for the investigation of the sectoral integration of biomass-based SNG and FT diesel in the Austrian energy system

Table S9. Assumptions for sectoral integration of DFB products

Parameter	Unit	Value	Reference
Sectoral integration of biomass-based SNG			
Gross value added for energy sector 2019	M€/a	9 840	[127]
Gross value added for energy sector 2022	M€/a	14 520	[127]
CO_2 footprint for energy sector	Mt_{CO2e}/a	8 269	[2]
Gross value added for public and private sector 2019 (only households with gas heaters - 25% [75])	M€/a	16 825	[129]
Gross value added for public and private sector 2022 (only households with gas heaters - 25% [75])	M€/a	16 135	[129]
CO_2 footprint for public and private sector	Mt_{CO2e}/a	8 046	[2]
Gross value added for industry sector 2019	M€/a	66 790	[127]
Gross value added for industry sector 2022	M€/a	71 290	[127]
CO_2 footprint for industry sector	Mt_{CO2e}/a	26 540	[2]
Sectoral integration of biomass-based FT diesel			
Gross value added for public and private transport sector 2019 (only diesel vehicles – 73.6% of inland transport [75])	M€/a	49 533	[129]
Gross value added for public and private transport sector 2022 (only diesel vehicles – 73.8% of inland transport [75])	M€/a	47 822	[129]
CO_2 footprint for public and private transport sector	Mt_{CO2e}/a	12 246	[2]
Gross value added for heavy-duty traffic sector 2019	M€/a	22 847	[130}
Gross value added for heavy-duty traffic sector 2022	M€/a	26 769	[130]
CO_2 footprint for heavy-duty traffic sector	Mt_{CO2e}/a	9 243	[2]
Gross value added for heat and power sector 2019	M€/a	66 790	[127]
Gross value added for heat and power sector 2022	M€/a	71 290	[127]
CO_2 footprint for heat and power sector	Mt_{CO2e}/a	26 540	[2]