sustainability MDPI

S5: Parameters

Table S2: Parameters and values, units used in connection to the specific sources.

Specific driver variables	Description	1. Literature based values	Unit	2. Literature based values	Unit	Sources	Data base for Driver (ID)
Biogenic residues							
$Q_{mobi(dm)}$	Mobilizable potential of biogenic residues in dry matter (Baseline 2015)	10.216.000	Mg_{dm}/a*			[87]	D1
$Q_{tech(dm)}$	Technical potential of biogenic residues in dry matter (Baseline 2015´)	137.550.000	Mg_{dm}/a			[87]	D1
Residues of lignocellulosic composition							
$QLIG_{mobi(dm)}$	Residues with lignocellulosic composition	9.938.000	Mg_{dm}/a			[87]	D15
$QLIG_{tech(dm)}$	Residues with lignocellulosic composition	112.632.000	Mg_{dm}/a			[87]	D15
Food wastes							
$QFW_{mobimin(dm)}$	Mobilizable minimum potential of Food waste in trade + Kitchen and canteen waste	30.000	Mg_{dm}/a			[87]	D15
$QFW_{mobimax(dm)}$	Mobilizable maximum potential of Food waste in trade + Kitchen and canteen waste	253.000	Mg_{dm}/a			[87]	D15
$QFW_{techmin(dm))}$	Technical minimum potential of Food waste in trade + Kitchen and canteen waste	400.000	Mg_{dm}/a			[87]	D15
$QFW_{techmax(dm)}$	Technical maximum potential of Food waste in trade + Kitchen and canteen waste	902.000	Mg_{dm}/a			[87]	D15
Urban agriculture							
Y_{minUA}	supply of foods for urban population	2,9	%			[89]	D2
Y_{maxUA}	supply of food for urban population	15	%			[90]	D2
Y_{minVF}	Potential yields of Vertical farming appliances	71	Mg/ha			[92]	D2
Y_{maxVF}	Potential yields of Vertical farming appliances	155	Mg/ha			[92]	D2
Urban population							
$UP_{avg(\%)}$ / $UP_{avg\ (head)}$	Urbanisation rate Germany**	77,3	%	63.938.000	head	[91,160]	D2
$F_{cons(\frac{kg}{head})}$	Fruit consumption (average 2017 -2019)	69,6	kg_{head}			[93]	D2
$Veg_{cons(\frac{kg}{head})}$	Vegetable consumption (average 2017 -2019)	100,9	kg_{head}			[93]	D2
$F_{\mathrm{prod(ha)}}$ / $F_{prod\ (\frac{t}{a})}$	Fruit production (average 2015 – 2019)	67.140	ha	1.254.180	Mg/a	[93]	D2
$Veg_{prod(ha)}$ / $Veg_{prod(\frac{t}{a})}$	Fruit production (average 2015 – 2020)	125.139	ha	3.709.764	Mg/a	[93]	D2
Marginal areas							

$Ab_{\min\,(ha)}$	Minimum potential of abandoned, degraded areas, old industrial sites (urban areas)	120.000	ha			[97,98]	D3
$Ab_{\max\,(ha)}$	Maximum potential of abandoned, degraded areas, old industrial sites (urban areas)	175.000	ha			[97,98]	D3
$Ma_{ag(ha)}$	All marginal areas within Germany	3.300.000	ha			[64]	D3
$Ma_{sum(ha)}$	Abandoned, degraded areas, old industrial sites and marginal areas in Germany in 2050	3.420.000	ha			Calculated	D3
Aquatic biomass							
$Y_{\mathrm{minALG\,(dm)}}$	Potential yield of algae biomass in Germany in dry matter	30	Mg/ha a^{-1}			[66,100]	D4, D16
$Y_{\mathrm{maxALG\,(dm)}}$	Potential yield of algae biomass in Germany in dry matter	60	Mg/ha a^{-1}			[66,100]	D4, D16
$ALG_{(\mathrm{ha})}$	Potential of algae biomass production areas in Germany (limitation of geographic conditions)	9.700	ha			[100]	D4, D16
$LIP_{ALG\,min/max}$	Lipid content of t_{dm} of Algea biomass	25 – 30	%			[66]	D16
Perennial biomass							
$CU_{\max(ha)}$	Potential of short rotation coppice planted on areas that was previously in usage for energy plants (from 2023 to 2050) and shared 60/40 between Short rotation coppice and miscanthus	1.800.000	ha			[57,103]	D5, D15, D16
$Y_{minSRC(dm)}$	Minimum potential yield of Short rotation coppice found in literature	5	Mg/ha a^{-1}			[57,103]	D5, D15, D16
$Y_{maxSRC(dm)}$	Maximum potential yield of Short rotation coppice	18	Mg/ha a^{-1}			[57,103]	D5, D15, D16
$SRC_{minAG(ha)}$	Potential for short rotation coppice on agricultural areas in 2050	102.000	ha			[102]	D5, D15, D16
$SRC_{maxAG(ha)}$	Potential for short rotation coppice on agricultural areas in 2050 (Share 60/40 with miscanthus based on actual establishment)	300.000	ha			[102]	D5, D15, D16
$Y_{\mathrm{minMSC(dm)}}$	Minimum potential yield of miscanthus	6	Mg/ha a^{-1}			[104]	D5, D15, D16
$Y_{\mathrm{maxMSC(dm)}}$	Maximum potential yield of miscanthus	12	Mg/ha a^{-1}			[105]	D5, D15, D16
$MSC_{minAG(ha)}$	Potential for miscanthus on agricultural areas in 2050 (Share 40/60 with SRC based on actual establishment)	68.000	ha			[84]	D5, D15, D16
$MSC_{maxAG(ha)}$	Potential for miscanthus on agricultural areas in 2050 (Share 40/60 with SRC based on actual establishment)	200.000	ha			[84]	D5, D15, D16
Paludiculture							
$Y_{\mathrm{minPAL(dm)}}$	Potential yield of paludiculture	3,6	Mg/ha a^{-1}			[70,108]	D6, D15, D16
$Y_{\mathrm{maxPAL(dm)}}$	Potential yield of paludiculture	20,4	Mg/ha a^{-1}			[70,108]	D6, D15, D16
$PAL_{\max\,(ha)}$	Maximum area rewetted for cultivation with paludiculture until 2050	1.314.000	ha			[70]	D6, D15, D16
Plastic production/demand							
$POLD_{GER}$	Plastic demand Germany	12.269.400	Mg/a			[145]	D15

$POLD_{EU}$	Plastic demand Europe	50.700.000	Mg/a			[145]	D15
$POLP_{EU}$	Plastic production Europe	58.000.000	Mg/a			[145]	D15
$POLP_{World}$	Plastic production Worldwide	368.000.000	Mg/a			[145]	D15
PLA (food waste)							
FOP	Food waste powder conversion rate	0,5				[146]	D15
LAC_{FOP}	Conversion food waste powder to lactide	0,17	Mg/Mg			[146]	D15
PLA_{LAC}	Conversion rate from lactide to PLA	0,13	Mg/Mg			[146]	D15
PLA out of lignocellulosic material							
$LACA_{LIG_{min/max}}$	Conversion rate Lignocellulosic material to lactic acid	0,32 – 0,9	Mg/Mg			[144]	D15
$PLA_{LACA_{min/max}}$	Conversion rate from lactic acid to PLA	0,7 – 0,8	Mg/Mg			[147,148]	D15
Biodiesel consumption							
$BIODI_{GERcons}$	Biodiesel consumption in Germany in the year 2018	2.291.700	Mg/a			[151]	D16
LIP_{FAME}	Conversion rate lipid to FAME (diesel)	0,97	%			[159]	D16
Ethanol consumption							
$ETHP_{Ger}$	Bioethanol consumption in Germany (2018)	1.187.400	Mg/a			[151]	D16
$ETHP_{EU}$	Bioethanol consumption in Europe (2019)	435 * 107	Mg/a			[152]	D16
$ETHP_{World}$	Bioethanol consumption in World (2019)	909 * 10^8	Mg/a			[153]	D16
Biogenic residues suitable for ethanol production							
$QBRETH_{min(dm)}$	Biogenic residues suitable for ethanol production	3.631.000	Mg_{dm}/a			[154]	D16
$QBRETH_{max(dm)}$	Biogenic residues suitable for ethanol production	75.450.000	Mg_{dm}/a			[154]	D16
Ethanol out of lignocellulosic material							
ETH_{conv}	Conversion rate from 1 l of Ethanol to 1 kg	0,79				[155]	D16
$Y_{ETH_{\mathrm{min/maxbeech}}}$	Yield of litre from 1 tonne of dry matter beech wood	131 – 220	l/Mg			[156]	D16
$Y_{ETH_{\mathrm{min/maxwheat}}}$	Yield of litre from 1 tonne of dry matter wheat straw	183 - 490	l/Mg			[144,157]	D16
$Y_{ETH_{\mathrm{min/maxmisc}}}$	Yield of liter from 1 tonne of dry matter miscanthus	314 - 341	l/Mg			[158]	D16
Animal numbers (2016)							
$AN_{di2016(pc)}$	Animal numbers dairy cows in 1000, Germany, 2016	4.218	pc			[83]	D18
$AN_{ca2016(pc)}$	Animal numbers cattle in 1000 , Germany 2016	8.249	pc			[83]	D18

$AN_{pi2016(pc)}$	Animal numbers pigs in 1000, Germany 2016	22.761	pc			[83]	D18
$AN_{po2016(pc)}$	Animal numbers Poultry in 1000, Germany 2016	106.200	pc			[83]	D18
Reduction rate of animal numbers by 25% less dairy and meat products							
AN_{dirr25}	Reduction rate for animal numbers dairy cows if 25% less dairy and meat consumption	23	%			[83]	D18
AN_{carr25}	Reduction rate for animal numbers cattle if 25% less dairy and meat consumption	20	%			[83]	D18
AN_{pirr25}	Reduction rate for animal numbers of pig if 25% less dairy and meat consumption	21	%			[83]	D18
AN_{porr25}	Reduction rate for animal numbers of poultry if 25% less dairy and meat consumption	24	%			[83]	D18
Reduction rate of animal numbers for meat consumption of 30 kg_{head} a^{-1}							
$AN_{dirr30k}$	Reduction rate for animal numbers dairy cows for meat consumption of 30 kg_{head} a^{-1}	0	%			Adapted [83]	D18
$AN_{carr30k}$	Reduction rate for animal numbers cattle for meat consumption of 30 kg_{head} a^{-1}	54	%			Adapted [83]	D18
$AN_{pirr30k}$	Reduction rate for animal numbers pig for meat consumption of 30 kg_{head} a^{-1}	41	%			Adapted [83]	D18
$AN_{porr30k}$	Reduction rate for animal numbers poultry for meat consumption of 30 kg_{head} a^{-1}	51	%			Adapted [83]	D18
Fodder consumption rates of domestic livestock							
FC_{di2016}	Fodder consumption rate, dairy cows Germany 2017	39.5	%			[164]	D18
FC_{ca2016}	Fodder consumption rate, cattle Germany 2017	26.3	%			[164]	D18
FC_{pi2016}	Fodder consumption rate, pig Germany 2017	11.9	%			[164]	D18
FC_{po2016}	Fodder consumption rate, poultry Germany 2017	8.1	%			[164]	D18
FC_{se2016}	Fodder consumption rate, some else (calves, sheep, horses) Germany 2017	14.2	%			[164]	D18
Land use of fodder domestic in 1000 ha and tonnes							
$FoD_{2017(t)}$	Fodder quantities from domestic in 1000, Germany 2017	114.991	Mg/a			[164]	D18
$FoD_{2017(ha)}$	Areas domestic used for fodder production in 1000, Germany 2017	9317	ha			[164]	D18

* dm = dry matter
**Urban areas larger than 10.000 people