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Data Documentation

Deutsches Institut für Wirtschaftsforschung 2015

An Economic Assessment of Soil Carbon Sequestration with Biochar in Germany: Data Documentation

Isabel Teichmann

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Data Documentation 78

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An Economic Assessment of Soil Carbon Sequestration with Biochar in Germany: Data Documentation[1]

Berlin, April 2015

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List of Abbreviations

a	Year
CHP	Combined heat and power
CO_2	Carbon dioxide
CO_2e	Carbon-dioxide equivalent
ct	Euro cent
db	Dry base
DM	Dry mass
€	Euro
E_{in}	Pyrolysis energy input without process heat recovery
E'_{in}	Pyrolysis energy input with process heat recovery
E_{out}	Energy recovered in pyrolysis by-products
el	Electrical power
f_t	Degression factor
FW	Fresh weight
GHG	Greenhouse gas
GJ	Gigajoule
HHV	Higher heating value
HWWI	Hamburg Institute of International Economics
kg	Kilogram
km	Kilometer
kW	Kilowatt
kWh	Kilowatt hour
l	Liter
L	Large-scale pyrolysis unit
LHV	Lower heating value
m^3	Cubic meter
M	Medium-scale pyrolysis unit
MJ	Megajoule
n.a.	Not available
S	Small-scale pyrolysis unit
t	Tonne
Tsd.	Thousand
USD	US-Dollar
VAT	Value-added tax
wt%	Weight percent
-	Not applicable
~	Approximately

S.1) Introduction

This data documentation accompanies the study "An Economic Assessment of Soil Carbon Sequestration with Biochar in Germany" (Teichmann 2015), which analyzes the economically viable greenhouse-gas (GHG) mitigation potentials that can be obtained in Germany in 2015, 2030, and 2050 when slow-pyrolysis biochar is used for soil carbon sequestration and when the pyrolysis by-products – pyrolysis oils and gases – are turned into renewable energy. The analysis, which draws on the corresponding technical GHG mitigation potentials derived by Teichmann (2014a, b), focuses on the GHG mitigation costs of biochar produced from a wide variety of biomass residues diverted from conventional feedstock management.

In addition to the detailed derivation of the net GHG mitigation costs of biochar entering Teichmann (2015), the data documentation gives background information on the total net avoided GHG emissions associated with biochar and presents any supplementary results tables referred to but not displayed in Teichmann (2015).

The data documentation is organized as follows: Section S.2 provides the derivation of the net GHG mitigation costs of biochar – expressed per dry tonne of feedstock turned into biochar – used in Teichmann (2015) and gives some supplementary results tables. In turn, Section S.3 displays the biochar-related total net avoided GHG emissions per dry tonne of feedstock obtained from Teichmann (2014a, b), which serve to transform the net GHG mitigation costs per dry tonne of feedstock into net GHG mitigation costs per tonne of carbon-dioxide equivalent (CO_2e) abated. Finally, Section A.4 presents supplementary results tables for the net GHG mitigation costs per tonne of CO_2e abated.

S.2) Net GHG Mitigation Costs per Dry Tonne of Feedstock

This section contains the details for the calculation of the net GHG mitigation costs of biochar, expressed per dry tonne of feedstock turned into biochar, as described in Section 4 of Teichmann (2015).[2] Moreover, it contains supplementary results tables referred to but not displayed in Teichmann (2015).

Table S.1: Specific Capital Costs for Pyrolysis Units

Pyrolysis scale	Specific capital costs	
t_{DM} feedstock/a	Tsd. USD_{2007}/unit[a]	Tsd. €$_{2012}$/unit[b]
	(1)	(2)
2,000	900	721
16,000	8,000	6,406
184,800	41,250	33,031

Sources:
a) Shackley et al. (2011: Table 6), i.e. cost assessments derived from bioenergy plants.
b) Own calculation, based on the 2007 average exchange rate of 1.3705 USD/€ (Deutsche Bundesbank 2012) and the 2007 and 2012 producer price indices of 97.5 and 107.0, respectively (Deutsche Bundesbank 2015), i.e. (2) = (1)/1.3705 · 107.0/97.5.

Notes: Values rounded. DM = dry mass. a = year. t = tonne. Tsd. = thousand.

[2] Any section without the leading 'S.' refers to Teichmann (2015).

Table S.2: Cumulative Number of Pyrolysis Units Produced, Germany, 2015-2050

Biomass scenario and year of installation of pyrolysis units	Small-scale pyrolysis units (à 2,000 t_{DM} feedstock/a)						Medium-scale pyrolysis units (à 16,000 t_{DM} feedstock/a)						Large-scale pyrolysis units (à 184,800 t_{DM} feedstock/a)					
	2015	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**
	units						units						units					
Scenario *Max 1* (units/a)*	**2,478**	**4,556**	**9,157**	**9,157**	**9,352**	**9,482**	**310**	**569**	**1,145**	**1,145**	**1,169**	**1,185**	**27**	**49**	**99**	**99**	**101**	**103**
2015	2,478	2,478	2,478	-	-	-	310	310	310	-	-	-	27	27	27	-	-	-
2020	-	2,078	2,078	2,078	-	-	-	260	260	260	-	-	-	22	22	22	-	-
2030	-	-	4,601	4,601	4,601	-	-	-	575	575	575	-	-	-	50	50	50	-
2035	-	-	-	2,478	2,478	2,478	-	-	-	310	310	310	-	-	-	27	27	27
2040	-	-	-	-	2,273	2,273	-	-	-	-	284	284	-	-	-	-	25	25
2050	-	-	-	-	-	4,731	-	-	-	-	-	591	-	-	-	-	-	51
Cumulative**	**2,478**	**4,556**	**9,157**	**11,635**	**13,907**	**18,638**	**310**	**569**	**1,145**	**1,454**	**1,738**	**2,330**	**27**	**49**	**99**	**126**	**151**	**202**
Scenario *Min 1* (units/a)*	**2,478**	**2,733**	**3,434**	**3,434**	**3,507**	**3,556**	**310**	**342**	**429**	**429**	**438**	**444**	**27**	**30**	**37**	**37**	**38**	**38**
2015	2,478	2,478	2,478	-	-	-	310	310	310	-	-	-	27	27	27	-	-	-
2020	-	255	255	255	-	-	-	32	32	32	-	-	-	3	3	3	-	-
2030	-	-	700	700	700	-	-	-	88	88	88	-	-	-	8	8	8	-
2035	-	-	-	2,478	2,478	2,478	-	-	-	310	310	310	-	-	-	27	27	27
2040	-	-	-	-	329	329	-	-	-	-	41	41	-	-	-	-	4	4
2050	-	-	-	-	-	749	-	-	-	-	-	94	-	-	-	-	-	8
Cumulative**	**2,478**	**2,733**	**3,434**	**5,912**	**6,240**	**6,989**	**310**	**342**	**429**	**739**	**780**	**874**	**27**	**30**	**37**	**64**	**68**	**76**
Scenario *Max 2* (units/a)*	**2,143**	**3,644**	**7,563**	**7,563**	**7,705**	**7,817**	**268**	**455**	**945**	**945**	**963**	**977**	**23**	**39**	**82**	**82**	**83**	**85**
2015	2,143	2,143	2,143	-	-	-	268	268	268	-	-	-	23	23	23	-	-	-
2020	-	1,501	1,501	1,501	-	-	-	188	188	188	-	-	-	16	16	16	-	-
2030	-	-	3,919	3,919	3,919	-	-	-	490	490	490	-	-	-	42	42	42	-
2035	-	-	-	2,143	2,143	2,143	-	-	-	268	268	268	-	-	-	23	23	23
2040	-	-	-	-	1,643	1,643	-	-	-	-	205	205	-	-	-	-	18	18
2050	-	-	-	-	-	4,031	-	-	-	-	-	504	-	-	-	-	-	44
Cumulative**	**2,143**	**3,644**	**7,563**	**9,706**	**11,349**	**15,380**	**268**	**455**	**945**	**1,213**	**1,419**	**1,923**	**23**	**39**	**82**	**105**	**123**	**166**

Table will be continued on the next page.

Table S.2 continued

Biomass scenario and year of installation of pyrolysis units	Small-scale pyrolysis units (à 2,000 t_{DM} feedstock/a)						Medium-scale pyrolysis units (à 16,000 t_{DM} feedstock/a)						Large-scale pyrolysis units (à 184,800 t_{DM} feedstock/a)					
	2015	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**
	units						units						units					
Scenario *Min 2* (units/a)*	**2,143**	**2,429**	**3,361**	**3,361**	**3,424**	**3,474**	**268**	**304**	**420**	**420**	**428**	**434**	**23**	**26**	**36**	**36**	**37**	**38**
2015	2,143	2,143	2,143	-	-	-	268	268	268	-	-	-	23	23	23	-	-	-
2020	-	287	287	287	-	-	-	36	36	36	-	-	-	3	3	3	-	-
2030	-	-	932	932	932	-	-	-	116	116	116	-	-	-	10	10	10	-
2035	-	-	-	2,143	2,143	2,143	-	-	-	268	268	268	-	-	-	23	23	23
2040	-	-	-	-	350	350	-	-	-	-	44	44	-	-	-	-	4	4
2050	-	-	-	-	-	982	-	-	-	-	-	123	-	-	-	-	-	11
Cumulative**	**2,143**	**2,429**	**3,361**	**5,504**	**5,854**	**6,836**	**268**	**304**	**420**	**688**	**732**	**854**	**23**	**26**	**36**	**60**	**63**	**74**

Sources: Own calculation, based on the required number of pyrolysis units in operation in each year and an assumed lifetime of each pyrolysis unit of 20 years. For example, pyrolysis units installed in 2015 will be replaced in 2035; those installed in 2035 will be in operation until the end of 2054.

Notes: Values rounded. DM = dry mass. a = year. t = tonne. - = not applicable.

* = Annual number of pyrolysis units in operation in each period as given in Teichmann (2014a: Table 39).

** = The numbers refer to the beginning of each period.

Table S.3: Specific Capital Costs for Pyrolysis Units in Germany, 2015-2050

	Small-scale pyrolysis units (à 2,000 t_{DM} feedstock/a)						Medium-scale pyrolysis units (à 16,000 t_{DM} feedstock/a)						Large-scale pyrolysis units (à 184,800 t_{DM} feedstock/a)					
	2015	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**
Degression factor f_t[a]	-	0.88	0.93	0.95	0.95	0.97	-	0.88	0.93	0.95	0.95	0.97	-	0.88	0.93	0.95	0.95	0.97
Biomass scenarios	Tsd. €$_{2012}$/unit[b]						Tsd. €$_{2012}$/unit[b]						Tsd. €$_{2012}$/unit[b]					
Scenario *Max 1*	721	644	599	588	580	573	6,406	5,726	5,322	5,229	5,160	5,094	33,031	29,522	27,442	26,960	26,606	26,266
Scenario *Min 1*	721	708	691	664	661	658	6,406	6,291	6,143	5,901	5,877	5,848	33,031	32,439	31,673	30,425	30,304	30,153
Scenario *Max 2*	721	653	605	594	587	580	6,406	5,808	5,381	5,282	5,222	5,152	33,031	29,950	27,745	27,238	26,924	26,567
Scenario *Min 2*	721	704	681	656	653	649	6,406	6,259	6,050	5,833	5,807	5,767	33,031	32,274	31,196	30,078	29,941	29,738

Sources:

a) The values for 2020 and 2030 correspond to the degression factors assumed by Fritsche et al. (2004: Table 10) for flash-pyrolysis technologies. The 2040 and 2050 values continue the f_t series in the same way as done in Fritsche et al. (2004: Table 10) for other technologies. Since the value for 2040 refers to the period 2030-2040, the same degression factor is assumed for 2035 as for 2040.

b) The values for 2015 are taken from Table S.1, column 2. The 2020-2050 values are calculated with the help of formula (I) given in Teichmann (2015), using the respective 2015 capital costs as starting value and based on the degression factors given in this table and the cumulative numbers of pyrolysis units from Table S.2.

Notes: Values rounded. DM = dry mass. a = year. t = tonne. Tsd. = thousand.

Table S.4: Annual Capital Costs for Pyrolysis Units in Germany, 2015-2050

Biomass scenarios	Small-scale pyrolysis units (à 2,000 t_{DM} feedstock/a)						Medium-scale pyrolysis units (à 16,000 t_{DM} feedstock/a)						Large-scale pyrolysis units (à 184,800 t_{DM} feedstock/a)					
	2015	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**
	Tsd. €$_{2012}$/unit						Tsd. €$_{2012}$/unit						Tsd. €$_{2012}$/unit					
Scenario *Max 1*	63	56	52	51	51	50	559	499	464	456	450	444	2,880	2,574	2,392	2,350	2,320	2,290
Scenario *Min 1*	63	62	60	58	58	57	559	548	536	514	512	510	2,880	2,828	2,761	2,653	2,642	2,629
Scenario *Max 2*	63	57	53	52	51	51	559	506	469	461	455	449	2,880	2,611	2,419	2,375	2,347	2,316
Scenario *Min 2*	63	61	59	57	57	57	559	546	527	509	506	503	2,880	2,814	2,720	2,622	2,610	2,593

Sources: Own calculation, based on the specific capital costs from Table S.3, a lifetime of pyrolysis units of 20 years and a discount rate of 6%, i.e. Table S.4 = Table S.3 · $[(1 + 0.06)^{20} \cdot 0.06]/[(1 + 0.06)^{20} - 1]$.

Notes: Values rounded. DM = dry mass. a = year. t = tonne. Tsd. = thousand.

Table S.5: Annual Capital Costs for Pyrolysis Units in Germany per Dry Tonne of Feedstock, 2015-2050

Biomass scenarios	Small-scale pyrolysis units (à 2,000 t_{DM} feedstock/a)						Medium-scale pyrolysis units (à 16,000 t_{DM} feedstock/a)						Large-scale pyrolysis units (à 184,800 t_{DM} feedstock/a)					
	2015	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**	**2015**	**2020**	**2030**	**2035**	**2040**	**2050**
	€$_{2012}$/t_{DM} feedstock						€$_{2012}$/t_{DM} feedstock						€$_{2012}$/t_{DM} feedstock					
Scenario *Max 1*	39	35	33	32	32	31	44	39	36	36	35	35	19	17	16	16	16	15
Scenario *Min 1*	39	39	38	36	36	36	44	43	42	40	40	40	19	19	19	18	18	18
Scenario *Max 2*	39	36	33	32	32	32	44	40	37	36	36	35	19	18	16	16	16	16
Scenario *Min 2*	39	38	37	36	36	35	44	43	41	40	40	39	19	19	18	18	18	18

Sources: Own calculation, dividing the annual capital costs from Table S.4 by the respective annual capacity of the pyrolysis units (corrected for the common load factor of 0.8) and expressing the values in 2012 euros.

Notes: Values rounded. DM = dry mass. a = year. t = tonne.

Table S.6: Pyrolysis Energy Inputs and Corresponding Fossil-Fuel Requirements

	No process heat recovery				Process heat recovery			
		Lignite[b]	Hard coal[c]	Natural gas[d]		Lignite[f]	Hard coal[g]	Natural gas[h]
	$E_{in}{}^{a}$	Fossil-fuel requirements			$E'_{in}{}^{e}$	Fossil-fuel requirements		
	MJ/kg_{db}				MJ/kg_{db}			
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cereal straw	1.3	1.6	1.6	1.8	0.4	0.5	0.5	0.6
Forestry residues	1.4	1.7	1.7	1.9	0.5	0.6	0.6	0.7
Open-country biomass residues	1.3	1.6	1.6	1.8	0.4	0.5	0.5	0.6
Industrial wood waste	1.3	1.6	1.6	1.8	0.4	0.5	0.5	0.6
Wood in municipal solid waste	1.4	1.7	1.7	1.9	0.5	0.6	0.6	0.7
Green waste: Compensation areas	1.2	1.5	1.5	1.7	0.4	0.5	0.5	0.5
Biomass: Habitat-connectivity areas	1.3	1.6	1.6	1.8	0.4	0.5	0.5	0.6
Green waste: Extensive grassland	1.3	1.6	1.6	1.8	0.4	0.5	0.5	0.6
Short-rotation coppice: Erosion areas	1.6	2.0	2.0	2.2	0.8	0.9	0.9	1.0
Solid cattle manure	5.3	6.6	6.6	7.3	4.5	5.6	5.6	6.2
Solid swine manure	9.9	12.4	12.4	13.7	9.1	11.4	11.4	12.6
Solid poultry manure	1.4	1.7	1.7	1.9	0.6	0.7	0.7	0.8
Commercial and industrial waste	4.9	6.2	6.2	6.8	4.1	5.1	5.1	5.6
Organic municipal solid waste	6.9	8.7	8.7	9.5	6.2	7.7	7.7	8.5

Sources:

a) Teichmann (2014a: Table 21, column 6).
b) Own calculation, using a thermal efficiency of 80% as applied in Teichmann (2014a: Table 22),* i.e. (2) = (1) · 100/80.
c) Own calculation, using a thermal efficiency of 80% as applied in Teichmann (2014a: Table 22),* i.e. (3) = (1) · 100/80.
d) Own calculation, using a thermal efficiency of 72.5% as applied in Teichmann (2014a: Table 22),* i.e. (4) = (1) · 100/72.5.
e) Teichmann (2014a: Table 21, column 10).
f) Own calculation, using a thermal efficiency of 80% as applied in Teichmann (2014a: Table 23),* i.e. (6) = (5) · 100/80.
g) Own calculation, using a thermal efficiency of 80% as applied in Teichmann (2014a: Table 23),* i.e. (7) = (5) · 100/80.
h) Own calculation, using a thermal efficiency of 72.5% as applied in Teichmann (2014a: Table 23),* i.e. (8) = (5) · 100/72.5.

Notes: Values rounded. db = dry base. kg = kilogram. MJ = megajoule.

* = The thermal efficiencies refer to the conversion of the fossil fuels to heat. They were calculated by Teichmann (2014a) as simple averages of the *new boiler efficiencies* of industrial boilers displayed in Vatopoulos et al. (2012: Table 2-2), whereby the efficiency for *"coal"* was applied to both hard coal and lignite, and the efficiency for *"gas"* to natural gas.

Table S.7: GHG Emissions from Fossil-Fuel Requirements for Biochar Production

Feedstocks	No process heat recovery			Process heat recovery		
	Lignite[a]	**Hard coal**[b]	**Natural gas**[c]	**Lignite**[d]	**Hard coal**[e]	**Natural gas**[f]
	t CO_2e/t_{DM} feedstock			t CO_2e/t_{DM} feedstock		
	(1)	(2)	(3)	(4)	(5)	(6)
Cereal straw	0.185	0.155	0.099	0.061	0.051	0.033
Forestry residues	0.203	0.170	0.108	0.075	0.063	0.040
Open-country biomass residues	0.187	0.156	0.099	0.061	0.051	0.033
Industrial wood waste	0.191	0.160	0.102	0.063	0.053	0.034
Wood in municipal solid waste	0.203	0.170	0.108	0.075	0.063	0.040
Green waste: Compensation areas	0.179	0.149	0.095	0.055	0.046	0.029
Biomass: Habitat-connectivity areas	0.187	0.156	0.099	0.061	0.051	0.033
Green waste: Extensive grassland	0.187	0.156	0.099	0.061	0.051	0.033
Short-rotation coppice: Erosion areas	0.237	0.198	0.126	0.109	0.091	0.058
Solid cattle manure	0.767	0.641	0.409	0.651	0.544	0.347
Solid swine manure	1.442	1.205	0.768	1.327	1.109	0.707
Solid poultry manure	0.196	0.164	0.105	0.083	0.070	0.044
Commercial and industrial waste	0.718	0.601	0.383	0.594	0.497	0.317
Organic municipal solid waste	1.007	0.842	0.536	0.895	0.748	0.477

Sources:
a) Teichmann (2014a: Table 22, column 4).
b) Teichmann (2014a: Table 22, column 8).
c) Teichmann (2014a: Table 22, column 12).
d) Teichmann (2014a: Table 23, column 4).
e) Teichmann (2014a: Table 23, column 8).
f) Teichmann (2014a: Table 23, column 12).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.8: Electricity Generation Costs of New Fossil-Fuel Power Plants, Germany, 2010-2050

Electricity generation costs – Price path A[a]			Lignite					Hard coal					Natural gas				
			2010*	2020	2030	2040	2050	2010*	2020	2030	2040	2050	2010*	2020	2030	2040	2050
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Capital costs[b]	ct_{2009}/kWh_{el}	(A)	~1.8	~1.8	~1.7	~1.7	~1.7	~1.6	~1.5	~1.5	~1.5	~1.5	~0.9	~0.9	~0.9	~0.9	~0.9
Operational costs[b]	ct_{2009}/kWh_{el}	(B)	~0.9	~0.9	~0.9	~0.9	~0.9	~0.8	~0.8	~0.8	~0.8	~0.8	~0.7	~0.7	~0.7	~0.7	~0.7
Fuel costs[b]	ct_{2009}/kWh_{el}	(C)	~1.0	~1.0	~1.1	~1.1	~1.2	~2.3	~3.7	~4.5	~5.5	~6.4	~3.8	~5.1	~6.4	~7.7	~9.0
CO_2 costs[b]	ct_{2009}/kWh_{el}	(D)	~1.3	~2.3	~3.6	~4.9	~6.2	~1.0	~1.8	~3.0	~3.9	~4.9	~0.5	~0.9	~1.4	~2.0	~2.5
Imputed efficiency																	
Fuel prices[c]	€$_{2009}$/GJ	(E)	n.a.	n.a.	n.a.	n.a.	n.a.	~2.9	~4.3	~5.6	~7.0	~8.6	~6.2	~9.1	~12.0	~14.9	~17.9
Efficiency[d]	%	(F)	n.a.	n.a.	n.a.	n.a.	n.a.	45	45[e]	45	46	48	59	64	68	70	72
Imputed fuel prices for lignite																	
Efficiency[f]	%	(G)	45	45	45	46	48	-	-	-	-	-	-	-	-	-	-
Fuel prices[g]	€$_{2009}$/GJ	(H)	**1.3**	**1.3**	**1.4**	**1.4**	**1.6**	-	-	-	-	-	-	-	-	-	-
Capital and operational costs																	
Capital costs[h]	€$_{2009}$/GJ$_{el}$	(I)	5.0	5.0	4.7	4.7	4.7	4.4	4.2	4.2	4.2	4.2	2.5	2.5	2.5	2.5	2.5
Operational costs[i]	€$_{2009}$/GJ$_{el}$	(J)	2.5	2.5	2.5	2.5	2.5	2.2	2.2	2.2	2.2	2.2	1.9	1.9	1.9	1.9	1.9
Total capital and operational costs	€$_{2009}$/GJ$_{el}$[j]	(K)	7.5	7.5	7.2	7.2	7.2	6.7	6.4	6.4	6.4	6.4	4.4	4.4	4.4	4.4	4.4
	€$_{2012}$/MJ$_{el}$[k]	(L)	**0.0081**	**0.0081**	**0.0078**	**0.0078**	**0.0078**	**0.0072**	**0.0069**	**0.0069**	**0.0069**	**0.0069**	**0.0048**	**0.0048**	**0.0048**	**0.0048**	**0.0048**

Sources:

a) Price path A reflects substantial price increases for fossil fuels and CO_2 emissions (Nitsch et al. 2012a). Note that the capital and operational costs do not vary with the price paths.

b) Nitsch et al. (2012a: Figure 7.6 – Price path A), based on newly installed fossil-fuel power plants at an interest rate of 6% per annum, a life time of 25 years and 6,000 full-load hours per year. According to Nitsch et al. (2012a), the assumption of 6,000 annual full-load hours is rather optimistic; thus, the capital costs are considered to be lower bounds. Note that the electricity generation costs for natural gas refer to a gas-and-steam power plants (cp. Nitsch et al. 2012a: Figure 7.6). Further note that the electricity generation costs are calculated free power plant and, thus, do not include any network and transmission costs (Nitsch et al. 2012a).

c) Nitsch et al. (2012a: Figure 2.5 – Price path A, free power plant). Note that the prices refer to a unit of energy input.

d) Own calculation, (F) = (E) · 0.36/(C) · 100.

e) Own assumption, as in 2010 and 2030.

f) Own assumption, as for hard coal. Traber and Kemfert (2011), for example, also apply the same efficiencies for lignite as for hard coal.

g) Own calculation, (H) = (C)/0.36 · (G)/100. That is, the prices refer to a unit of energy input.

h) Own calculation, (I) = (A)/0.36.

i) Own calculation, (J) = (B)/0.36.

j) Own calculation, (K) = (I) + (J).

k) Own calculation, based on the 2009 and 2012 producer price indices of 98.5 and 107.0, respectively (Deutsche Bundesbank 2015), i.e. (L) = (K)/1,000 · 107.0/98.5.

Notes: Values rounded. ct = euro cent. kWh = kilowatt hour. GJ = gigajoule. MJ = megajoule. el = electrical power. - = not applicable. Values with the leading "~" refer to data obtained from graphical illustrations.

* = The 2010 values will be used for 2015.

Table S.9: Fossil-Fuel Prices, Germany, 2010-2050

Fossil fuels		Fossil-fuel prices											
		2010	2015	2020	2030	2040	2050	2010	2015	2020	2030	2040	2050
		€$_{2009}$/GJ						€$_{2012}$/MJ[g]					
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lignite													
Nitsch et al. (2012a): Price path A, free power plant[a, d]	(A)	**1.3**	**1.3**[e]	**1.3**	**1.4**	**1.4**	**1.6**	**0.0025**	**0.0025**	**0.0025**	**0.0027**	**0.0027**	**0.0031**
Hard coal													
Nitsch et al. (2012a: Table 2-3): Price path A, import price at border[a]	(B)	2.9	3.9	4.9	6.3	7.7	8.9	0.0057	0.0076	0.0096	0.0123	0.0150	0.0173
Nitsch et al. (2012a: Figure 2.5): Price path A, free power plant[a, f]	(C)	**~2.9**	**~3.7**	**~4.3**	**~5.6**	**~7.0**	**~8.6**	**0.0057**	**0.0072**	**0.0084**	**0.0109**	**0.0136**	**0.0168**
Nitsch et al. (2012a: Table 2-3): Price path B, import price at border[b]	(D)	2.9	3.5	4.0	4.9	5.7	6.4	0.0057	0.0068	0.0078	0.0096	0.0111	0.0125
Nitsch et al. (2012a: Figure 2.5): Price path B, free power plant[b, f]	(E)	**~2.9**	**~3.5**	**~3.8**	**~4.7**	**~5.6**	**~6.2**	**0.0057**	**0.0068**	**0.0074**	**0.0092**	**0.0109**	**0.0121**
Nitsch et al. (2012a: Table 2-3): Price path C, import price at border[c]	(F)	2.9	3.1	3.4	3.8	4.3	4.7	0.0057	0.0060	0.0066	0.0074	0.0084	0.0092
Nitsch et al. (2012a: Figure 2.5): Price path C, free power plant[c, f]	(G)	**~2.9**	**~3.1**	**~3.4**	**~3.8**	**~4.3**	**~4.7**	**0.0057**	**0.0060**	**0.0066**	**0.0074**	**0.0084**	**0.0092**
Natural gas													
Nitsch et al. (2012a: Table 2-3): Price path A, import price at border[a]	(H)	5.8	7.1	8.1	10.5	12.7	14.9	0.0113	0.0138	0.0158	0.0205	0.0248	0.0290
Nitsch et al. (2012a: Figure 2.5): Price path A, free power plant[a, f]	(I)	**~6.2**	**~7.7**	**~9.1**	**~12.0**	**~14.9**	**~17.9**	**0.0121**	**0.0150**	**0.0177**	**0.0234**	**0.0290**	**0.0349**
Nitsch et al. (2012a: Table 2-3): Price path B, import price at border[b]	(J)	5.8	6.4	7.0	8.3	9.6	10.6	0.0113	0.0125	0.0136	0.0162	0.0187	0.0207
Nitsch et al. (2012a: Figure 2.5): Price path B, free power plant[b, f]	(K)	**~6.2**	**~7.0**	**~8.1**	**~10.1**	**~11.7**	**~12.9**	**0.0121**	**0.0136**	**0.0158**	**0.0197**	**0.0228**	**0.0251**
Nitsch et al. (2012a: Table 2-3): Price path C, import price at border[c]	(L)	5.8	5.9	6.1	6.6	7.3	8.1	0.0113	0.0115	0.0119	0.0129	0.0142	0.0158
Nitsch et al. (2012a: Figure 2.5): Price path C, free power plant[c, f]	(M)	**~6.2**	**~6.5**	**~7.0**	**~8.4**	**~9.2**	**~10.0**	**0.0121**	**0.0127**	**0.0136**	**0.0164**	**0.0179**	**0.0195**

Sources:
a) Price path A reflects substantial price increases (Nitsch et al. 2012a).
b) Price path B reflects moderate price increases (Nitsch et al. 2012a).
c) Price path C reflects very low price increases (Nitsch et al. 2012a).
d) Table S.8, row H.
e) As for 2010 and 2020.
f) The prices free power plant are based on the respective price path for import prices (Nitsch et al. 2012a).
g) Own calculation, transforming the fossil-fuel prices from columns 1 to 6 into 2012 euros with the help of the Hamburg Institute of International Economics (HWWI) index of world market prices for energy raw materials of 72.8 for 2009 and 141.9 for 2012 (Deutsche Bundesbank 2013: 68*) and expressing them per MJ, e.g., (7) = (1)/1,000 · 141.9/72.8.

Notes: Values rounded. GJ = gigajoule. MJ = megajoule. Values with the leading "~" refer to data obtained from graphical illustrations.

Table S.10: Prices of GHG Emission Allowances, Germany, 2010-2050

Price paths		CO₂ prices										
		2010	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
		$€_{2009}$/t CO_2						$€_{2012}$/t CO_2[d]				
Price paths		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Price path A[a]	(A)	14.3	20	27	45	60	75	5[e]	27	45	60	75
Price path B[b]	(B)	14.3	18	23	34	45	57	5[e]	23	34	45	57
Price path C[c]	(C)	14.3	17	20	26	36	45	5[e]	20	26	36	45

Sources:

a) Nitsch et al. (2012a: Table 2-3); price path A reflects substantial price increases, where the 2050 CO_2 price is considered to include external costs, such as future damage costs of unmitigated climate change.
b) Nitsch et al. (2012a: Table 2-3); price path B reflects moderate price increases.
c) Nitsch et al. (2012a: Table 2-3); price path C reflects very low price increases.
d) Own assumption, i.e. without adjustments in the price levels between 2009 and 2012.
e) Own assumption, based on the low level of spot-market prices for European emission allowances observed since the beginning of the third trading phase in the EU Emissions Trading System (EU ETS) in 2013 (see the settlement prices for European emission allowances retrieveable from the European Energy Exchange at: http://www.eex.com/en/market-data/emission-allowances/spot-market/european-emission-allowances#!/2015/01/12, last access: 12 January 2015). To simplify the analysis, the current prices are expressed in 2012 euros without any adjustments.

Table S.11: Costs for the Fossil Fuels Used During Pyrolysis When Process Heat is Not Recovered, Germany, 2015-2050 – Price Path A

	Lignite					Hard coal					Natural gas				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock[a]					€$_{2012}$/t$_{DM}$ feedstock[b]					€$_{2012}$/t$_{DM}$ feedstock[c]				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	4.0	4.0	4.3	4.3	5.0	11.5	13.3	17.4	21.7	26.7	26.3	31.1	41.0	51.0	61.2
Forestry residues	4.4	4.4	4.8	4.8	5.4	12.6	14.6	19.0	23.8	29.2	28.9	34.1	45.0	55.9	67.1
Open-country biomass residues	4.1	4.1	4.4	4.4	5.0	11.6	13.4	17.5	21.9	26.9	26.6	31.4	41.4	51.4	61.8
Industrial wood waste	4.2	4.2	4.5	4.5	5.1	11.9	13.8	17.9	22.4	27.5	27.2	32.2	42.4	52.7	63.3
Wood in municipal solid waste	4.4	4.4	4.8	4.8	5.4	12.6	14.6	19.1	23.8	29.3	28.9	34.2	45.1	56.0	67.3
Green waste: Compensation areas	3.9	3.9	4.2	4.2	4.8	11.1	12.9	16.8	21.0	25.8	25.5	30.1	39.7	49.2	59.2
Biomass: Habitat-connectivity areas	4.1	4.1	4.4	4.4	5.0	11.6	13.4	17.5	21.9	26.9	26.6	31.4	41.4	51.4	61.8
Green waste: Extensive grassland	4.1	4.1	4.4	4.4	5.0	11.6	13.4	17.5	21.9	26.9	26.6	31.4	41.4	51.4	61.8
Short-rotation coppice: Erosion areas	5.2	5.2	5.6	5.6	6.4	14.7	17.1	22.2	27.8	34.1	33.7	39.9	52.6	65.3	78.4
Solid cattle manure	16.7	16.7	18.0	18.0	20.6	47.6	55.3	72.0	90.0	110.5	109.2	129.1	170.2	211.3	253.9
Solid swine manure	31.4	31.4	33.8	33.8	38.6	89.4	103.9	135.3	169.1	207.7	205.2	242.6	319.8	397.1	477.1
Solid poultry manure	4.3	4.3	4.6	4.6	5.3	12.2	14.2	18.4	23.0	28.3	28.0	33.1	43.6	54.1	65.0
Commercial and industrial waste	15.6	15.6	16.8	16.8	19.3	44.5	51.8	67.4	84.2	103.5	102.3	120.9	159.4	197.9	237.7
Organic municipal solid waste	21.9	21.9	23.6	23.6	27.0	62.4	72.5	94.5	118.1	145.1	143.3	169.4	223.4	277.3	333.2

Sources:

a) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 2 by the lignite prices for price path A (Table S.9, row A, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (1) = Table S.6 (column 2) · Table S.9 (row A, column 8) · 1,000.

b) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 3 by the hard-coal prices for price path A (Table S.9, row C, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (6) = Table S.6 (column 3) · Table S.9 (row C, column 8) · 1,000.

c) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 4 by the natural-gas prices for price path A (Table S.9, row I, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (11) = Table S.6 (column 4) · Table S.9 (row I, column 8) · 1,000.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.12: Costs for the Fossil Fuels Used During Pyrolysis When Process Heat is Not Recovered, Germany, 2015-2050 – Price Path C

	Lignite					Hard coal					Natural gas				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock[a]					€$_{2012}$/t$_{DM}$ feedstock[b]					€$_{2012}$/t$_{DM}$ feedstock[c]				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	4.0	4.0	4.3	4.3	5.0	9.6	10.5	11.8	13.3	14.6	22.2	23.9	28.7	31.5	34.2
Forestry residues	4.4	4.4	4.8	4.8	5.4	10.5	11.6	12.9	14.6	16.0	24.4	26.2	31.5	34.5	37.5
Open-country biomass residues	4.1	4.1	4.4	4.4	5.0	9.7	10.6	11.9	13.4	14.7	22.4	24.2	29.0	31.7	34.5
Industrial wood waste	4.2	4.2	4.5	4.5	5.1	9.9	10.9	12.2	13.8	15.1	23.0	24.7	29.7	32.5	35.3
Wood in municipal solid waste	4.4	4.4	4.8	4.8	5.4	10.6	11.6	12.9	14.6	16.0	24.4	26.3	31.6	34.6	37.6
Green waste: Compensation areas	3.9	3.9	4.2	4.2	4.8	9.3	10.2	11.4	12.9	14.1	21.5	23.1	27.8	30.4	33.1
Biomass: Habitat-connectivity areas	4.1	4.1	4.4	4.4	5.0	9.7	10.6	11.9	13.4	14.7	22.4	24.2	29.0	31.7	34.5
Green waste: Extensive grassland	4.1	4.1	4.4	4.4	5.0	9.7	10.6	11.9	13.4	14.7	22.4	24.2	29.0	31.7	34.5
Short-rotation coppice: Erosion areas	5.2	5.2	5.6	5.6	6.4	12.3	13.5	15.1	17.1	18.7	28.5	30.7	36.8	40.3	43.8
Solid cattle manure	16.7	16.7	18.0	18.0	20.6	39.8	43.7	48.8	55.3	60.4	92.2	99.3	119.1	130.5	141.8
Solid swine manure	31.4	31.4	33.8	33.8	38.6	74.9	82.1	91.8	103.9	113.5	173.3	186.6	223.9	245.2	266.5
Solid poultry manure	4.3	4.3	4.6	4.6	5.3	10.2	11.2	12.5	14.2	15.5	23.6	25.4	30.5	33.4	36.3
Commercial and industrial waste	15.6	15.6	16.8	16.8	19.3	37.3	40.9	45.7	51.8	56.6	86.3	93.0	111.6	122.2	132.8
Organic municipal solid waste	21.9	21.9	23.6	23.6	27.0	52.3	57.4	64.1	72.5	79.3	121.0	130.3	156.4	171.2	186.1

Sources:

a) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 2 by the lignite prices for price path A[*] (Table S.9, row A, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (1) = Table S.6 (column 2) · Table S.9 (row A, column 8) · 1,000.

b) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 3 by the hard-coal prices for price path C (Table S.9, row G, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (6) = Table S.6 (column 3) · Table S.9 (row G, column 8) · 1,000.

c) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 4 by the natural-gas prices for price path C (Table S.9, row M, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (11) = Table S.6 (column 4) · Table S.9 (row M, column 8) · 1,000.

Notes: Values rounded. DM = dry mass. t = tonne.

* = Note that the fuel prices for lignite do not vary across the price paths, but refer to price path A throughout.

Table S.13: Costs for the Fossil Fuels Used During Pyrolysis When Process Heat is Recovered, Germany, 2015-2050 – Price Path A

	Lignite					Hard coal					Natural gas				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock[a]					€$_{2012}$/t$_{DM}$ feedstock[b]					€$_{2012}$/t$_{DM}$ feedstock[c]				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	1.3	1.3	1.4	1.4	1.6	3.8	4.4	5.8	7.2	8.8	8.7	10.3	13.6	16.9	20.3
Forestry residues	1.6	1.6	1.8	1.8	2.0	4.6	5.4	7.0	8.8	10.8	10.7	12.6	16.6	20.7	24.8
Open-country biomass residues	1.3	1.3	1.4	1.4	1.6	3.8	4.4	5.8	7.2	8.8	8.7	10.3	13.6	16.9	20.3
Industrial wood waste	1.4	1.4	1.5	1.5	1.7	3.9	4.6	5.9	7.4	9.1	9.0	10.7	14.0	17.4	21.0
Wood in municipal solid waste	1.6	1.6	1.8	1.8	2.0	4.7	5.4	7.1	8.8	10.9	10.7	12.7	16.7	20.8	25.0
Green waste: Compensation areas	1.2	1.2	1.3	1.3	1.5	3.4	4.0	5.1	6.4	7.9	7.8	9.2	12.2	15.1	18.2
Biomass: Habitat-connectivity areas	1.3	1.3	1.4	1.4	1.6	3.8	4.4	5.8	7.2	8.8	8.7	10.3	13.6	16.9	20.3
Green waste: Extensive grassland	1.3	1.3	1.4	1.4	1.6	3.8	4.4	5.8	7.2	8.8	8.7	10.3	13.6	16.9	20.3
Short-rotation coppice: Erosion areas	2.4	2.4	2.6	2.6	2.9	6.8	7.9	10.3	12.8	15.8	15.6	18.4	24.3	30.1	36.2
Solid cattle manure	14.2	14.2	15.3	15.3	17.4	40.3	46.9	61.0	76.3	93.7	92.6	109.4	144.3	179.2	215.3
Solid swine manure	28.9	28.9	31.1	31.1	35.6	82.3	95.6	124.5	155.6	191.2	188.9	223.3	294.4	365.6	439.2
Solid poultry manure	1.8	1.8	2.0	2.0	2.2	5.2	6.0	7.8	9.8	12.0	11.9	14.0	18.5	22.9	27.6
Commercial and industrial waste	12.9	12.9	13.9	13.9	15.9	36.8	42.8	55.8	69.7	85.6	84.6	100.0	131.8	163.7	196.7
Organic municipal solid waste	19.5	19.5	21.0	21.0	24.0	55.4	64.4	83.9	104.9	128.9	127.3	150.5	198.4	246.4	296.0

Sources:

a) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 6 by the lignite prices for price path A (Table S.9, row A, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (1) = Table S.6 (column 6) · Table S.9 (row A, column 8) · 1,000.

b) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 7 by the hard-coal prices for price path A (Table S.9, row C, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (6) = Table S.6 (column 7) · Table S.9 (row C, column 8) · 1,000.

c) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 8 by the natural-gas prices for price path A (Table S.9, row I, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (11) = Table S.6 (column 8) · Table S.9 (row I, column 8) · 1,000.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.14: Costs for the Fossil Fuels Used During Pyrolysis When Process Heat is Recovered, Germany, 2015-2050 – Price Path C

	Lignite					Hard coal					Natural gas				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock[a]					€$_{2012}$/t$_{DM}$ feedstock[b]					€$_{2012}$/t$_{DM}$ feedstock[c]				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	1.3	1.3	1.4	1.4	1.6	3.2	3.5	3.9	4.4	4.8	7.4	7.9	9.5	10.4	11.4
Forestry residues	1.6	1.6	1.8	1.8	2.0	3.9	4.3	4.8	5.4	5.9	9.0	9.7	11.6	12.8	13.9
Open-country biomass residues	1.3	1.3	1.4	1.4	1.6	3.2	3.5	3.9	4.4	4.8	7.4	7.9	9.5	10.4	11.3
Industrial wood waste	1.4	1.4	1.5	1.5	1.7	3.3	3.6	4.0	4.6	5.0	7.6	8.2	9.8	10.8	11.7
Wood in municipal solid waste	1.6	1.6	1.8	1.8	2.0	3.9	4.3	4.8	5.4	5.9	9.1	9.8	11.7	12.8	13.9
Green waste: Compensation areas	1.2	1.2	1.3	1.3	1.5	2.9	3.1	3.5	4.0	4.3	6.6	7.1	8.5	9.3	10.1
Biomass: Habitat-connectivity areas	1.3	1.3	1.4	1.4	1.6	3.2	3.5	3.9	4.4	4.8	7.4	7.9	9.5	10.4	11.3
Green waste: Extensive grassland	1.3	1.3	1.4	1.4	1.6	3.2	3.5	3.9	4.4	4.8	7.4	7.9	9.5	10.4	11.3
Short-rotation coppice: Erosion areas	2.4	2.4	2.6	2.6	2.9	5.7	6.2	7.0	7.9	8.6	13.1	14.2	17.0	18.6	20.2
Solid cattle manure	14.2	14.2	15.3	15.3	17.4	33.8	37.1	41.4	46.9	51.2	78.2	84.2	101.0	110.6	120.3
Solid swine manure	28.9	28.9	31.1	31.1	35.6	68.9	75.6	84.5	95.6	104.5	159.5	171.7	206.1	225.7	245.3
Solid poultry manure	1.8	1.8	2.0	2.0	2.2	4.3	4.7	5.3	6.0	6.6	10.0	10.8	12.9	14.2	15.4
Commercial and industrial waste	12.9	12.9	13.9	13.9	15.9	30.9	33.9	37.8	42.8	46.8	71.4	76.9	92.3	101.1	109.9
Organic municipal solid waste	19.5	19.5	21.0	21.0	24.0	46.5	51.0	56.9	64.4	70.4	107.5	115.8	138.9	152.1	165.4

Sources:
a) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 6 by the lignite prices for price path A* (Table S.9, row A, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (1) = Table S.6 (column 6) · Table S.9 (row A, column 8) · 1,000.
b) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 7 by the hard-coal prices for price path C (Table S.9, row G, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (6) = Table S.6 (column 7) · Table S.9 (row G, column 8) · 1,000.
c) Own calculation, multiplying the fossil-fuel requirements from Table S.6, column 8 by the natural-gas prices for price path C (Table S.9, row M, columns 8-12) and expressing the resulting costs per dry tonne of feedstock, e.g., (11) = Table S.6 (column 8) · Table S.9 (row M, column 8) · 1,000.

Notes: Values rounded. DM = dry mass. t = tonne.

* = Note that the fuel prices for lignite do not vary across the price paths, but refer to price path A throughout.

Table S.15: GHG Emission Costs Associated with Pyrolysis When Process Heat is Not Recovered, Germany, 2015-2050 – Price Path A

	Lignite					Hard coal					Natural gas				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	$€_{2012}/t_{DM}$ feedstock[a]					$€_{2012}/t_{DM}$ feedstock[b]					$€_{2012}/t_{DM}$ feedstock[c]				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.9	5.0	8.3	11.1	13.9	0.8	4.2	7.0	9.3	11.6	0.5	2.7	4.4	5.9	7.4
Forestry residues	1.0	5.5	9.1	12.2	15.2	0.8	4.6	7.6	10.2	12.7	0.5	2.9	4.9	6.5	8.1
Open-country biomass residues	0.9	5.0	8.4	11.2	14.0	0.8	4.2	7.0	9.4	11.7	0.5	2.7	4.5	6.0	7.5
Industrial wood waste	1.0	5.2	8.6	11.5	14.3	0.8	4.3	7.2	9.6	12.0	0.5	2.8	4.6	6.1	7.6
Wood in municipal solid waste	1.0	5.5	9.1	12.2	15.2	0.8	4.6	7.6	10.2	12.7	0.5	2.9	4.9	6.5	8.1
Green waste: Compensation areas	0.9	4.8	8.0	10.7	13.4	0.7	4.0	6.7	9.0	11.2	0.5	2.6	4.3	5.7	7.1
Biomass: Habitat-connectivity areas	0.9	5.0	8.4	11.2	14.0	0.8	4.2	7.0	9.4	11.7	0.5	2.7	4.5	6.0	7.5
Green waste: Extensive grassland	0.9	5.0	8.4	11.2	14.0	0.8	4.2	7.0	9.4	11.7	0.5	2.7	4.5	6.0	7.5
Short-rotation coppice: Erosion areas	1.2	6.4	10.7	14.2	17.8	1.0	5.3	8.9	11.9	14.9	0.6	3.4	5.7	7.6	9.5
Solid cattle manure	3.8	20.7	34.5	46.0	57.5	3.2	17.3	28.9	38.5	48.1	2.0	11.0	18.4	24.5	30.7
Solid swine manure	7.2	38.9	64.9	86.5	108.1	6.0	32.5	54.2	72.3	90.4	3.8	20.7	34.6	46.1	57.6
Solid poultry manure	1.0	5.3	8.8	11.8	14.7	0.8	4.4	7.4	9.9	12.3	0.5	2.8	4.7	6.3	7.9
Commercial and industrial waste	3.6	19.4	32.3	43.1	53.9	3.0	16.2	27.0	36.0	45.0	1.9	10.3	17.2	23.0	28.7
Organic municipal solid waste	5.0	27.2	45.3	60.4	75.5	4.2	22.7	37.9	50.5	63.1	2.7	14.5	24.1	32.2	40.2

Sources:

a) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 1 by the CO_2 prices for price path A (Table S.10, row A, columns 7-11), e.g., (1) = Table S.7 (column 1) · Table S.10 (row A, column 7).

b) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 2 by the CO_2 prices for price path A (Table S.10, row A, columns 7-11), e.g., (6) = Table S.7 (column 2) · Table S.10 (row A, column 7).

c) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 3 by the CO_2 prices for price path A (Table S.10, row A, columns 7-11), e.g., (11) = Table S.7 (column 3) · Table S.10 (row A, column 7).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.16: GHG Emission Costs Associated with Pyrolysis When Process Heat is Not Recovered, Germany, 2015-2050 – Price Path C

	Lignite					Hard coal					Natural gas				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock[a]					€$_{2012}$/t$_{DM}$ feedstock[b]					€$_{2012}$/t$_{DM}$ feedstock[c]				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.9	3.7	4.8	6.7	8.3	0.8	3.1	4.0	5.6	7.0	0.5	2.0	2.6	3.5	4.4
Forestry residues	1.0	4.1	5.3	7.3	9.1	0.8	3.4	4.4	6.1	7.6	0.5	2.2	2.8	3.9	4.9
Open-country biomass residues	0.9	3.7	4.9	6.7	8.4	0.8	3.1	4.1	5.6	7.0	0.5	2.0	2.6	3.6	4.5
Industrial wood waste	1.0	3.8	5.0	6.9	8.6	0.8	3.2	4.2	5.8	7.2	0.5	2.0	2.6	3.7	4.6
Wood in municipal solid waste	1.0	4.1	5.3	7.3	9.1	0.8	3.4	4.4	6.1	7.6	0.5	2.2	2.8	3.9	4.9
Green waste: Compensation areas	0.9	3.6	4.6	6.4	8.0	0.7	3.0	3.9	5.4	6.7	0.5	1.9	2.5	3.4	4.3
Biomass: Habitat-connectivity areas	0.9	3.7	4.9	6.7	8.4	0.8	3.1	4.1	5.6	7.0	0.5	2.0	2.6	3.6	4.5
Green waste: Extensive grassland	0.9	3.7	4.9	6.7	8.4	0.8	3.1	4.1	5.6	7.0	0.5	2.0	2.6	3.6	4.5
Short-rotation coppice: Erosion areas	1.2	4.7	6.2	8.5	10.7	1.0	4.0	5.2	7.1	8.9	0.6	2.5	3.3	4.5	5.7
Solid cattle manure	3.8	15.3	19.9	27.6	34.5	3.2	12.8	16.7	23.1	28.9	2.0	8.2	10.6	14.7	18.4
Solid swine manure	7.2	28.8	37.5	51.9	64.9	6.0	24.1	31.3	43.4	54.2	3.8	15.4	20.0	27.7	34.6
Solid poultry manure	1.0	3.9	5.1	7.1	8.8	0.8	3.3	4.3	5.9	7.4	0.5	2.1	2.7	3.8	4.7
Commercial and industrial waste	3.6	14.4	18.7	25.9	32.3	3.0	12.0	15.6	21.6	27.0	1.9	7.7	10.0	13.8	17.2
Organic municipal solid waste	5.0	20.1	26.2	36.2	45.3	4.2	16.8	21.9	30.3	37.9	2.7	10.7	13.9	19.3	24.1

Sources:

a) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 1 by the CO_2 prices for price path C (Table S.10, row C, columns 7-11), e.g., (1) = Table S.7 (column 1) · Table S.10 (row C, column 7).

b) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 2 by the CO_2 prices for price path C (Table S.10, row C, columns 7-11), e.g., (6) = Table S.7 (column 2) · Table S.10 (row C, column 7).

c) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 3 by the CO_2 prices for price path C (Table S.10, row C, columns 7-11), e.g., (11) = Table S.7 (column 3) · Table S.10 (row C, column 7).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.17: GHG Emission Costs Associated with Pyrolysis When Process Heat is Recovered, Germany, 2015-2050 – Price Path A

	Lignite					Hard coal					Natural gas				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock[a]					€$_{2012}$/t$_{DM}$ feedstock[b]					€$_{2012}$/t$_{DM}$ feedstock[c]				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.3	1.7	2.8	3.7	4.6	0.3	1.4	2.3	3.1	3.9	0.2	0.9	1.5	2.0	2.5
Forestry residues	0.4	2.0	3.4	4.5	5.6	0.3	1.7	2.8	3.8	4.7	0.2	1.1	1.8	2.4	3.0
Open-country biomass residues	0.3	1.7	2.8	3.7	4.6	0.3	1.4	2.3	3.1	3.8	0.2	0.9	1.5	2.0	2.5
Industrial wood waste	0.3	1.7	2.8	3.8	4.7	0.3	1.4	2.4	3.2	4.0	0.2	0.9	1.5	2.0	2.5
Wood in municipal solid waste	0.4	2.0	3.4	4.5	5.7	0.3	1.7	2.8	3.8	4.7	0.2	1.1	1.8	2.4	3.0
Green waste: Compensation areas	0.3	1.5	2.5	3.3	4.1	0.2	1.2	2.1	2.8	3.4	0.1	0.8	1.3	1.8	2.2
Biomass: Habitat-connectivity areas	0.3	1.7	2.8	3.7	4.6	0.3	1.4	2.3	3.1	3.8	0.2	0.9	1.5	2.0	2.5
Green waste: Extensive grassland	0.3	1.7	2.8	3.7	4.6	0.3	1.4	2.3	3.1	3.8	0.2	0.9	1.5	2.0	2.5
Short-rotation coppice: Erosion areas	0.5	3.0	4.9	6.6	8.2	0.5	2.5	4.1	5.5	6.9	0.3	1.6	2.6	3.5	4.4
Solid cattle manure	3.3	17.6	29.3	39.0	48.8	2.7	14.7	24.5	32.6	40.8	1.7	9.4	15.6	20.8	26.0
Solid swine manure	6.6	35.8	59.7	79.6	99.5	5.5	30.0	49.9	66.6	83.2	3.5	19.1	31.8	42.4	53.0
Solid poultry manure	0.4	2.2	3.7	5.0	6.2	0.3	1.9	3.1	4.2	5.2	0.2	1.2	2.0	2.7	3.3
Commercial and industrial waste	3.0	16.0	26.7	35.7	44.6	2.5	13.4	22.4	29.8	37.3	1.6	8.5	14.2	19.0	23.7
Organic municipal solid waste	4.5	24.2	40.3	53.7	67.1	3.7	20.2	33.7	44.9	56.1	2.4	12.9	21.4	28.6	35.7

Sources:

a) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 4 by the CO_2 prices for price path A (Table S.10, row A, columns 7-11), e.g., (1) = Table S.7 (column 4) · Table S.10 (row A, column 7).

b) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 5 by the CO_2 prices for price path A (Table S.10, row A, columns 7-11), e.g., (6) = Table S.7 (column 5) · Table S.10 (row A, column 7).

c) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 6 by the CO_2 prices for price path A (Table S.10, row A, columns 7-11), e.g., (11) = Table S.7 (column 6) · Table S.10 (row A, column 7).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.18: GHG Emission Costs Associated with Pyrolysis When Process Heat is Recovered, Germany, 2015-2050 – Price Path C

	Lignite					Hard coal					Natural gas				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock[a]					€$_{2012}$/t$_{DM}$ feedstock[b]					€$_{2012}$/t$_{DM}$ feedstock[c]				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.3	1.2	1.6	2.2	2.8	0.3	1.0	1.3	1.8	2.3	0.2	0.7	0.9	1.2	1.5
Forestry residues	0.4	1.5	2.0	2.7	3.4	0.3	1.3	1.6	2.3	2.8	0.2	0.8	1.0	1.4	1.8
Open-country biomass residues	0.3	1.2	1.6	2.2	2.8	0.3	1.0	1.3	1.8	2.3	0.2	0.7	0.9	1.2	1.5
Industrial wood waste	0.3	1.3	1.6	2.3	2.8	0.3	1.1	1.4	1.9	2.4	0.2	0.7	0.9	1.2	1.5
Wood in municipal solid waste	0.4	1.5	2.0	2.7	3.4	0.3	1.3	1.6	2.3	2.8	0.2	0.8	1.0	1.4	1.8
Green waste: Compensation areas	0.3	1.1	1.4	2.0	2.5	0.2	0.9	1.2	1.7	2.1	0.1	0.6	0.8	1.1	1.3
Biomass: Habitat-connectivity areas	0.3	1.2	1.6	2.2	2.8	0.3	1.0	1.3	1.8	2.3	0.2	0.7	0.9	1.2	1.5
Green waste: Extensive grassland	0.3	1.2	1.6	2.2	2.8	0.3	1.0	1.3	1.8	2.3	0.2	0.7	0.9	1.2	1.5
Short-rotation coppice: Erosion areas	0.5	2.2	2.8	3.9	4.9	0.5	1.8	2.4	3.3	4.1	0.3	1.2	1.5	2.1	2.6
Solid cattle manure	3.3	13.0	16.9	23.4	29.3	2.7	10.9	14.1	19.6	24.5	1.7	6.9	9.0	12.5	15.6
Solid swine manure	6.6	26.5	34.5	47.8	59.7	5.5	22.2	28.8	39.9	49.9	3.5	14.1	18.4	25.5	31.8
Solid poultry manure	0.4	1.7	2.2	3.0	3.7	0.3	1.4	1.8	2.5	3.1	0.2	0.9	1.2	1.6	2.0
Commercial and industrial waste	3.0	11.9	15.5	21.4	26.7	2.5	9.9	12.9	17.9	22.4	1.6	6.3	8.2	11.4	14.2
Organic municipal solid waste	4.5	17.9	23.3	32.2	40.3	3.7	15.0	19.4	26.9	33.7	2.4	9.5	12.4	17.2	21.4

Sources:

a) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 4 by the CO_2 prices for price path C (Table S.10, row C, columns 7-11), e.g., (1) = Table S.7 (column 4) · Table S.10 (row C, column 7).

b) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 5 by the CO_2 prices for price path C (Table S.10, row C, columns 7-11), e.g., (6) = Table S.7 (column 5) · Table S.10 (row C, column 7).

c) Own calculation, multiplying the GHG emissions from the fossil-fuel use in biochar production from Table S.7, column 6 by the CO_2 prices for price path C (Table S.10, row C, columns 7-11), e.g., (11) = Table S.7 (column 6) · Table S.10 (row C, column 7).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.19: Costs Related to Biomass Combustion, Germany, 2015-2050

			2015	**2020**	**2030**	**2040**	**2050**
			(1)	(2)	(3)	(4)	(5)
Annual specific capital costs[a]	$€_{2009}/kW_{el}$	(A)	675	650	650	650	650
Annual operational costs[a]	$€_{2009}/kW_{el}$	(B)	34	33	33	33	33
Total	$€_{2009}/kW_{el}$[b]	(C)	709	683	683	683	683
	$€_{2009}/kWh_{el}$[c]	(D)	0.0945	0.0911	0.0911	0.0911	0.0911
	$€_{2009}/GJ_{el}$[d]	(E)	26.3	25.3	25.3	25.3	25.3
	$€_{2012}/MJ_{el}$[e]	(F)	0.0285	0.0275	0.0275	0.0275	0.0275
Feedstocks			**Costs related to biomass combustion** $€_{2012}/t_{DM}$ feedstock[f]				
Industrial wood waste		(G)	**165.2**	**159.1**	**159.1**	**159.1**	**159.1**
Short-rotation coppice: Erosion areas		(H)	**165.2**	**159.1**	**159.1**	**159.1**	**159.1**

Sources:

a) Nitsch et al. (2012b: Table 1-5), based on newly installed biomass steam power plants at an interest rate of 6% per annum and a life time of 20 years.

b) Own calculation, (C) = (A) + (B).

c) Own calculation, based on 7,500 full-load hours per year in each period as assumed in Nitsch et al. (2012b: Table 1-5), i.e. (D) = (C)/7,500.

d) Own calculation, (E) = (D)/0.0036.

e) Own calculation, based on the 2009 and 2012 producer price indices of 98.5 and 107.0, respectively (Deutsche Bundesbank 2015), i.e. (F) = (E)/1,000 · 107.0/98.5.

f) Own calculation, based on assumptions from Teichmann (2014a: Table 18), i.e. using the higher heating value (HHV)* of 19.3 MJ/kg_{db} for both biomass feedstocks and an electrical efficiency** of 30% as reached in dedicated bio-power plants (IEA 2007: 2), i.e. (G) = (F) · 19.3 · 0.3 · 1,000 and (H) = (F) · 19.3 · 0.3 · 1,000. Note that Nitsch et al. (2012b: Table 1-5) assume a similar average electrical efficiency of 28%.

Notes: Values rounded. DM = dry mass. db = dry base. kg = kilogram. t = tonne. kW = kilowatt. kWh = kilowatt hour. GJ = gigajoule. MJ = megajoule. el = electrical power.

* = Due to data availability, HHVs are used instead of lower heating values (LHVs).

** = The efficiency refers to the conversion of biomass to electricity only, i.e. not considering combined heat and power (CHP).

Table S.20: Fossil-Fuel Electricity Generation Costs that Are Offset by the Energetic Use of Biomass, Germany, 2015-2050

				Lignite					Hard coal					Natural gas				
				2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
				(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Electrical efficiency[a]		%	(A)	43					43					40				
Avoided GHG emissions[b]		t CO_2e/t_{DM} feedstock	(B)	1.567					1.310					0.813				
Fossil-fuel costs	Price path A[c]	€$_{2012}/t_{DM}$ feedstock	(C)	34.1	34.1	36.7	36.7	42.0	97.1	112.9	147.0	183.7	225.7	217.3	256.8	338.6	420.4	505.0
	Price path B[d]		(D)	34.1	34.1	36.7	36.7	42.0	91.9	99.7	123.4	147.0	162.7	197.5	228.5	285.0	330.1	364.0
	Price path C[e]		(E)	34.1	34.1	36.7	36.7	42.0	81.4	89.2	99.7	112.9	123.4	183.4	197.5	237.0	259.6	282.1
CO_2 costs	Price path A[f]	€$_{2012}/t_{DM}$ feedstock	(F)	7.8	42.3	70.5	94.0	117.5	6.5	35.4	58.9	78.6	98.2	4.1	22.0	36.6	48.8	61.0
	Price path B[g]		(G)	7.8	36.0	53.3	70.5	89.3	6.5	30.1	44.5	58.9	74.7	4.1	18.7	27.6	36.6	46.4
	Price path C[h]		(H)	7.8	31.3	40.7	56.4	70.5	6.5	26.2	34.1	47.1	58.9	4.1	16.3	21.1	29.3	36.6
Capital + operational costs of fossil-fuel power plants[i]		€$_{2012}/t_{DM}$ feedstock	(I)	47.2	47.2	45.4	45.4	45.4	41.9	40.2	40.2	40.2	40.2	28.0	28.0	28.0	28.0	28.0
Feedstocks				**Total avoided electricity generation costs** €$_{2012}/t_{DM}$ feedstock					**Total avoided electricity generation costs** €$_{2012}/t_{DM}$ feedstock					**Total avoided electricity generation costs** €$_{2012}/t_{DM}$ feedstock				
Industrial wood waste		Price path A[j]	(J)	**89.1**	**123.6**	**152.7**	**176.2**	**204.9**	**145.6**	**188.4**	**246.1**	**302.5**	**364.1**	**249.3**	**306.7**	**403.1**	**497.1**	**594.0**
		Price path B[k]	(K)	**89.1**	**117.3**	**135.4**	**152.7**	**176.7**	**140.3**	**170.0**	**208.1**	**246.1**	**277.6**	**229.5**	**275.2**	**340.6**	**394.7**	**438.3**
		Price path C[l]	(L)	**89.1**	**112.6**	**122.9**	**138.6**	**157.9**	**129.8**	**155.6**	**174.0**	**200.2**	**222.5**	**215.4**	**241.7**	**286.1**	**316.8**	**346.7**
Short-rotation coppice: Erosion areas		Price path A[j]	(M)	**89.1**	**123.6**	**152.7**	**176.2**	**204.9**	**145.6**	**188.4**	**246.1**	**302.5**	**364.1**	**249.3**	**306.7**	**403.1**	**497.1**	**594.0**
		Price path B[k]	(N)	**89.1**	**117.3**	**135.4**	**152.7**	**176.7**	**140.3**	**170.0**	**208.1**	**246.1**	**277.6**	**229.5**	**275.2**	**340.6**	**394.7**	**438.3**
		Price path C[l]	(O)	**89.1**	**112.6**	**122.9**	**138.6**	**157.9**	**129.8**	**155.6**	**174.0**	**200.2**	**222.5**	**215.4**	**241.7**	**286.1**	**316.8**	**346.7**

Sources:

a) The efficiencies refer to the conversion of biomass/fossil fuel to electricity only, i.e. not considering combined heat and power (CHP) due to the lack of consistent data for CHP efficiencies. For the biomass feedstocks, we apply electrical efficiencies of 30%, as reached in dedicated bio-power plants (IEA 2007: 2). The electrical efficiencies for the fossil fuels are taken from Traber and Kemfert (2011: Table 1), whereby the value for lignite refers to *"new brown coal" (BC New)*, i.e. to lignite-fired power plants with optimized plant engineering (Schröder et al. 2013), the value for hard coal to *"new hard coal" (HC New)*, i.e. to supercritical pulverized-coal-fired power plants (Schröder et al. 2013), and the one for natural gas *(NG ST)* to steam turbines. Note that the assumptions are the same as those applied by Teichmann (2014a: Table 18) for the calculation of the GHG emissions from fossil fuels that are offset by the energetic use of biomass. For this reason, the electrical efficiency for natural gas deviates from the corresponding efficiencies calculated in Table S.8 (row F, columns 11-15), which were based on gas-and-steam power plants.

b) Teichmann (2014a: Table 18), i.e. the GHG emissions from the fossil fuels that are offset by the energetic use of the biomass coincide for both biomass feedstocks.

c) Own calculation, multiplying the higher heating value (HHV)* of 19.3 MJ/kg_{db} for both biomass feedstocks by the prices for lignite (Table S.9, row A, columns 8-12), hard coal (Table S.9, row C, columns 8-12) and natural gas (Table S.9, row I, columns 8-12), respectively, and correcting for the different electrical efficiencies of biomass (30%, see note a) and fossil fuels (see row A), e.g., (1) = Table S.9 (row A, column 8) $\cdot$ 19.3 $\cdot$ 30/43 $\cdot$ 1,000.

d) Own calculation, multiplying the higher heating value (HHV)* of 19.3 MJ/kg_{db} for both biomass feedstocks by the prices for lignite** (Table S.9, row A, columns 8-12), hard coal (Table S.9, row E, columns 8-12) and natural gas (Table S.9, row K, columns 8-12), respectively, and correcting for the different electrical efficiencies of biomass (30%, see note a) and fossil fuels (see row A), e.g., (1) = Table S.9 (row A, column 8) $\cdot$ 19.3 $\cdot$ 30/43 $\cdot$ 1,000.

e) Own calculation, multiplying the higher heating value (HHV)* of 19.3 MJ/kg_{db} for both biomass feedstocks by the prices for lignite** (Table S.9, row A, columns 8-12), hard coal (Table S.9, row G, columns 8-12) and natural gas (Table S.9, row M, columns 8-12), respectively, and correcting for the different electrical efficiencies of biomass (30%, see note a) and fossil fuels (see row A), e.g., (1) = Table S.9 (row A, column 8) · 19.3 · 30/43 · 1,000.
f) Own calculation, multiplying the respective avoided GHG emissions from row B by the CO_2 prices from Table S.10, row A, columns 7-11, e.g., (1) = Table S.10 (row A, column 7) · 1.567.
g) Own calculation, multiplying the respective avoided GHG emissions from row B by the CO_2 prices from Table S.10, row B, columns 7-11, e.g., (1) = Table S.10 (row B, column 7) · 1.567.
h) Own calculation, multiplying the respective avoided GHG emissions from row B by the CO_2 prices from Table S.10, row C, columns 7-11, e.g., (1) = Table S.10 (row C, column 7) · 1.567.
i) Own calculation, multiplying the higher heating value (HHV)* of 19.3 MJ/kg_{db} for both biomass feedstocks – adjusted for the electrical efficiency of biomass (30%, see note a) to arrive at the amount of electrical power generated per dry tonne of feedstock (MJ_{el}/kg_{db}) – by the respective total capital and operational costs of new fossil-fuel power plants (Table S.8, row L), e.g., (1) = Table S.8 (row L, column 1) · 19.3 · 30/100 · 1,000.
j) Own calculation, (J) = (C) + (F) + (I).
k) Own calculation, (J) = (D) + (G) + (I).
l) Own calculation, (J) = (E) + (H) + (I).

Notes: Values rounded. DM = dry mass. db = dry base. kg = kilogram. t = tonne. MJ = megajoule. el = electrical power.

* = Due to data availability, HHVs are used instead of lower heating values (LHVs).

** = Note that the fuel prices for lignite do not vary across the price paths, but refer to price path A throughout.

Table S.21: GHG Emissions from Fossil Fuels Offset by the Pyrolysis By-Products

Feedstocks	Lignite[a]	Hard coal[b]	Natural gas[c]
	$t\ CO_2e/t_{DM}$ feedstock		
	(1)	(2)	(3)
Cereal straw	0.658	0.550	0.342
Forestry residues	0.745	0.623	0.387
Open-country biomass residues	0.655	0.548	0.340
Industrial wood waste	0.728	0.609	0.378
Wood in municipal solid waste	0.745	0.623	0.387
Green waste: Compensation areas	0.600	0.502	0.312
Biomass: Habitat-connectivity areas	0.655	0.548	0.340
Green waste: Extensive grassland	0.655	0.548	0.340
Short-rotation coppice: Erosion areas	0.821	0.686	0.426
Solid cattle manure	0.586	0.490	0.304
Solid swine manure	0.751	0.628	0.390
Solid poultry manure	0.535	0.447	0.278
Commercial and industrial waste	0.709	0.593	0.368
Organic municipal solid waste	0.492	0.411	0.255

Sources:
a) Teichmann (2014a: Table 20, column 4).
b) Teichmann (2014a: Table 20, column 8).
c) Teichmann (2014a: Table 20, column 12).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.22: Fossil-Fuel Costs Avoided by the Energetic Use of the Pyrolysis By-Products, Germany, 2015-2050 – Price Path A

			Lignite					Hard coal					Natural gas				
Electrical efficiency[a]	%	(A)	43					43					40				
	E_{out}[b]		Fossil-fuel costs[c]					Fossil-fuel costs[d]					Fossil-fuel costs[e]				
			2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	MJ/kg$_{db}$		€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Cereal straw	7.6		14.3	14.3	15.4	15.4	17.6	40.8	47.4	61.7	77.2	94.8	91.3	107.9	142.2	176.6	212.2
Forestry residues	8.6		16.2	16.2	17.5	17.5	20.0	46.2	53.7	69.9	87.4	107.4	103.4	122.1	161.1	200.0	240.3
Open-country biomass residues	7.6		14.3	14.3	15.4	15.4	17.6	40.6	47.2	61.5	76.9	94.4	90.9	107.4	141.6	175.9	211.3
Industrial wood waste	8.4		15.9	15.9	17.1	17.1	19.5	45.1	52.5	68.3	85.4	104.9	101.0	119.3	157.4	195.4	234.8
Wood in municipal solid waste	8.6		16.2	16.2	17.5	17.5	20.0	46.2	53.7	69.9	87.4	107.4	103.4	122.1	161.1	200.0	240.3
Green waste: Compensation areas	6.9		13.1	13.1	14.1	14.1	16.1	37.2	43.2	56.3	70.4	86.5	83.2	98.4	129.7	161.0	193.5
Biomass: Habitat-connectivity areas	7.6		14.3	14.3	15.4	15.4	17.6	40.6	47.2	61.5	76.9	94.4	90.9	107.4	141.6	175.9	211.3
Green waste: Extensive grassland	7.6		14.3	14.3	15.4	15.4	17.6	40.6	47.2	61.5	76.9	94.4	90.9	107.4	141.6	175.9	211.3
Short-rotation coppice: Erosion areas	9.5		17.9	17.9	19.3	19.3	22.0	50.9	59.1	77.0	96.3	118.3	113.8	134.5	177.4	220.3	264.6
Solid cattle manure	6.8		12.8	12.8	13.8	13.8	15.7	36.3	42.2	55.0	68.8	84.5	81.3	96.1	126.7	157.3	189.0
Solid swine manure	8.7		16.4	16.4	17.6	17.6	20.1	46.6	54.1	70.5	88.1	108.2	104.2	123.1	162.4	201.6	242.2
Solid poultry manure	6.2		11.7	11.7	12.5	12.5	14.3	33.2	38.5	50.2	62.7	77.1	74.2	87.7	115.6	143.6	172.5
Commercial and industrial waste	8.2		15.4	15.4	16.6	16.6	19.0	44.0	51.1	66.5	83.2	102.2	98.4	116.2	153.3	190.3	228.7
Organic municipal solid waste	5.7		10.7	10.7	11.5	11.5	13.2	30.5	35.4	46.1	57.7	70.9	68.2	80.6	106.3	132.0	158.5

Sources:

a) The efficiencies refer to the conversion of the pyrolysis by-products/fossil fuels to electricity only, i.e. not considering combined heat and power (CHP) due to the lack of consistent data for CHP efficiencies. For the pyrolysis by-products, we apply electrical efficiencies of 32% as done by Woolf et al. (2010b). The electrical efficiencies for the fossil fuels are taken from Traber and Kemfert (2011: Table 1), whereby the value for lignite refers to *"new brown coal" (BC New)*, i.e. to lignite-fired power plants with optimized plant engineering (Schröder et al. 2013), the value for hard coal to *"new hard coal" (HC New)*, i.e. to supercritical pulverized-coal-fired power plants (Schröder et al. 2013), and the one for natural gas *(NG ST)* to steam turbines. Note that the assumptions are the same as those applied by Teichmann (2014a: Table 20) for the calculation of the GHG emissions from fossil fuels that are offset by the energetic use of the pyrolysis by-products. For this reason, the electrical efficiency for natural gas deviates from the corresponding efficiencies calculated in Table S.8 (row F, columns 11-15), which were based on gas-and-steam power plants.

b) Teichmann (2014a: Table 19, column 5).

c) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) by the prices for lignite (Table S.9, row A, columns 8-12) and correcting for the different electrical efficiencies of the pyrolysis by-products (32%, see note a) and fossil fuels (see row A), e.g., (2) = Table S.9 (row A, column 8) · (1) · 32/43 · 1,000.

d) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) by the prices for hard coal (Table S.9, row C, columns 8-12) and correcting for the different electrical efficiencies of the pyrolysis by-products (32%, see note a) and fossil fuels (see row A), e.g., (7) = Table S.9 (row C, column 8) · (1) · 32/43 · 1,000.

e) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) by the prices for natural gas (Table S.9, row I, columns 8-12) and correcting for the different electrical efficiencies of the pyrolysis by-products (32%, see note a) and fossil fuels (see row A), e.g., (12) = Table S.9 (row I, column 8) · (1) · 32/40 · 1,000.

Notes: Values rounded. DM = dry mass. db = dry base. kg = kilogram. t = tonne. MJ = megajoule.

Table S.23: Fossil-Fuel Costs Avoided by the Energetic Use of the Pyrolysis By-Products, Germany, 2015-2050 – Price Path B

			Lignite					Hard coal					Natural gas				
Electrical efficiency[a]	%	(A)	43					43					40				
	E_{out}[b]		Fossil-fuel costs[c]					Fossil-fuel costs[d]					Fossil-fuel costs[e]				
			2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	MJ/kg_{db}		$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Cereal straw	7.6		14.3	14.3	15.4	15.4	17.6	38.6	41.9	51.8	61.7	68.4	83.0	96.0	119.7	138.7	152.9
Forestry residues	8.6		16.2	16.2	17.5	17.5	20.0	43.7	47.4	58.7	69.9	77.4	94.0	108.7	135.6	157.0	173.2
Open-country biomass residues	7.6		14.3	14.3	15.4	15.4	17.6	38.4	41.7	51.6	61.5	68.1	82.6	95.6	119.2	138.1	152.3
Industrial wood waste	8.4		15.9	15.9	17.1	17.1	19.5	42.7	46.4	57.3	68.3	75.6	91.8	106.2	132.5	153.4	169.2
Wood in municipal solid waste	8.6		16.2	16.2	17.5	17.5	20.0	43.7	47.4	58.7	69.9	77.4	94.0	108.7	135.6	157.0	173.2
Green waste: Compensation areas	6.9		13.1	13.1	14.1	14.1	16.1	35.2	38.2	47.3	56.3	62.3	75.7	87.5	109.2	126.5	139.4
Biomass: Habitat-connectivity areas	7.6		14.3	14.3	15.4	15.4	17.6	38.4	41.7	51.6	61.5	68.1	82.6	95.6	119.2	138.1	152.3
Green waste: Extensive grassland	7.6		14.3	14.3	15.4	15.4	17.6	38.4	41.7	51.6	61.5	68.1	82.6	95.6	119.2	138.1	152.3
Short-rotation coppice: Erosion areas	9.5		17.9	17.9	19.3	19.3	22.0	48.1	52.3	64.6	77.0	85.3	103.5	119.7	149.3	173.0	190.7
Solid cattle manure	6.8		12.8	12.8	13.8	13.8	15.7	34.4	37.3	46.2	55.0	60.9	73.9	85.5	106.6	123.5	136.2
Solid swine manure	8.7		16.4	16.4	17.6	17.6	20.1	44.1	47.8	59.2	70.5	78.0	94.7	109.6	136.7	158.3	174.5
Solid poultry manure	6.2		11.7	11.7	12.5	12.5	14.3	31.4	34.1	42.1	50.2	55.6	67.4	78.0	97.3	112.7	124.3
Commercial and industrial waste	8.2		15.4	15.4	16.6	16.6	19.0	41.6	45.2	55.8	66.5	73.7	89.4	103.5	129.0	149.5	164.8
Organic municipal solid waste	5.7		10.7	10.7	11.5	11.5	13.2	28.8	31.3	38.7	46.1	51.1	62.0	71.7	89.5	103.6	114.3

Sources:

a) The efficiencies refer to the conversion of the pyrolysis by-products/fossil fuels to electricity only, i.e. not considering combined heat and power (CHP) due to the lack of consistent data for CHP efficiencies. For the pyrolysis by-products, we apply electrical efficiencies of 32% as done by Woolf et al. (2010b). The electrical efficiencies for the fossil fuels are taken from Traber and Kemfert (2011: Table 1), whereby the value for lignite refers to *"new brown coal" (BC New)*, i.e. to lignite-fired power plants with optimized plant engineering (Schröder et al. 2013), the value for hard coal to *"new hard coal" (HC New)*, i.e. to supercritical pulverized-coal-fired power plants (Schröder et al. 2013), and the one for natural gas *(NG ST)* to steam turbines. Note that the assumptions are the same as those applied by Teichmann (2014a: Table 20) for the calculation of the GHG emissions from fossil fuels that are offset by the energetic use of the pyrolysis by-products. For this reason, the electrical efficiency for natural gas deviates from the corresponding efficiencies calculated in Table S.8 (row F, columns 11-15), which were based on gas-and-steam power plants.

b) Teichmann (2014a: Table 19, column 5).

c) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) by the prices for lignite* (Table S.9, row A, columns 8-12) and correcting for the different electrical efficiencies of the pyrolysis by-products (32%, see note a) and fossil fuels (see row A), e.g., (2) = Table S.9 (row A, column 8) · (1) · 32/43 · 1,000.

d) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) by the prices for hard coal (Table S.9, row E, columns 8-12) and correcting for the different electrical efficiencies of the pyrolysis by-products (32%, see note a) and fossil fuels (see row A), e.g., (7) = Table S.9 (row E, column 8) · (1) · 32/43 · 1,000.

e) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) by the prices for natural gas (Table S.9, row K, columns 8-12) and correcting for the different electrical efficiencies of the pyrolysis by-products (32%, see note a) and fossil fuels (see row A), e.g., (12) = Table S.9 (row K, column 8) · (1) · 32/40 · 1,000.

Notes: Values rounded. DM = dry mass. db = dry base. kg = kilogram. t = tonne. MJ = megajoule.

* = Note that the fuel prices for lignite do not vary across the price paths, but refer to price path A throughout.

Table S.24: Fossil-Fuel Costs Avoided by the Energetic Use of the Pyrolysis By-Products, Germany, 2015-2050 – Price Path C

		Lignite					Hard coal					Natural gas				
Electrical efficiency[a]	% (A)	43					43					40				
	E_{out}[b]	**Fossil-fuel costs**[c]					**Fossil-fuel costs**[d]					**Fossil-fuel costs**[e]				
		2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	MJ/kg_{db}	$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Cereal straw	7.6	14.3	14.3	15.4	15.4	17.6	34.2	37.5	41.9	47.4	51.8	77.0	83.0	99.6	109.1	118.5
Forestry residues	8.6	16.2	16.2	17.5	17.5	20.0	38.7	42.5	47.4	53.7	58.7	87.2	94.0	112.8	123.5	134.2
Open-country biomass residues	7.6	14.3	14.3	15.4	15.4	17.6	34.0	37.3	41.7	47.2	51.6	76.7	82.6	99.2	108.6	118.0
Industrial wood waste	8.4	15.9	15.9	17.1	17.1	19.5	37.8	41.5	46.4	52.5	57.3	85.2	91.8	110.2	120.7	131.1
Wood in municipal solid waste	8.6	16.2	16.2	17.5	17.5	20.0	38.7	42.5	47.4	53.7	58.7	87.2	94.0	112.8	123.5	134.2
Green waste: Compensation areas	6.9	13.1	13.1	14.1	14.1	16.1	31.2	34.2	38.2	43.2	47.3	70.3	75.7	90.8	99.4	108.1
Biomass: Habitat-connectivity areas	7.6	14.3	14.3	15.4	15.4	17.6	34.0	37.3	41.7	47.2	51.6	76.7	82.6	99.2	108.6	118.0
Green waste: Extensive grassland	7.6	14.3	14.3	15.4	15.4	17.6	34.0	37.3	41.7	47.2	51.6	76.7	82.6	99.2	108.6	118.0
Short-rotation coppice: Erosion areas	9.5	17.9	17.9	19.3	19.3	22.0	42.6	46.8	52.3	59.1	64.6	96.1	103.5	124.2	136.0	147.8
Solid cattle manure	6.8	12.8	12.8	13.8	13.8	15.7	30.4	33.4	37.3	42.2	46.2	68.6	73.9	88.7	97.1	105.6
Solid swine manure	8.7	16.4	16.4	17.6	17.6	20.1	39.0	42.8	47.8	54.1	59.2	87.9	94.7	113.7	124.5	135.3
Solid poultry manure	6.2	11.7	11.7	12.5	12.5	14.3	27.8	30.5	34.1	38.5	42.1	62.6	67.4	80.9	88.6	96.4
Commercial and industrial waste	8.2	15.4	15.4	16.6	16.6	19.0	36.8	40.4	45.2	51.1	55.8	83.0	89.4	107.3	117.5	127.7
Organic municipal solid waste	5.7	10.7	10.7	11.5	11.5	13.2	25.5	28.0	31.3	35.4	38.7	57.6	62.0	74.4	81.5	88.6

Sources:

a) The efficiencies refer to the conversion of the pyrolysis by-products/fossil fuels to electricity only, i.e. not considering combined heat and power (CHP) due to the lack of consistent data for CHP efficiencies. For the pyrolysis by-products, we apply electrical efficiencies of 32% as done by Woolf et al. (2010b). The electrical efficiencies for the fossil fuels are taken from Traber and Kemfert (2011: Table 1), whereby the value for lignite refers to *"new brown coal" (BC New)*, i.e. to lignite-fired power plants with optimized plant engineering (Schröder et al. 2013), the value for hard coal to *"new hard coal" (HC New)*, i.e. to supercritical pulverized-coal-fired power plants (Schröder et al. 2013), and the one for natural gas *(NG ST)* to steam turbines. Note that the assumptions are the same as those applied by Teichmann (2014a: Table 20) for the calculation of the GHG emissions from fossil fuels that are offset by the energetic use of the pyrolysis by-products. For this reason, the electrical efficiency for natural gas deviates from the corresponding efficiencies calculated in Table S.8 (row F, columns 11-15), which were based on gas-and-steam power plants.

b) Teichmann (2014a: Table 19, column 5).

c) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) by the prices for lignite* (Table S.9, row A, columns 8-12) and correcting for the different electrical efficiencies of the pyrolysis by-products (32%, see note a) and fossil fuels (see row A), e.g., (2) = Table S.9 (row A, column 8) · (1) · 32/43 · 1,000.

d) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) by the prices for hard coal (Table S.9, row G, columns 8-12) and correcting for the different electrical efficiencies of the pyrolysis by-products (32%, see note a) and fossil fuels (see row A), e.g., (7) = Table S.9 (row G, column 8) · (1) · 32/43 · 1,000.

e) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) by the prices for natural gas (Table S.9, row M, columns 8-12) and correcting for the different electrical efficiencies of the pyrolysis by-products (32%, see note a) and fossil fuels (see row A), e.g., (12) = Table S.9 (row M, column 8) · (1) · 32/40 · 1,000.

Notes: Values rounded. DM = dry mass. db = dry base. kg = kilogram. t = tonne. MJ = megajoule.

* = Note that the fuel prices for lignite do not vary across the price paths, but refer to price path A throughout.

Table S.25: GHG Emission Costs Avoided by the Energetic Use of the Pyrolysis By-Products, Germany, 2015-2050 – Price Path A

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	3.3	17.8	29.6	39.5	49.4	2.8	14.9	24.8	33.0	41.3	1.7	9.2	15.4	20.5	25.6
Forestry residues	3.7	20.1	33.5	44.7	55.9	3.1	16.8	28.0	37.4	46.7	1.9	10.4	17.4	23.2	29.0
Open-country biomass residues	3.3	17.7	29.5	39.3	49.2	2.7	14.8	24.7	32.9	41.1	1.7	9.2	15.3	20.4	25.5
Industrial wood waste	3.6	19.7	32.8	43.7	54.6	3.0	16.4	27.4	36.5	45.7	1.9	10.2	17.0	22.7	28.3
Wood in municipal solid waste	3.7	20.1	33.5	44.7	55.9	3.1	16.8	28.0	37.4	46.7	1.9	10.4	17.4	23.2	29.0
Green waste: Compensation areas	3.0	16.2	27.0	36.0	45.0	2.5	13.5	22.6	30.1	37.6	1.6	8.4	14.0	18.7	23.4
Biomass: Habitat-connectivity areas	3.3	17.7	29.5	39.3	49.2	2.7	14.8	24.7	32.9	41.1	1.7	9.2	15.3	20.4	25.5
Green waste: Extensive grassland	3.3	17.7	29.5	39.3	49.2	2.7	14.8	24.7	32.9	41.1	1.7	9.2	15.3	20.4	25.5
Short-rotation coppice: Erosion areas	4.1	22.2	36.9	49.3	61.6	3.4	18.5	30.9	41.2	51.5	2.1	11.5	19.2	25.6	32.0
Solid cattle manure	2.9	15.8	26.4	35.2	44.0	2.5	13.2	22.1	29.4	36.8	1.5	8.2	13.7	18.3	22.8
Solid swine manure	3.8	20.3	33.8	45.1	56.3	3.1	17.0	28.3	37.7	47.1	1.9	10.5	17.5	23.4	29.2
Solid poultry manure	2.7	14.4	24.1	32.1	40.1	2.2	12.1	20.1	26.8	33.5	1.4	7.5	12.5	16.7	20.8
Commercial and industrial waste	3.5	19.2	31.9	42.6	53.2	3.0	16.0	26.7	35.6	44.5	1.8	9.9	16.6	22.1	27.6
Organic municipal solid waste	2.5	13.3	22.1	29.5	36.9	2.1	11.1	18.5	24.7	30.8	1.3	6.9	11.5	15.3	19.1

Sources:

a) Own calculation, multiplying the GHG emissions from the fossil-fuel use in electricity generation that are avoided by the energetic use of the pyrolysis by-products from Table S.21, column 1 by the CO_2 prices for price path A (Table S.10, row A, columns 7-11), e.g., (1) = Table S.21 (column 1) · Table S.10 (row A, column 7).

b) Own calculation, multiplying the GHG emissions from the fossil-fuel use in electricity generation that are avoided by the energetic use of the pyrolysis by-products from Table S.21, column 2 by the CO_2 prices for price path A (Table S.10, row A, columns 7-11), e.g., (6) = Table S.21 (column 2) · Table S.10 (row A, column 7).

c) Own calculation, multiplying the GHG emissions from the fossil-fuel use in electricity generation that are avoided by the energetic use of the pyrolysis by-products from Table S.21, column 3 by the CO_2 prices for price path A (Table S.10, row A, columns 7-11), e.g., (11) = Table S.21 (column 3) · Table S.10 (row A, column 7).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.26: GHG Emission Costs Avoided by the Energetic Use of the Pyrolysis By-Products, Germany, 2015-2050 – Price Path B

	Lignite[a]					**Hard coal**[b]					**Natural gas**[c]				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	3.3	15.1	22.4	29.6	37.5	2.8	12.7	18.7	24.8	31.4	1.7	7.9	11.6	15.4	19.5
Forestry residues	3.7	17.1	25.3	33.5	42.5	3.1	14.3	21.2	28.0	35.5	1.9	8.9	13.2	17.4	22.1
Open-country biomass residues	3.3	15.1	22.3	29.5	37.4	2.7	12.6	18.6	24.7	31.2	1.7	7.8	11.6	15.3	19.4
Industrial wood waste	3.6	16.7	24.8	32.8	41.5	3.0	14.0	20.7	27.4	34.7	1.9	8.7	12.9	17.0	21.5
Wood in municipal solid waste	3.7	17.1	25.3	33.5	42.5	3.1	14.3	21.2	28.0	35.5	1.9	8.9	13.2	17.4	22.1
Green waste: Compensation areas	3.0	13.8	20.4	27.0	34.2	2.5	11.5	17.1	22.6	28.6	1.6	7.2	10.6	14.0	17.8
Biomass: Habitat-connectivity areas	3.3	15.1	22.3	29.5	37.4	2.7	12.6	18.6	24.7	31.2	1.7	7.8	11.6	15.3	19.4
Green waste: Extensive grassland	3.3	15.1	22.3	29.5	37.4	2.7	12.6	18.6	24.7	31.2	1.7	7.8	11.6	15.3	19.4
Short-rotation coppice: Erosion areas	4.1	18.9	27.9	36.9	46.8	3.4	15.8	23.3	30.9	39.1	2.1	9.8	14.5	19.2	24.3
Solid cattle manure	2.9	13.5	19.9	26.4	33.4	2.5	11.3	16.7	22.1	27.9	1.5	7.0	10.3	13.7	17.3
Solid swine manure	3.8	17.3	25.5	33.8	42.8	3.1	14.4	21.4	28.3	35.8	1.9	9.0	13.3	17.5	22.2
Solid poultry manure	2.7	12.3	18.2	24.1	30.5	2.2	10.3	15.2	20.1	25.5	1.4	6.4	9.4	12.5	15.8
Commercial and industrial waste	3.5	16.3	24.1	31.9	40.4	3.0	13.6	20.2	26.7	33.8	1.8	8.5	12.5	16.6	21.0
Organic municipal solid waste	2.5	11.3	16.7	22.1	28.0	2.1	9.5	14.0	18.5	23.4	1.3	5.9	8.7	11.5	14.6

Sources:

a) Own calculation, multiplying the GHG emissions from the fossil-fuel use in electricity generation that are avoided by the energetic use of the pyrolysis by-products from Table S.21, column 1 by the CO_2 prices for price path B (Table S.10, row B, columns 7-11), e.g., (1) = Table S.21 (column 1) · Table S.10 (row B, column 7).

b) Own calculation, multiplying the GHG emissions from the fossil-fuel use in electricity generation that are avoided by the energetic use of the pyrolysis by-products from Table S.21, column 2 by the CO_2 prices for price path B (Table S.10, row B, columns 7-11), e.g., (6) = Table S.21 (column 2) · Table S.10 (row B, column 7).

c) Own calculation, multiplying the GHG emissions from the fossil-fuel use in electricity generation that are avoided by the energetic use of the pyrolysis by-products from Table S.21, column 3 by the CO_2 prices for price path B (Table S.10, row B, columns 7-11), e.g., (11) = Table S.21 (column 3) · Table S.10 (row B, column 7).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.27: GHG Emission Costs Avoided by the Energetic Use of the Pyrolysis By-Products, Germany, 2015-2050 – Price Path C

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	3.3	13.2	17.1	23.7	29.6	2.8	11.0	14.3	19.8	24.8	1.7	6.8	8.9	12.3	15.4
Forestry residues	3.7	14.9	19.4	26.8	33.5	3.1	12.5	16.2	22.4	28.0	1.9	7.7	10.1	13.9	17.4
Open-country biomass residues	3.3	13.1	17.0	23.6	29.5	2.7	11.0	14.2	19.7	24.7	1.7	6.8	8.8	12.2	15.3
Industrial wood waste	3.6	14.6	18.9	26.2	32.8	3.0	12.2	15.8	21.9	27.4	1.9	7.6	9.8	13.6	17.0
Wood in municipal solid waste	3.7	14.9	19.4	26.8	33.5	3.1	12.5	16.2	22.4	28.0	1.9	7.7	10.1	13.9	17.4
Green waste: Compensation areas	3.0	12.0	15.6	21.6	27.0	2.5	10.0	13.0	18.1	22.6	1.6	6.2	8.1	11.2	14.0
Biomass: Habitat-connectivity areas	3.3	13.1	17.0	23.6	29.5	2.7	11.0	14.2	19.7	24.7	1.7	6.8	8.8	12.2	15.3
Green waste: Extensive grassland	3.3	13.1	17.0	23.6	29.5	2.7	11.0	14.2	19.7	24.7	1.7	6.8	8.8	12.2	15.3
Short-rotation coppice: Erosion areas	4.1	16.4	21.3	29.6	36.9	3.4	13.7	17.8	24.7	30.9	2.1	8.5	11.1	15.3	19.2
Solid cattle manure	2.9	11.7	15.2	21.1	26.4	2.5	9.8	12.7	17.6	22.1	1.5	6.1	7.9	11.0	13.7
Solid swine manure	3.8	15.0	19.5	27.0	33.8	3.1	12.6	16.3	22.6	28.3	1.9	7.8	10.1	14.0	17.5
Solid poultry manure	2.7	10.7	13.9	19.3	24.1	2.2	8.9	11.6	16.1	20.1	1.4	5.6	7.2	10.0	12.5
Commercial and industrial waste	3.5	14.2	18.4	25.5	31.9	3.0	11.9	15.4	21.3	26.7	1.8	7.4	9.6	13.3	16.6
Organic municipal solid waste	2.5	9.8	12.8	17.7	22.1	2.1	8.2	10.7	14.8	18.5	1.3	5.1	6.6	9.2	11.5

Sources:

a) Own calculation, multiplying the GHG emissions from the fossil-fuel use in electricity generation that are avoided by the energetic use of the pyrolysis by-products from Table S.21, column 1 by the CO_2 prices for price path C (Table S.10, row C, columns 7-11), e.g., (1) = Table S.21 (column 1) · Table S.10 (row C, column 7).

b) Own calculation, multiplying the GHG emissions from the fossil-fuel use in electricity generation that are avoided by the energetic use of the pyrolysis by-products from Table S.21, column 2 by the CO_2 prices for price path C (Table S.10, row C, columns 7-11), e.g., (6) = Table S.21 (column 2) · Table S.10 (row C, column 7).

c) Own calculation, multiplying the GHG emissions from the fossil-fuel use in electricity generation that are avoided by the energetic use of the pyrolysis by-products from Table S.21, column 3 by the CO_2 prices for price path C (Table S.10, row C, columns 7-11), e.g., (11) = Table S.21 (column 3) · Table S.10 (row C, column 7).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.28: Capital & Operational Costs of Fossil-Fuel Power Plants Avoided by the Use of Pyrolysis By-Products, Germany, 2015-2050

		Lignite					Hard coal					Natural gas				
Electrical efficiency[a]	% (A)	43					43					40				
	E_{out}[b]	**Capital and operational costs**[c]					**Capital and operational costs**[d]					**Capital and operational costs**[e]				
		2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	MJ/kg_{db}	€$_{2012}$/t_{DM} feedstock					€$_{2012}$/t_{DM} feedstock					€$_{2012}$/t_{DM} feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Cereal straw	7.6	19.8	19.8	19.1	19.1	19.1	17.6	16.9	16.9	16.9	16.9	11.7	11.7	11.7	11.7	11.7
Forestry residues	8.6	22.4	22.4	21.6	21.6	21.6	19.9	19.1	19.1	19.1	19.1	13.3	13.3	13.3	13.3	13.3
Open-country biomass residues	7.6	19.7	19.7	19.0	19.0	19.0	17.5	16.8	16.8	16.8	16.8	11.7	11.7	11.7	11.7	11.7
Industrial wood waste	8.4	21.9	21.9	21.1	21.1	21.1	19.5	18.7	18.7	18.7	18.7	13.0	13.0	13.0	13.0	13.0
Wood in municipal solid waste	8.6	22.4	22.4	21.6	21.6	21.6	19.9	19.1	19.1	19.1	19.1	13.3	13.3	13.3	13.3	13.3
Green waste: Compensation areas	6.9	18.1	18.1	17.4	17.4	17.4	16.1	15.4	15.4	15.4	15.4	10.7	10.7	10.7	10.7	10.7
Biomass: Habitat-connectivity areas	7.6	19.7	19.7	19.0	19.0	19.0	17.5	16.8	16.8	16.8	16.8	11.7	11.7	11.7	11.7	11.7
Green waste: Extensive grassland	7.6	19.7	19.7	19.0	19.0	19.0	17.5	16.8	16.8	16.8	16.8	11.7	11.7	11.7	11.7	11.7
Short-rotation coppice: Erosion areas	9.5	24.7	24.7	23.8	23.8	23.8	22.0	21.1	21.1	21.1	21.1	14.6	14.6	14.6	14.6	14.6
Solid cattle manure	6.8	17.7	17.7	17.0	17.0	17.0	15.7	15.0	15.0	15.0	15.0	10.5	10.5	10.5	10.5	10.5
Solid swine manure	8.7	22.6	22.6	21.8	21.8	21.8	20.1	19.3	19.3	19.3	19.3	13.4	13.4	13.4	13.4	13.4
Solid poultry manure	6.2	16.1	16.1	15.5	15.5	15.5	14.3	13.7	13.7	13.7	13.7	9.5	9.5	9.5	9.5	9.5
Commercial and industrial waste	8.2	21.4	21.4	20.6	20.6	20.6	19.0	18.2	18.2	18.2	18.2	12.7	12.7	12.7	12.7	12.7
Organic municipal solid waste	5.7	14.8	14.8	14.3	14.3	14.3	13.2	12.6	12.6	12.6	12.6	8.8	8.8	8.8	8.8	8.8

Sources:

a) The efficiencies refer to the conversion of the pyrolysis by-products/fossil fuels to electricity only, i.e. not considering combined heat and power (CHP) due to the lack of consistent data for CHP efficiencies. For the pyrolysis by-products, we apply electrical efficiencies of 32% as done by Woolf et al. (2010b). The electrical efficiencies for the fossil fuels are taken from Traber and Kemfert (2011: Table 1), whereby the value for lignite refers to *"new brown coal" (BC New)*, i.e. to lignite-fired power plants with optimized plant engineering (Schröder et al. 2013), the value for hard coal to *"new hard coal" (HC New)*, i.e. to supercritical pulverized-coal-fired power plants (Schröder et al. 2013), and the one for natural gas *(NG ST)* to steam turbines. Note that the assumptions are the same as those applied by Teichmann (2014a: Table 20) for the calculation of the GHG emissions from fossil fuels that are offset by the energetic use of the pyrolysis by-products. For this reason, the electrical efficiency for natural gas deviates from the corresponding efficiencies calculated in Table S.8 (row F, columns 11-15), which were based on gas-and-steam power plants.

b) Teichmann (2014a: Table 19, column 5).

c) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) – adjusted for the electrical efficiency of the pyrolysis by-products (32%, see note a) to arrive at the amount of electrical power generated per dry tonne of feedstock (MJ_{el}/kg_{db}) – by the total capital and operational costs of new fossil-fuel power plants (Table S.8, row L, columns 1-5), e.g., (2) = Table S.8 (row L, column 1) · (1) · 32/100 · 1,000.

d) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) – adjusted for the electrical efficiency of the pyrolysis by-products (32%, see note a) to arrive at the amount of electrical power generated per dry tonne of feedstock (MJ_{el}/kg_{db}) – by the total capital and operational costs of new fossil-fuel power plants (Table S.8, row L, columns 6-10), e.g., (7) = Table S.8 (row L, column 6) · (1) · 32/100 · 1,000.

e) Own calculation, multiplying the energy in the pyrolysis by-products (E_{out}) – adjusted for the electrical efficiency of the pyrolysis by-products (32%, see note a) to arrive at the amount of electrical power generated per dry tonne of feedstock (MJ_{el}/kg_{db}) – by the total capital and operational costs of new fossil-fuel power plants (Table S.8, row L, columns 11-15), e.g., (12) = Table S.8 (row L, column 11) · (1) · 32/100 · 1,000.

Notes: Values rounded. DM = dry mass. db = dry base. kg = kilogram. t = tonne. MJ = megajoule. el = electrical power.

Table S.29: Costs Related to Pyrolysis-By-Products Combustion, Germany, 2015-2050

			2015	2020	2030	2040	2050
			(1)	(2)	(3)	(4)	(5)
Annual specific capital costs[a]	€$_{2009}$/kW$_{el}$	(A)	1,325	1,300	1,300	1,300	1,300
Annual operational costs[a]	€$_{2009}$/kW$_{el}$	(B)	86	85	85	85	85
Total	€$_{2009}$/kW$_{el}$[b]	(C)	1,411	1,385	1,385	1,385	1,385
	€$_{2009}$/kWh$_{el}$[c]	(D)	0.1881	0.1847	0.1847	0.1847	0.1847
	€$_{2009}$/GJ$_{el}$[d]	(E)	52.3	51.3	51.3	51.3	51.3
	€$_{2012}$/MJ$_{el}$[e]	(F)	0.0568	0.0557	0.0557	0.0557	0.0557
	$\boldsymbol{E_{out}}$[f]		**Costs related to the combustion of the pyrolysis by-products**				
Feedstocks	MJ/kg$_{db}$		€$_{2012}$/t$_{DM}$ feedstock[g]				
Cereal straw	7.6	(G)	**138.1**	**135.5**	**135.5**	**135.5**	**135.5**
Forestry residues	8.6	(H)	**156.4**	**153.5**	**153.5**	**153.5**	**153.5**
Open-country biomass residues	7.6	(I)	**137.5**	**135.0**	**135.0**	**135.0**	**135.0**
Industrial wood waste	8.4	(J)	**152.8**	**150.0**	**150.0**	**150.0**	**150.0**
Wood in municipal solid waste	8.6	(K)	**156.4**	**153.5**	**153.5**	**153.5**	**153.5**
Green waste: Compensation areas	6.9	(L)	**125.9**	**123.6**	**123.6**	**123.6**	**123.6**
Biomass: Habitat-connectivity areas	7.6	(M)	**137.5**	**135.0**	**135.0**	**135.0**	**135.0**
Green waste: Extensive grassland	7.6	(N)	**137.5**	**135.0**	**135.0**	**135.0**	**135.0**
Short-rotation coppice: Erosion areas	9.5	(O)	**172.2**	**169.0**	**169.0**	**169.0**	**169.0**
Solid cattle manure	6.8	(P)	**123.0**	**120.7**	**120.7**	**120.7**	**120.7**
Solid swine manure	8.7	(Q)	**157.6**	**154.7**	**154.7**	**154.7**	**154.7**
Solid poultry manure	6.2	(R)	**112.3**	**110.2**	**110.2**	**110.2**	**110.2**
Commercial and industrial waste	8.2	(S)	**148.8**	**146.1**	**146.1**	**146.1**	**146.1**
Organic municipal solid waste	5.7	(T)	**103.2**	**101.3**	**101.3**	**101.3**	**101.3**

Sources:

a) Nitsch et al. (2012b: Table 1-9), based on newly installed block-type thermal power stations using gas from purification plants at an interest rate of 6% per annum and a life time of 20 years.
b) Own calculation, (C) = (A) + (B).
c) Own calculation, based on 7,500 full-load hours per year in each period as assumed in Nitsch et al. (2012b: Table 1-9), i.e. (D) = (C)/7,500.
d) Own calculation, (E) = (D)/0.0036.
e) Own calculation, based on the 2009 and 2012 producer price indices of 98.5 and 107.0, respectively (Deutsche Bundesbank 2015), i.e. (F) = (E)/1,000 · 107.0/98.5.
f) Teichmann (2014a: Table 19, column 5).
g) Own calculation, based on the energy in the pyrolysis by-products (E_{out}) and an electrical efficiency* of 32% as obtained from Woolf et al. (2010b) and used by Teichmann (2014a: Table 20), i.e. calculated as (F) · E_{out} · 0.32 · 1,000.

Notes: Values rounded. DM = dry mass. db = dry base. kg = kilogram. t = tonne. kW = kilowatt. kWh = kilowatt hour. GJ = gigajoule. MJ = megajoule. el = electrical power.

* = The efficiency refers to the conversion of the pyrolysis by-products to electricity only, i.e. not considering combined heat and power (CHP).

Table S.30: Net Benefits Associated with the Energetic Use of the Pyrolysis By-Products, Germany, 2015-2050 – Price Path A

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	-100.6	-83.6	-71.4	-61.5	-49.5	-76.9	-56.4	-32.2	-8.5	17.4	-33.4	-6.7	33.8	73.3	114.0
Forestry residues	-114.0	-94.7	-80.9	-69.7	-56.0	-87.1	-63.9	-36.4	-9.6	19.7	-37.8	-7.6	38.3	83.0	129.1
Open-country biomass residues	-100.2	-83.3	-71.1	-61.3	-49.2	-76.6	-56.2	-32.0	-8.4	17.4	-33.2	-6.7	33.7	73.0	113.5
Industrial wood waste	-111.4	-92.5	-79.0	-68.1	-54.7	-85.1	-62.4	-35.6	-9.4	19.3	-36.9	-7.4	37.4	81.1	126.1
Wood in municipal solid waste	-114.0	-94.7	-80.9	-69.7	-56.0	-87.1	-63.9	-36.4	-9.6	19.7	-37.8	-7.6	38.3	83.0	129.1
Green waste: Compensation areas	-91.8	-76.2	-65.1	-56.1	-45.1	-70.1	-51.4	-29.3	-7.7	15.9	-30.4	-6.1	30.8	66.8	103.9
Biomass: Habitat-connectivity areas	-100.2	-83.3	-71.1	-61.3	-49.2	-76.6	-56.2	-32.0	-8.4	17.4	-33.2	-6.7	33.7	73.0	113.5
Green waste: Extensive grassland	-100.2	-83.3	-71.1	-61.3	-49.2	-76.6	-56.2	-32.0	-8.4	17.4	-33.2	-6.7	33.7	73.0	113.5
Short-rotation coppice: Erosion areas	-125.5	-104.3	-89.1	-76.7	-61.7	-95.9	-70.3	-40.1	-10.6	21.7	-41.6	-8.4	42.2	91.4	142.2
Solid cattle manure	-89.7	-74.5	-63.6	-54.8	-44.1	-68.5	-50.2	-28.6	-7.5	15.5	-29.7	-6.0	30.1	65.3	101.5
Solid swine manure	-114.9	-95.5	-81.5	-70.2	-56.5	-87.8	-64.4	-36.7	-9.7	19.9	-38.1	-7.7	38.6	83.7	130.1
Solid poultry manure	-81.8	-68.0	-58.0	-50.0	-40.2	-62.5	-45.8	-26.1	-6.9	14.2	-27.1	-5.5	27.5	59.6	92.7
Commercial and industrial waste	-108.5	-90.1	-77.0	-66.3	-53.3	-82.9	-60.8	-34.7	-9.1	18.8	-36.0	-7.2	36.4	79.0	122.9
Organic municipal solid waste	-75.2	-62.5	-53.4	-46.0	-37.0	-57.5	-42.1	-24.0	-6.3	13.0	-24.9	-5.0	25.3	54.8	85.2

Sources:
a) Own calculation, Table S.30 (columns 1-5) = Table S.22 (columns 2-6) + Table S.25 (columns 1-5) + Table S.28 (columns 2-6) – Table S.29 (columns 1-5).
b) Own calculation, Table S.30 (columns 6-10) = Table S.22 (columns 7-11) + Table S.25 (columns 6-10) + Table S.28 (columns 7-11) – Table S.29 (columns 1-5).
c) Own calculation, Table S.30 (columns 11-15) = Table S.22 (columns 12-16) + Table S.25 (columns 11-15) + Table S.28 (columns 12-16) – Table S.29 (columns 1-5).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.31: Net Benefits Associated with the Energetic Use of the Pyrolysis By-Products, Germany, 2015-2050 – Price Path C

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	-100.6	-88.2	-83.9	-77.3	-69.2	-83.5	-70.2	-62.5	-51.4	-42.1	-47.6	-34.0	-15.4	-2.5	10.1
Forestry residues	-114.0	-99.9	-95.0	-87.6	-78.4	-94.6	-79.5	-70.7	-58.3	-47.7	-53.9	-38.5	-17.4	-2.8	11.4
Open-country biomass residues	-100.2	-87.9	-83.6	-77.0	-68.9	-83.2	-69.9	-62.2	-51.2	-41.9	-47.4	-33.9	-15.3	-2.4	10.1
Industrial wood waste	-111.4	-97.6	-92.8	-85.6	-76.6	-92.4	-77.6	-69.1	-56.9	-46.6	-52.7	-37.6	-17.0	-2.7	11.2
Wood in municipal solid waste	-114.0	-99.9	-95.0	-87.6	-78.4	-94.6	-79.5	-70.7	-58.3	-47.7	-53.9	-38.5	-17.4	-2.8	11.4
Green waste: Compensation areas	-91.8	-80.4	-76.5	-70.5	-63.1	-76.2	-64.0	-56.9	-46.9	-38.4	-43.4	-31.0	-14.0	-2.2	9.2
Biomass: Habitat-connectivity areas	-100.2	-87.9	-83.6	-77.0	-68.9	-83.2	-69.9	-62.2	-51.2	-41.9	-47.4	-33.9	-15.3	-2.4	10.1
Green waste: Extensive grassland	-100.2	-87.9	-83.6	-77.0	-68.9	-83.2	-69.9	-62.2	-51.2	-41.9	-47.4	-33.9	-15.3	-2.4	10.1
Short-rotation coppice: Erosion areas	-125.5	-110.0	-104.6	-96.4	-86.3	-104.2	-87.5	-77.9	-64.2	-52.5	-59.4	-42.4	-19.1	-3.1	12.6
Solid cattle manure	-89.7	-78.6	-74.7	-68.9	-61.6	-74.4	-62.5	-55.6	-45.8	-37.5	-42.4	-30.3	-13.7	-2.2	9.0
Solid swine manure	-114.9	-100.7	-95.8	-88.3	-79.0	-95.4	-80.1	-71.3	-58.7	-48.0	-54.3	-38.8	-17.5	-2.8	11.5
Solid poultry manure	-81.8	-71.7	-68.2	-62.9	-56.3	-67.9	-57.0	-50.8	-41.8	-34.2	-38.7	-27.6	-12.5	-2.0	8.2
Commercial and industrial waste	-108.5	-95.1	-90.4	-83.3	-74.6	-90.0	-75.6	-67.3	-55.4	-45.3	-51.3	-36.6	-16.5	-2.6	10.9
Organic municipal solid waste	-75.2	-65.9	-62.7	-57.8	-51.7	-62.4	-52.4	-46.7	-38.4	-31.4	-35.6	-25.4	-11.5	-1.8	7.6

Sources:
a) Own calculation, Table S.31 (columns 1-5) = Table S.24 (columns 2-6) + Table S.27 (columns 1-5) + Table S.28 (columns 2-6) – Table S.29 (columns 1-5).
b) Own calculation, Table S.31 (columns 6-10) = Table S.24 (columns 7-11) + Table S.27 (columns 6-10) + Table S.28 (columns 7-11) – Table S.29 (columns 1-5).
c) Own calculation, Table S.31 (columns 11-15) = Table S.24 (columns 12-16) + Table S.27 (columns 11-15) + Table S.28 (columns 12-16) – Table S.29 (columns 1-5).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.32: Mean Transport Distances, Germany, 2015-2050

Biomass scenarios		Small-scale pyrolysis units (à 2,000 t_{DM} feedstock/a)					Medium-scale pyrolysis units (à 16,000 t_{DM} feedstock/a)					Large-scale pyrolysis units (à 184,800 t_{DM} feedstock/a)				
		2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
		km					km					km				
Scenario *Max 1*	(A)	5.9	4.4	3.1	3.1	3.0	16.8	12.4	8.7	8.6	8.6	57.0	42.0	29.7	29.3	29.1
Scenario *Min 1*	(B)	5.9	5.6	5.0	5.0	5.0	16.8	16.0	14.3	14.1	14.0	57.0	54.3	48.4	47.9	47.6
Scenario *Max 2*	(C)	6.4	4.9	3.4	3.4	3.3	18.0	13.8	9.6	9.5	9.4	61.3	47.0	32.6	32.3	32.1
Scenario *Min 2*	(D)	6.4	6.0	5.1	5.0	5.0	18.0	16.9	14.4	14.3	14.2	61.3	57.6	49.0	48.5	48.1

Sources: Teichmann (2014b: Table A.67).

Notes: DM = dry mass. t = tonne. a = year. km = kilometer.

Note that the mean transport distances for the transportation of biomass to the pyrolysis units and of biochar from the pyrolysis units to the farms are assumed to be symmetric.

Table S.33: Average Costs for Equipment and Labor in Road Transports

Transport distance	Total transport costs		Fuel costs[c]	Equipment and labor costs		Average costs for equipment and labor in road transports[f]
km	€~2002/t_{FW} freight[a]	€~2002/(t_{FW} freight · km)[b]	€2002/(t_{FW} freight · km)	€2002/(t_{FW} freight · km)[d]	€2012/(t_{FW} freight · km)[e]	€2012/(t_{FW} freight · km)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5	6.5	1.30	0.0143	1.29	1.72	1.7
10	7.5	0.75		0.74	0.98	0.8
15	8.5	0.57		0.55	0.74	
20	9.3	0.47		0.45	0.60	
25	10.1	0.40		0.39	0.52	0.4
30	10.9	0.36		0.35	0.47	
50	13.7	0.27		0.26	0.35	
70	17.2	0.25		0.23	0.31	

Sources:

a) FNR (2005: Table 6-11), i.e. excluding VAT and referring to spruce chips, without loading costs and based on truck combinations with a transport volume of 80 m^3 and a payload of 23 t.

b) Own calculation, (3) = (2)/(1).

c) Own calculation, based on the average 2002 diesel consumption by semi-trailers in Germany of 36.9 l/100 km (Kunert and Radke 2013: Table 3), the average 2002 VAT-free diesel price of 0.72 €/l – derived from the average 2002 tax-inclusive diesel price of 0.84 €/l from Radke (2014: 302) minus 14% VAT valid at that time – and the total load of 18.56 t_{FW} as derived from the assumed transport volume of 80 m^3 (see note a) and a bulk density of spruce chips of 0.232 t_{FW}/m^3 (FNR 2005: Table 6-11), i.e. (4) = 36.9/100 · 0.72/(80 · 0.232).

d) Own calculation, (5) = (3) – (4).

e) Own calculation, based on the producer price index for agricultural products of 89.4 for 2002 and 119.4 for 2012 (Statistisches Bundesamt 2015a), i.e. (6) = (5) · 119.4/89.4. Note that we have chosen the producer price index for agricultural products since more specific producer price indices for transport-related services are not available before 2006.

f) Own calculation, simple average over the respective values in column 6.

Notes: Values rounded. FW = fresh weight. t = tonne. km = kilometer. m^3 = cubic meter. l = liter. VAT = value-added tax.

Table S.34: Equipment and Labor Costs for Biomass Transports

			Small-scale pyrolysis units	Medium-scale pyrolysis units	Large-scale pyrolysis units
Average costs[a]	€$_{2012}$/(t_{FW} freight · km)	(A)	1.7	0.8	0.4
	Feedstock water content[b]		**Costs for equipment and labor**[c]		
	wt%		€$_{2012}$/(t_{DM} feedstock · km)		
Feedstocks	(1)		(2)	(3)	(4)
Cereal straw	7.9		1.85	0.87	0.43
Forestry residues	10.8		1.91	0.90	0.45
Open-country biomass residues	7.8		1.84	0.87	0.43
Industrial wood waste	8.1		1.85	0.87	0.44
Wood in municipal solid waste	10.9		1.91	0.90	0.45
Green waste: Compensation areas	6.3		1.81	0.85	0.43
Biomass: Habitat-connectivity areas	7.8		1.84	0.87	0.43
Green waste: Extensive grassland	7.8		1.84	0.87	0.43
Short-rotation coppice: Erosion areas	17.9		2.07	0.97	0.49
Solid cattle manure	63.6		4.67	2.20	1.10
Solid swine manure	78.5		7.91	3.72	1.86
Solid poultry manure	13.4		1.96	0.92	0.46
Commercial and industrial waste	61.3		4.39	2.07	1.03
Organic municipal solid waste	70.9		5.84	2.75	1.37

Sources:

a) Table S.33, column 7, i.e. the 5-km value is assigned to small-scale pyrolysis units since these tend to be associated with transport distances around 5 km (see Table S.32), while the average of the values for 10 to 20 km (25 to 70 km) is assigned to medium-scale (large-scale) pyrolysis units since the corresponding transport distances given in Table S.32 tend to be in the respective ranges.

b) Teichmann (2014a: Table 8, column 4). The feedstock water contents are based on as-received fresh weight.

c) Own calculation, transforming the respective values from row A into t_{DM}-feedstock basis using the water contents from column 1, e.g., (2) = 1.7/(1 - (1)/100).

Notes: Values rounded. DM = dry mass. FW = fresh weight. t = tonne. wt% = weight percent. km = kilometer.

Table S.35: Equipment and Labor Costs for Biomass Transportation, Germany, 2015-2050, Scenario *Min 1*

	Small-scale pyrolysis units					**Medium-scale pyrolysis units**					**Large-scale pyrolysis units**				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	10.9	10.4	9.3	9.2	9.1	14.6	13.9	12.4	12.2	12.2	24.8	23.6	21.0	20.8	20.7
Forestry residues	11.3	10.8	9.6	9.5	9.4	15.0	14.3	12.8	12.6	12.6	25.6	24.3	21.7	21.5	21.3
Open-country biomass residues	10.9	10.4	9.3	9.2	9.1	14.6	13.9	12.4	12.2	12.2	24.7	23.5	21.0	20.8	20.6
Industrial wood waste	11.0	10.4	9.3	9.2	9.2	14.6	13.9	12.4	12.3	12.2	24.8	23.6	21.1	20.9	20.7
Wood in municipal solid waste	11.3	10.8	9.6	9.5	9.4	15.1	14.3	12.8	12.7	12.6	25.6	24.4	21.7	21.5	21.4
Green waste: Compensation areas	10.8	10.2	9.1	9.0	9.0	14.3	13.6	12.2	12.0	12.0	24.3	23.2	20.7	20.5	20.3
Biomass: Habitat-connectivity areas	10.9	10.4	9.3	9.2	9.1	14.6	13.9	12.4	12.2	12.2	24.7	23.5	21.0	20.8	20.6
Green waste: Extensive grassland	10.9	10.4	9.3	9.2	9.1	14.6	13.9	12.4	12.2	12.2	24.7	23.5	21.0	20.8	20.6
Short-rotation coppice: Erosion areas	12.3	11.7	10.4	10.3	10.3	16.3	15.6	13.9	13.7	13.6	27.8	26.4	23.6	23.3	23.2
Solid cattle manure	27.7	26.4	23.5	23.3	23.1	36.9	35.1	31.3	31.0	30.8	62.7	59.7	53.2	52.7	52.3
Solid swine manure	46.9	44.7	39.8	39.4	39.1	62.4	59.4	53.0	52.5	52.1	106.1	101.0	90.1	89.2	88.5
Solid poultry manure	11.6	11.1	9.9	9.8	9.7	15.5	14.8	13.2	13.0	12.9	26.3	25.1	22.4	22.1	22.0
Commercial and industrial waste	26.1	24.8	22.1	21.9	21.7	34.7	33.0	29.5	29.2	28.9	58.9	56.1	50.1	49.5	49.2
Organic municipal solid waste	34.6	33.0	29.4	29.1	28.9	46.1	43.9	39.2	38.8	38.5	78.4	74.6	66.6	65.9	65.4

Sources: Own calculation, multiplying the equipment and labor costs for biomass transports from Table S.34, columns 2-4 by the mean transport distances of scenario *Min 1* given in Table S.32, row B.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.36: Equipment and Labor Costs for Biomass Transportation, Germany, 2015-2050, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	11.8	9.0	6.3	6.2	6.2	15.7	12.0	8.3	8.3	8.2	26.6	20.4	14.2	14.0	13.9
Forestry residues	12.2	9.3	6.5	6.4	6.4	16.2	12.4	8.6	8.5	8.5	27.5	21.1	14.6	14.5	14.4
Open-country biomass residues	11.8	9.0	6.3	6.2	6.2	15.7	12.0	8.3	8.3	8.2	26.6	20.4	14.2	14.0	13.9
Industrial wood waste	11.8	9.0	6.3	6.2	6.2	15.7	12.0	8.4	8.3	8.2	26.7	20.5	14.2	14.1	14.0
Wood in municipal solid waste	12.2	9.3	6.5	6.4	6.4	16.2	12.4	8.6	8.5	8.5	27.5	21.1	14.7	14.5	14.4
Green waste: Compensation areas	11.6	8.9	6.2	6.1	6.1	15.4	11.8	8.2	8.1	8.1	26.2	20.1	13.9	13.8	13.7
Biomass: Habitat-connectivity areas	11.8	9.0	6.3	6.2	6.2	15.7	12.0	8.3	8.3	8.2	26.6	20.4	14.2	14.0	13.9
Green waste: Extensive grassland	11.8	9.0	6.3	6.2	6.2	15.7	12.0	8.3	8.3	8.2	26.6	20.4	14.2	14.0	13.9
Short-rotation coppice: Erosion areas	13.2	10.1	7.0	7.0	6.9	17.6	13.5	9.4	9.3	9.2	29.9	22.9	15.9	15.8	15.6

Sources: Own calculation, multiplying the equipment and labor costs for biomass transports from Table S.34, columns 2-4 by the mean transport distances of scenario *Max 2* given in Table S.32, row C.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.37: Equipment and Labor Costs for Biomass Transportation, Germany, 2015-2050, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	11.8	11.1	9.4	9.3	9.2	15.7	14.7	12.5	12.4	12.3	26.6	25.0	21.3	21.1	20.9
Forestry residues	12.2	11.4	9.7	9.6	9.5	16.2	15.2	12.9	12.8	12.7	27.5	25.8	22.0	21.7	21.6
Open-country biomass residues	11.8	11.0	9.4	9.3	9.2	15.7	14.7	12.5	12.4	12.3	26.6	25.0	21.2	21.0	20.9
Industrial wood waste	11.8	11.1	9.4	9.3	9.3	15.7	14.7	12.5	12.4	12.3	26.7	25.1	21.3	21.1	21.0
Wood in municipal solid waste	12.2	11.4	9.7	9.6	9.6	16.2	15.2	12.9	12.8	12.7	27.5	25.8	22.0	21.8	21.6
Green waste: Compensation areas	11.6	10.9	9.2	9.2	9.1	15.4	14.5	12.3	12.2	12.1	26.2	24.6	20.9	20.7	20.6
Biomass: Habitat-connectivity areas	11.8	11.0	9.4	9.3	9.2	15.7	14.7	12.5	12.4	12.3	26.6	25.0	21.2	21.0	20.9
Green waste: Extensive grassland	11.8	11.0	9.4	9.3	9.2	15.7	14.7	12.5	12.4	12.3	26.6	25.0	21.2	21.0	20.9
Short-rotation coppice: Erosion areas	13.2	12.4	10.5	10.4	10.4	17.6	16.5	14.0	13.9	13.8	29.9	28.1	23.8	23.6	23.5

Sources: Own calculation, multiplying the equipment and labor costs for biomass transports from Table S.34, columns 2-4 by the mean transport distances of scenario *Min 2* given in Table S.32, row D.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.38: Transport Fuel Prices and Diesel Fuel Consumption

				2015	2020	2030	2040	2050
				(1)	(2)	(3)	(4)	(5)
Average costs for gasoline and diesel (without taxes)	Price path A	ct_{2009}/kWh[a]	(A)	6.0	8.8	12.0	14.0	16.0
	Price path B		(B)	6.0	7.6	10.6	12.2	14.0
	Price path C		(C)	6.0	7.0	9.4	10.5	11.8
	Price path A	$€_{2012}$/MJ[b]	(D)	0.023	0.034	0.046	0.054	0.061
	Price path B		(E)	0.023	0.029	0.041	0.047	0.054
	Price path C		(F)	0.023	0.027	0.036	0.040	0.045
	Price path A	$€_{2012}$/l[c]	(G)	0.82	1.21	1.65	1.92	2.20
	Price path B		(H)	0.82	1.04	1.46	1.68	1.92
	Price path C		(I)	0.82	0.96	1.29	1.44	1.62
Diesel fuel consumption - Trucks		l/(t_{FW} freight · km)[d]	(J)	0.018	0.017	0.015	0.014	0.013
Diesel prices - Trucks	Price path A	$€_{2012}$/(t_{FW} freight · km)[e]	(K)	**0.015**	**0.021**	**0.025**	**0.027**	**0.029**
	Price path B		(L)	**0.015**	**0.018**	**0.022**	**0.023**	**0.025**
	Price path C		(M)	**0.015**	**0.016**	**0.019**	**0.020**	**0.021**
Diesel fuel consumption - Tractors		l/(t_{FW} freight · km)[f]	(N)	0.046	0.044	0.038	0.036	0.034
Diesel prices - Tractors	Price path A	$€_{2012}$/(t_{FW} freight · km)[g]	(O)	**0.038**	**0.053**	**0.063**	**0.069**	**0.075**
	Price path B		(P)	**0.038**	**0.046**	**0.055**	**0.060**	**0.065**
	Price path C		(Q)	**0.038**	**0.042**	**0.049**	**0.052**	**0.055**

Sources:

a) Nitsch et al. (2012a: Table 7-5); the 2050 value of price path A is considered to include external costs, such as future damage costs of unmitigated climate change. Note that we use the 2010 data (instead of the 2015 data) from Nitsch et al. (2012a: Table 7-5) as our 2015 values. The reason is that these lower fuel prices tend to be more in line with the current tax-free diesel price of about $€_{2012}$0.78 per liter as observed in 2012, where the 0.78 $€_{2012}$/l have been derived from the 2012 tax-inclusive diesel price of 1.49 $€_{2012}$/l (Radke 2014: 303) reduced by 16% VAT (i.e. 0.24 $€_{2012}$/l) and 0.47 $€_{2012}$/l energy taxes (Radke 2014: 294).

b) Own calculation, transforming the prices in ct_{2009}/kWh from rows A to C, respectively, into $€_{2012}$/MJ based on the annual average consumer price index for heating oil and transport fuels of 88.2 for 2009 and 121.6 for 2012 (Statistisches Bundesamt 2015c), e.g., (D) = (A)/360 · 121.6/88.2.

c) Own calculation, transforming the prices in $€_{2012}$/MJ from rows D to F, respectively, into $€_{2012}$/l based on the heating value of 35.87 MJ per liter of diesel fuel (FNR 2012: 28), e.g., (G) = (D) · 35.87. Note that we follow Teichmann (2014b: Table A.19) in that we do not differentiate between fossil diesel and biodiesel since they have nearly the same heating values – 35.87 MJ/l for fossil diesel and 32.65 MJ/l for biodiesel (FNR 2012: 28).

d) Teichmann (2014b: Table A.19, row D).

e) Own calculation, multiplying the transport-fuel prices in $€_{2012}$/l from rows G to I, respectively, by the diesel fuel consumption for trucks from row J.

f) Teichmann (2014b: Table A.19, row G).

g) Own calculation, multiplying the transport-fuel prices in $€_{2012}$/l from rows G to I, respectively, by the diesel fuel consumption for tractors from row N.

Notes: Values rounded. ct = euro cent. t = tonne. km = kilometer. l = liter. kWh = kilowatt hour. MJ = megajoule. VAT = value-added tax.

Table S.39: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050

Feedstocks	Feedstock water content[a]	Price path A[b]					Price path B[c]					Price path C[d]				
		2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	wt%	€$_{2012}$/(t$_{DM}$ feedstock · km)					€$_{2012}$/(t$_{DM}$ feedstock · km)					€$_{2012}$/(t$_{DM}$ feedstock · km)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Cereal straw	7.9	0.016	0.022	0.027	0.029	0.031	0.016	0.019	0.024	0.025	0.027	0.016	0.018	0.021	0.022	0.023
Forestry residues	10.8	0.017	0.023	0.028	0.030	0.032	0.017	0.020	0.024	0.026	0.028	0.017	0.018	0.022	0.023	0.024
Open-country biomass residues	7.8	0.016	0.022	0.027	0.029	0.031	0.016	0.019	0.024	0.025	0.027	0.016	0.018	0.021	0.022	0.023
Industrial wood waste	8.1	0.016	0.022	0.027	0.029	0.031	0.016	0.019	0.024	0.026	0.027	0.016	0.018	0.021	0.022	0.023
Wood in municipal solid waste	10.9	0.017	0.023	0.028	0.030	0.032	0.017	0.020	0.025	0.026	0.028	0.017	0.018	0.022	0.023	0.024
Green waste: Compensation areas	6.3	0.016	0.022	0.026	0.029	0.030	0.016	0.019	0.023	0.025	0.027	0.016	0.017	0.021	0.022	0.022
Biomass: Habitat-connectivity areas	7.8	0.016	0.022	0.027	0.029	0.031	0.016	0.019	0.024	0.025	0.027	0.016	0.018	0.021	0.022	0.023
Green waste: Extensive grassland	7.8	0.016	0.022	0.027	0.029	0.031	0.016	0.019	0.024	0.025	0.027	0.016	0.018	0.021	0.022	0.023
Short-rotation coppice: Erosion areas	17.9	0.018	0.025	0.030	0.033	0.035	0.018	0.022	0.027	0.029	0.030	0.018	0.020	0.024	0.025	0.026
Solid cattle manure	63.6	0.041	0.056	0.068	0.074	0.078	0.041	0.049	0.060	0.064	0.069	0.041	0.045	0.053	0.055	0.058
Solid swine manure	78.5	0.069	0.096	0.115	0.125	0.133	0.069	0.083	0.102	0.109	0.116	0.069	0.076	0.090	0.094	0.098
Solid poultry manure	13.4	0.017	0.024	0.029	0.031	0.033	0.017	0.020	0.025	0.027	0.029	0.017	0.019	0.022	0.023	0.024
Commercial and industrial waste	61.3	0.038	0.053	0.064	0.070	0.074	0.038	0.046	0.056	0.061	0.065	0.038	0.042	0.050	0.052	0.054
Organic municipal solid waste	70.9	0.051	0.071	0.085	0.093	0.098	0.051	0.061	0.075	0.081	0.086	0.051	0.056	0.067	0.069	0.072

Sources:

a) Teichmann (2014a: Table 8, column 4). The feedstock water contents are based on as-received fresh weight.

b) Own calculation, transforming the values from Table S.38, row K (referring to the transportation of fresh-weight feedstocks) into dry-mass basis using the water contents from column 1, e.g., (2) = Table S.38 (row K, column 1)/(1 - (1)/100).

c) Own calculation, transforming the values from Table S.38, row L (referring to the transportation of fresh-weight feedstocks) into dry-mass basis using the water contents from column 1, e.g., (7) = Table S.38 (row L, column 1)/(1 - (1)/100).

d) Own calculation, transforming the values from Table S.38, row M (referring to the transportation of fresh-weight feedstocks) into dry-mass basis using the water contents from column 1, e.g., (12) = Table S.38 (row M, column 1)/(1 - (1)/100).

Notes: Values rounded. DM = dry mass. t = tonne. wt% = weight percent. km = kilometer.

Table S.40: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path A, Scenario *Max 1*

Feedstocks	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.096	0.098	0.083	0.089	0.094	0.270	0.276	0.234	0.252	0.266	0.918	0.938	0.796	0.858	0.904
Forestry residues	0.099	0.101	0.086	0.092	0.097	0.279	0.285	0.242	0.261	0.275	0.948	0.969	0.822	0.886	0.934
Open-country biomass residues	0.095	0.097	0.083	0.089	0.094	0.270	0.276	0.234	0.252	0.266	0.917	0.937	0.795	0.857	0.903
Industrial wood waste	0.096	0.098	0.083	0.089	0.094	0.271	0.277	0.235	0.253	0.267	0.920	0.940	0.798	0.860	0.906
Wood in municipal solid waste	0.099	0.101	0.086	0.092	0.097	0.279	0.285	0.242	0.261	0.275	0.949	0.970	0.823	0.887	0.935
Green waste: Compensation areas	0.094	0.096	0.081	0.088	0.092	0.266	0.271	0.230	0.248	0.262	0.903	0.922	0.783	0.843	0.889
Biomass: Habitat-connectivity areas	0.095	0.097	0.083	0.089	0.094	0.270	0.276	0.234	0.252	0.266	0.917	0.937	0.795	0.857	0.903
Green waste: Extensive grassland	0.095	0.097	0.083	0.089	0.094	0.270	0.276	0.234	0.252	0.266	0.917	0.937	0.795	0.857	0.903
Short-rotation coppice: Erosion areas	0.107	0.109	0.093	0.100	0.106	0.303	0.310	0.263	0.283	0.298	1.030	1.052	0.893	0.962	1.014
Solid cattle manure	0.242	0.247	0.210	0.226	0.238	0.684	0.698	0.593	0.639	0.673	2.324	2.374	2.015	2.171	2.288
Solid swine manure	0.409	0.418	0.355	0.382	0.403	1.158	1.183	1.004	1.081	1.140	3.934	4.019	3.411	3.675	3.873
Solid poultry manure	0.102	0.104	0.088	0.095	0.100	0.287	0.294	0.249	0.268	0.283	0.977	0.998	0.847	0.912	0.962
Commercial and industrial waste	0.227	0.232	0.197	0.212	0.224	0.643	0.657	0.558	0.601	0.633	2.186	2.233	1.895	2.042	2.152
Organic municipal solid waste	0.302	0.309	0.262	0.282	0.298	0.855	0.874	0.742	0.799	0.842	2.907	2.969	2.520	2.715	2.862

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 2-6 by the respective mean transport distances of scenario *Max 1* given in Table S.32, row A.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.41: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path A, Scenario *Min 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.096	0.126	0.135	0.146	0.154	0.270	0.356	0.383	0.412	0.434	0.918	1.211	1.300	1.401	1.477
Forestry residues	0.099	0.130	0.140	0.150	0.159	0.279	0.368	0.395	0.426	0.449	0.948	1.251	1.343	1.447	1.525
Open-country biomass residues	0.095	0.126	0.135	0.146	0.153	0.270	0.356	0.382	0.412	0.434	0.917	1.210	1.299	1.400	1.475
Industrial wood waste	0.096	0.126	0.136	0.146	0.154	0.271	0.357	0.383	0.413	0.435	0.920	1.214	1.303	1.404	1.480
Wood in municipal solid waste	0.099	0.130	0.140	0.151	0.159	0.279	0.368	0.395	0.426	0.449	0.949	1.252	1.344	1.448	1.526
Green waste: Compensation areas	0.094	0.124	0.133	0.143	0.151	0.266	0.350	0.376	0.405	0.427	0.903	1.191	1.278	1.377	1.451
Biomass: Habitat-connectivity areas	0.095	0.126	0.135	0.146	0.153	0.270	0.356	0.382	0.412	0.434	0.917	1.210	1.299	1.400	1.475
Green waste: Extensive grassland	0.095	0.126	0.135	0.146	0.153	0.270	0.356	0.382	0.412	0.434	0.917	1.210	1.299	1.400	1.475
Short-rotation coppice: Erosion areas	0.107	0.141	0.152	0.164	0.172	0.303	0.400	0.429	0.462	0.487	1.030	1.359	1.459	1.572	1.656
Solid cattle manure	0.242	0.319	0.342	0.369	0.389	0.684	0.902	0.968	1.043	1.099	2.324	3.065	3.290	3.545	3.736
Solid swine manure	0.409	0.540	0.579	0.624	0.658	1.158	1.527	1.639	1.766	1.861	3.934	5.189	5.570	6.002	6.325
Solid poultry manure	0.102	0.134	0.144	0.155	0.163	0.287	0.379	0.407	0.438	0.462	0.977	1.288	1.383	1.490	1.570
Commercial and industrial waste	0.227	0.300	0.322	0.347	0.366	0.643	0.848	0.911	0.981	1.034	2.186	2.883	3.094	3.334	3.514
Organic municipal solid waste	0.302	0.399	0.428	0.461	0.486	0.855	1.128	1.211	1.305	1.375	2.907	3.833	4.115	4.434	4.673

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 2-6 by the respective mean transport distances of scenario *Min 1* given in Table S.32, row B.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.42: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path A, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.103	0.109	0.091	0.098	0.104	0.291	0.309	0.258	0.278	0.293	0.988	1.049	0.876	0.945	0.996
Forestry residues	0.106	0.113	0.094	0.102	0.107	0.300	0.319	0.266	0.287	0.303	1.020	1.083	0.905	0.976	1.028
Open-country biomass residues	0.103	0.109	0.091	0.098	0.103	0.290	0.308	0.258	0.278	0.293	0.987	1.048	0.875	0.944	0.995
Industrial wood waste	0.103	0.109	0.091	0.099	0.104	0.291	0.309	0.258	0.279	0.294	0.990	1.051	0.878	0.947	0.998
Wood in municipal solid waste	0.106	0.113	0.094	0.102	0.107	0.300	0.319	0.266	0.287	0.303	1.021	1.084	0.906	0.977	1.029
Green waste: Compensation areas	0.101	0.107	0.090	0.097	0.102	0.286	0.303	0.253	0.273	0.288	0.971	1.031	0.861	0.929	0.979
Biomass: Habitat-connectivity areas	0.103	0.109	0.091	0.098	0.103	0.290	0.308	0.258	0.278	0.293	0.987	1.048	0.875	0.944	0.995
Green waste: Extensive grassland	0.103	0.109	0.091	0.098	0.103	0.290	0.308	0.258	0.278	0.293	0.987	1.048	0.875	0.944	0.995
Short-rotation coppice: Erosion areas	0.115	0.122	0.102	0.110	0.116	0.326	0.346	0.289	0.312	0.329	1.108	1.177	0.983	1.060	1.117

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 2-6 by the respective mean transport distances of scenario *Max 2* given in Table S.32, row C.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.43: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path A, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.103	0.134	0.137	0.147	0.155	0.291	0.378	0.387	0.417	0.440	0.988	1.285	1.314	1.418	1.494
Forestry residues	0.106	0.138	0.141	0.152	0.160	0.300	0.390	0.399	0.431	0.454	1.020	1.327	1.357	1.464	1.542
Open-country biomass residues	0.103	0.134	0.137	0.147	0.155	0.290	0.378	0.386	0.417	0.439	0.987	1.283	1.313	1.416	1.492
Industrial wood waste	0.103	0.134	0.137	0.148	0.156	0.291	0.379	0.388	0.418	0.440	0.990	1.288	1.317	1.421	1.497
Wood in municipal solid waste	0.106	0.138	0.141	0.152	0.161	0.300	0.391	0.400	0.431	0.454	1.021	1.328	1.358	1.466	1.544
Green waste: Compensation areas	0.101	0.131	0.134	0.145	0.153	0.286	0.372	0.380	0.410	0.432	0.971	1.263	1.292	1.394	1.468
Biomass: Habitat-connectivity areas	0.103	0.134	0.137	0.147	0.155	0.290	0.378	0.386	0.417	0.439	0.987	1.283	1.313	1.416	1.492
Green waste: Extensive grassland	0.103	0.134	0.137	0.147	0.155	0.290	0.378	0.386	0.417	0.439	0.987	1.283	1.313	1.416	1.492
Short-rotation coppice: Erosion areas	0.115	0.150	0.153	0.165	0.174	0.326	0.424	0.434	0.468	0.493	1.108	1.441	1.474	1.590	1.676

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 2-6 by the respective mean transport distances of scenario *Min 2* given in Table S.32, row D.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.44: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path B, Scenario *Min 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.096	0.109	0.119	0.127	0.134	0.270	0.308	0.338	0.359	0.380	0.918	1.046	1.149	1.221	1.292
Forestry residues	0.099	0.112	0.123	0.131	0.139	0.279	0.318	0.349	0.371	0.393	0.948	1.080	1.186	1.261	1.334
Open-country biomass residues	0.095	0.109	0.119	0.127	0.134	0.270	0.307	0.338	0.359	0.380	0.917	1.045	1.147	1.220	1.291
Industrial wood waste	0.096	0.109	0.120	0.127	0.135	0.271	0.308	0.339	0.360	0.381	0.920	1.048	1.151	1.224	1.295
Wood in municipal solid waste	0.099	0.112	0.124	0.131	0.139	0.279	0.318	0.349	0.371	0.393	0.949	1.081	1.187	1.262	1.335
Green waste: Compensation areas	0.094	0.107	0.117	0.125	0.132	0.266	0.303	0.332	0.353	0.374	0.903	1.028	1.129	1.200	1.270
Biomass: Habitat-connectivity areas	0.095	0.109	0.119	0.127	0.134	0.270	0.307	0.338	0.359	0.380	0.917	1.045	1.147	1.220	1.291
Green waste: Extensive grassland	0.095	0.109	0.119	0.127	0.134	0.270	0.307	0.338	0.359	0.380	0.917	1.045	1.147	1.220	1.291
Short-rotation coppice: Erosion areas	0.107	0.122	0.134	0.142	0.151	0.303	0.345	0.379	0.403	0.426	1.030	1.173	1.288	1.370	1.449
Solid cattle manure	0.242	0.275	0.302	0.321	0.340	0.684	0.779	0.855	0.909	0.962	2.324	2.647	2.906	3.089	3.269
Solid swine manure	0.409	0.466	0.512	0.544	0.576	1.158	1.319	1.448	1.539	1.629	3.934	4.481	4.920	5.230	5.535
Solid poultry manure	0.102	0.116	0.127	0.135	0.143	0.287	0.327	0.359	0.382	0.404	0.977	1.112	1.222	1.298	1.374
Commercial and industrial waste	0.227	0.259	0.284	0.302	0.320	0.643	0.733	0.804	0.855	0.905	2.186	2.489	2.733	2.906	3.075
Organic municipal solid waste	0.302	0.344	0.378	0.402	0.425	0.855	0.974	1.070	1.137	1.203	2.907	3.311	3.635	3.864	4.089

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 7-11 by the respective mean transport distances of scenario *Min 1* given in Table S.32, row B.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.45: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path B, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.103	0.094	0.081	0.086	0.091	0.291	0.267	0.228	0.242	0.256	0.988	0.906	0.774	0.824	0.871
Forestry residues	0.106	0.097	0.083	0.088	0.094	0.300	0.275	0.235	0.250	0.265	1.020	0.935	0.799	0.850	0.900
Open-country biomass residues	0.103	0.094	0.080	0.086	0.091	0.290	0.266	0.227	0.242	0.256	0.987	0.905	0.773	0.823	0.870
Industrial wood waste	0.103	0.094	0.081	0.086	0.091	0.291	0.267	0.228	0.243	0.257	0.990	0.908	0.776	0.825	0.873
Wood in municipal solid waste	0.106	0.097	0.083	0.089	0.094	0.300	0.276	0.235	0.251	0.265	1.021	0.937	0.800	0.851	0.901
Green waste: Compensation areas	0.101	0.093	0.079	0.084	0.089	0.286	0.262	0.224	0.238	0.252	0.971	0.891	0.761	0.810	0.856
Biomass: Habitat-connectivity areas	0.103	0.094	0.080	0.086	0.091	0.290	0.266	0.227	0.242	0.256	0.987	0.905	0.773	0.823	0.870
Green waste: Extensive grassland	0.103	0.094	0.080	0.086	0.091	0.290	0.266	0.227	0.242	0.256	0.987	0.905	0.773	0.823	0.870
Short-rotation coppice: Erosion areas	0.115	0.106	0.090	0.096	0.102	0.326	0.299	0.255	0.272	0.288	1.108	1.016	0.868	0.924	0.978

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 7-11 by the respective mean transport distances of scenario *Max 2* given in Table S.32, row C.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.46: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path B, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.103	0.115	0.121	0.129	0.136	0.291	0.326	0.342	0.364	0.385	0.988	1.110	1.161	1.236	1.307
Forestry residues	0.106	0.119	0.125	0.133	0.140	0.300	0.337	0.353	0.375	0.397	1.020	1.146	1.199	1.276	1.350
Open-country biomass residues	0.103	0.115	0.121	0.128	0.136	0.290	0.326	0.341	0.363	0.384	0.987	1.108	1.160	1.234	1.306
Industrial wood waste	0.103	0.116	0.121	0.129	0.136	0.291	0.327	0.342	0.364	0.385	0.990	1.112	1.163	1.238	1.310
Wood in municipal solid waste	0.106	0.119	0.125	0.133	0.141	0.300	0.337	0.353	0.376	0.398	1.021	1.147	1.200	1.277	1.351
Green waste: Compensation areas	0.101	0.113	0.119	0.126	0.134	0.286	0.321	0.336	0.357	0.378	0.971	1.091	1.141	1.214	1.285
Biomass: Habitat-connectivity areas	0.103	0.115	0.121	0.128	0.136	0.290	0.326	0.341	0.363	0.384	0.987	1.108	1.160	1.234	1.306
Green waste: Extensive grassland	0.103	0.115	0.121	0.128	0.136	0.290	0.326	0.341	0.363	0.384	0.987	1.108	1.160	1.234	1.306
Short-rotation coppice: Erosion areas	0.115	0.129	0.135	0.144	0.153	0.326	0.366	0.383	0.408	0.431	1.108	1.245	1.302	1.386	1.466

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 7-11 by the respective mean transport distances of scenario *Min 2* given in Table S.32, row D.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.47: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path C, Scenario *Max 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.096	0.078	0.065	0.067	0.069	0.270	0.220	0.184	0.189	0.196	0.918	0.746	0.624	0.643	0.667
Forestry residues	0.099	0.080	0.067	0.069	0.072	0.279	0.227	0.189	0.195	0.203	0.948	0.771	0.644	0.664	0.689
Open-country biomass residues	0.095	0.078	0.065	0.067	0.069	0.270	0.219	0.183	0.189	0.196	0.917	0.745	0.623	0.643	0.666
Industrial wood waste	0.096	0.078	0.065	0.067	0.070	0.271	0.220	0.184	0.190	0.197	0.920	0.748	0.625	0.645	0.668
Wood in municipal solid waste	0.099	0.080	0.067	0.069	0.072	0.279	0.227	0.190	0.196	0.203	0.949	0.771	0.645	0.665	0.689
Green waste: Compensation areas	0.094	0.076	0.064	0.066	0.068	0.266	0.216	0.180	0.186	0.193	0.903	0.734	0.613	0.632	0.655
Biomass: Habitat-connectivity areas	0.095	0.078	0.065	0.067	0.069	0.270	0.219	0.183	0.189	0.196	0.917	0.745	0.623	0.643	0.666
Green waste: Extensive grassland	0.095	0.078	0.065	0.067	0.069	0.270	0.219	0.183	0.189	0.196	0.917	0.745	0.623	0.643	0.666
Short-rotation coppice: Erosion areas	0.107	0.087	0.073	0.075	0.078	0.303	0.246	0.206	0.212	0.220	1.030	0.837	0.700	0.722	0.748
Solid cattle manure	0.242	0.196	0.164	0.169	0.176	0.684	0.556	0.464	0.479	0.496	2.324	1.888	1.578	1.628	1.687
Solid swine manure	0.409	0.333	0.278	0.287	0.297	1.158	0.941	0.786	0.811	0.841	3.934	3.197	2.672	2.756	2.857
Solid poultry manure	0.102	0.083	0.069	0.071	0.074	0.287	0.234	0.195	0.201	0.209	0.977	0.794	0.663	0.684	0.709
Commercial and industrial waste	0.227	0.185	0.154	0.159	0.165	0.643	0.523	0.437	0.451	0.467	2.186	1.776	1.484	1.531	1.587
Organic municipal solid waste	0.302	0.246	0.205	0.212	0.220	0.855	0.695	0.581	0.599	0.621	2.907	2.362	1.974	2.037	2.111

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 12-16 by the respective mean transport distances of scenario *Max 1* given in Table S.32, row A.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.48: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path C, Scenario *Min 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.096	0.100	0.106	0.109	0.113	0.270	0.283	0.300	0.309	0.320	0.918	0.963	1.019	1.051	1.089
Forestry residues	0.099	0.103	0.109	0.113	0.117	0.279	0.293	0.309	0.319	0.331	0.948	0.995	1.052	1.085	1.124
Open-country biomass residues	0.095	0.100	0.106	0.109	0.113	0.270	0.283	0.299	0.309	0.320	0.917	0.962	1.017	1.050	1.088
Industrial wood waste	0.096	0.100	0.106	0.110	0.114	0.271	0.284	0.300	0.310	0.321	0.920	0.966	1.021	1.053	1.091
Wood in municipal solid waste	0.099	0.104	0.110	0.113	0.117	0.279	0.293	0.310	0.320	0.331	0.949	0.996	1.053	1.086	1.126
Green waste: Compensation areas	0.094	0.099	0.104	0.107	0.111	0.266	0.279	0.295	0.304	0.315	0.903	0.947	1.001	1.033	1.070
Biomass: Habitat-connectivity areas	0.095	0.100	0.106	0.109	0.113	0.270	0.283	0.299	0.309	0.320	0.917	0.962	1.017	1.050	1.088
Green waste: Extensive grassland	0.095	0.100	0.106	0.109	0.113	0.270	0.283	0.299	0.309	0.320	0.917	0.962	1.017	1.050	1.088
Short-rotation coppice: Erosion areas	0.107	0.112	0.119	0.123	0.127	0.303	0.318	0.336	0.347	0.359	1.030	1.081	1.143	1.179	1.222
Solid cattle manure	0.242	0.254	0.268	0.277	0.287	0.684	0.717	0.758	0.782	0.811	2.324	2.438	2.577	2.659	2.755
Solid swine manure	0.409	0.429	0.454	0.468	0.485	1.158	1.214	1.284	1.324	1.373	3.934	4.127	4.363	4.501	4.665
Solid poultry manure	0.102	0.107	0.113	0.116	0.120	0.287	0.302	0.319	0.329	0.341	0.977	1.025	1.083	1.118	1.158
Commercial and industrial waste	0.227	0.239	0.252	0.260	0.270	0.643	0.675	0.713	0.736	0.763	2.186	2.293	2.424	2.501	2.592
Organic municipal solid waste	0.302	0.317	0.335	0.346	0.359	0.855	0.897	0.949	0.979	1.014	2.907	3.049	3.224	3.326	3.447

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 12-16 by the respective mean transport distances of scenario *Min 1* given in Table S.32, row B.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.49: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path C, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.103	0.087	0.071	0.074	0.076	0.291	0.246	0.202	0.209	0.216	0.988	0.834	0.686	0.709	0.734
Forestry residues	0.106	0.090	0.074	0.076	0.079	0.300	0.254	0.209	0.215	0.223	1.020	0.862	0.709	0.732	0.758
Open-country biomass residues	0.103	0.087	0.071	0.074	0.076	0.290	0.245	0.202	0.208	0.216	0.987	0.834	0.686	0.708	0.734
Industrial wood waste	0.103	0.087	0.072	0.074	0.077	0.291	0.246	0.202	0.209	0.217	0.990	0.836	0.688	0.710	0.736
Wood in municipal solid waste	0.106	0.090	0.074	0.076	0.079	0.300	0.254	0.209	0.216	0.223	1.021	0.863	0.709	0.733	0.759
Green waste: Compensation areas	0.101	0.085	0.070	0.072	0.075	0.286	0.241	0.198	0.205	0.212	0.971	0.820	0.675	0.697	0.722
Biomass: Habitat-connectivity areas	0.103	0.087	0.071	0.074	0.076	0.290	0.245	0.202	0.208	0.216	0.987	0.834	0.686	0.708	0.734
Green waste: Extensive grassland	0.103	0.087	0.071	0.074	0.076	0.290	0.245	0.202	0.208	0.216	0.987	0.834	0.686	0.708	0.734
Short-rotation coppice: Erosion areas	0.115	0.097	0.080	0.083	0.086	0.326	0.275	0.227	0.234	0.242	1.108	0.936	0.770	0.795	0.824

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 12-16 by the respective mean transport distances of scenario *Max 2* given in Table S.32, row C.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.50: Transport Fuel Costs for Biomass Transportation, Germany, 2015-2050 – Price Path C, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.103	0.106	0.107	0.111	0.115	0.291	0.301	0.303	0.313	0.324	0.988	1.022	1.029	1.063	1.102
Forestry residues	0.106	0.110	0.111	0.114	0.118	0.300	0.310	0.313	0.323	0.335	1.020	1.055	1.063	1.098	1.137
Open-country biomass residues	0.103	0.106	0.107	0.111	0.114	0.290	0.300	0.303	0.313	0.324	0.987	1.021	1.028	1.062	1.100
Industrial wood waste	0.103	0.107	0.107	0.111	0.115	0.291	0.301	0.304	0.314	0.325	0.990	1.024	1.032	1.066	1.104
Wood in municipal solid waste	0.106	0.110	0.111	0.114	0.118	0.300	0.311	0.313	0.323	0.335	1.021	1.056	1.064	1.099	1.139
Green waste: Compensation areas	0.101	0.105	0.105	0.109	0.113	0.286	0.296	0.298	0.308	0.319	0.971	1.005	1.012	1.045	1.083
Biomass: Habitat-connectivity areas	0.103	0.106	0.107	0.111	0.114	0.290	0.300	0.303	0.313	0.324	0.987	1.021	1.028	1.062	1.100
Green waste: Extensive grassland	0.103	0.106	0.107	0.111	0.114	0.290	0.300	0.303	0.313	0.324	0.987	1.021	1.028	1.062	1.100
Short-rotation coppice: Erosion areas	0.115	0.119	0.120	0.124	0.129	0.326	0.337	0.340	0.351	0.364	1.108	1.146	1.155	1.193	1.236

Sources: Own calculation, multiplying the transport fuel costs for biomass transports from Table S.39, columns 12-16 by the respective mean transport distances of scenario *Min 2* given in Table S.32, row D.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.51: Equipment and Labor Costs for Biochar Transports

			Small-scale pyrolysis units	Medium-scale pyrolysis units	Large-scale pyrolysis units
Average costs[a]	$€_{2012}$/(t_{FW} freight · km)	(A)	1.7	0.8	0.4

	Char yields[b]	Costs for equipment and labor[c]		
	$wt\%_{db}$	$€_{2012}$/(t_{DM} feedstock · km)		
Feedstocks	(1)	(2)	(3)	(4)
Cereal straw	34	0.58	0.27	0.14
Forestry residues	30	0.51	0.24	0.12
Open-country biomass residues	31	0.53	0.25	0.12
Industrial wood waste	29	0.49	0.23	0.12
Wood in municipal solid waste	30	0.51	0.24	0.12
Green waste: Compensation areas	32	0.54	0.26	0.13
Biomass: Habitat-connectivity areas	31	0.53	0.25	0.12
Green waste: Extensive grassland	31	0.53	0.25	0.12
Short-rotation coppice: Erosion areas	25	0.43	0.20	0.10
Solid cattle manure	47	0.80	0.38	0.19
Solid swine manure	47	0.80	0.38	0.19
Solid poultry manure	44	0.75	0.35	0.18
Commercial and industrial waste	37	0.63	0.30	0.15
Organic municipal solid waste	45	0.77	0.36	0.18

Sources:

a) Table S.33, column 7, i.e. the 5-km value is assigned to small-scale pyrolysis units since these tend to be associated with transport distances around 5 km (see Table S.32), while the average of the values for 10 to 20 km (25 to 70 km) is assigned to medium-scale (large-scale) pyrolysis units since the corresponding transport distances given in Table S.32 tend to be in the respective ranges.

b) Teichmann (2014a: Table 8, column 6). The char yields are based on feedstock dry weight. No differentiation takes place between biochar fresh weight and biochar dry weight.

c) Own calculation, transforming the respective values from row A into t_{DM}-feedstock basis using the char yields from column 1, e.g., (2) = 1.7 · (1)/100.

Notes: Values rounded. DM = dry mass. FW = fresh weight. t = tonne. wt% = weight percent. db = dry base. km = kilometer.

Table S.52: Equipment and Labor Costs for Biochar Transportation, Germany, 2015-2050, Scenario *Min 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	3.4	3.3	2.9	2.9	2.9	4.6	4.3	3.9	3.8	3.8	7.8	7.4	6.6	6.5	6.5
Forestry residues	3.0	2.9	2.6	2.5	2.5	4.0	3.8	3.4	3.4	3.4	6.8	6.5	5.8	5.8	5.7
Open-country biomass residues	3.1	3.0	2.7	2.6	2.6	4.2	4.0	3.5	3.5	3.5	7.1	6.7	6.0	5.9	5.9
Industrial wood waste	2.9	2.8	2.5	2.5	2.4	3.9	3.7	3.3	3.3	3.2	6.6	6.3	5.6	5.6	5.5
Wood in municipal solid waste	3.0	2.9	2.6	2.5	2.5	4.0	3.8	3.4	3.4	3.4	6.8	6.5	5.8	5.8	5.7
Green waste: Compensation areas	3.2	3.1	2.7	2.7	2.7	4.3	4.1	3.6	3.6	3.6	7.3	6.9	6.2	6.1	6.1
Biomass: Habitat-connectivity areas	3.1	3.0	2.7	2.6	2.6	4.2	4.0	3.5	3.5	3.5	7.1	6.7	6.0	5.9	5.9
Green waste: Extensive grassland	3.1	3.0	2.7	2.6	2.6	4.2	4.0	3.5	3.5	3.5	7.1	6.7	6.0	5.9	5.9
Short-rotation coppice: Erosion areas	2.5	2.4	2.1	2.1	2.1	3.4	3.2	2.9	2.8	2.8	5.7	5.4	4.8	4.8	4.8
Solid cattle manure	4.7	4.5	4.0	4.0	4.0	6.3	6.0	5.4	5.3	5.3	10.7	10.2	9.1	9.0	8.9
Solid swine manure	4.7	4.5	4.0	4.0	4.0	6.3	6.0	5.4	5.3	5.3	10.7	10.2	9.1	9.0	8.9
Solid poultry manure	4.4	4.2	3.8	3.7	3.7	5.9	5.6	5.0	5.0	4.9	10.0	9.6	8.5	8.4	8.4
Commercial and industrial waste	3.7	3.6	3.2	3.1	3.1	5.0	4.7	4.2	4.2	4.1	8.4	8.0	7.2	7.1	7.0
Organic municipal solid waste	4.5	4.3	3.9	3.8	3.8	6.0	5.8	5.1	5.1	5.0	10.3	9.8	8.7	8.6	8.6

Sources: Own calculation, multiplying the equipment and labor costs for biochar transports from Table S.51, columns 2-4 by the mean transport distances of scenario *Min 1* given in Table S.32, row B.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.53: Equipment and Labor Costs for Biochar Transportation, Germany, 2015-2050, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	3.7	2.8	2.0	1.9	1.9	4.9	3.8	2.6	2.6	2.6	8.3	6.4	4.4	4.4	4.4
Forestry residues	3.3	2.5	1.7	1.7	1.7	4.3	3.3	2.3	2.3	2.3	7.4	5.6	3.9	3.9	3.9
Open-country biomass residues	3.4	2.6	1.8	1.8	1.8	4.5	3.4	2.4	2.4	2.3	7.6	5.8	4.0	4.0	4.0
Industrial wood waste	3.1	2.4	1.7	1.7	1.6	4.2	3.2	2.2	2.2	2.2	7.1	5.5	3.8	3.8	3.7
Wood in municipal solid waste	3.3	2.5	1.7	1.7	1.7	4.3	3.3	2.3	2.3	2.3	7.4	5.6	3.9	3.9	3.9
Green waste: Compensation areas	3.5	2.7	1.8	1.8	1.8	4.6	3.5	2.5	2.4	2.4	7.8	6.0	4.2	4.1	4.1
Biomass: Habitat-connectivity areas	3.4	2.6	1.8	1.8	1.8	4.5	3.4	2.4	2.4	2.3	7.6	5.8	4.0	4.0	4.0
Green waste: Extensive grassland	3.4	2.6	1.8	1.8	1.8	4.5	3.4	2.4	2.4	2.3	7.6	5.8	4.0	4.0	4.0
Short-rotation coppice: Erosion areas	2.7	2.1	1.4	1.4	1.4	3.6	2.8	1.9	1.9	1.9	6.1	4.7	3.3	3.2	3.2

Sources: Own calculation, multiplying the equipment and labor costs for biochar transports from Table S.51, columns 2-4 by the mean transport distances of scenario *Max 2* given in Table S.32, row C.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.54: Equipment and Labor Costs for Biochar Transportation, Germany, 2015-2050, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	3.7	3.5	2.9	2.9	2.9	4.9	4.6	3.9	3.9	3.9	8.3	7.8	6.7	6.6	6.5
Forestry residues	3.3	3.1	2.6	2.6	2.6	4.3	4.1	3.5	3.4	3.4	7.4	6.9	5.9	5.8	5.8
Open-country biomass residues	3.4	3.2	2.7	2.7	2.6	4.5	4.2	3.6	3.5	3.5	7.6	7.1	6.1	6.0	6.0
Industrial wood waste	3.1	3.0	2.5	2.5	2.5	4.2	3.9	3.3	3.3	3.3	7.1	6.7	5.7	5.6	5.6
Wood in municipal solid waste	3.3	3.1	2.6	2.6	2.6	4.3	4.1	3.5	3.4	3.4	7.4	6.9	5.9	5.8	5.8
Green waste: Compensation areas	3.5	3.3	2.8	2.7	2.7	4.6	4.3	3.7	3.7	3.6	7.8	7.4	6.3	6.2	6.2
Biomass: Habitat-connectivity areas	3.4	3.2	2.7	2.7	2.6	4.5	4.2	3.6	3.5	3.5	7.6	7.1	6.1	6.0	6.0
Green waste: Extensive grassland	3.4	3.2	2.7	2.7	2.6	4.5	4.2	3.6	3.5	3.5	7.6	7.1	6.1	6.0	6.0
Short-rotation coppice: Erosion areas	2.7	2.5	2.2	2.1	2.1	3.6	3.4	2.9	2.9	2.8	6.1	5.8	4.9	4.8	4.8

Sources: Own calculation, multiplying the equipment and labor costs for biochar transports from Table S.51, columns 2-4 by the mean transport distances of scenario *Min 2* given in Table S.32, row D.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.55: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050

	Char yields[a]	Price path A[b]					Price path B[c]					Price path C[d]				
		2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	$wt\%_{db}$	$€_{2012}/(t_{DM}$ feedstock · km)					$€_{2012}/(t_{DM}$ feedstock · km)					$€_{2012}/(t_{DM}$ feedstock · km)				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Cereal straw	34	0.005	0.007	0.008	0.009	0.010	0.005	0.006	0.007	0.008	0.009	0.005	0.006	0.007	0.007	0.007
Forestry residues	30	0.004	0.006	0.007	0.008	0.009	0.004	0.005	0.007	0.007	0.008	0.004	0.005	0.006	0.006	0.006
Open-country biomass residues	31	0.005	0.006	0.008	0.008	0.009	0.005	0.006	0.007	0.007	0.008	0.005	0.005	0.006	0.006	0.007
Industrial wood waste	29	0.004	0.006	0.007	0.008	0.008	0.004	0.005	0.006	0.007	0.007	0.004	0.005	0.006	0.006	0.006
Wood in municipal solid waste	30	0.004	0.006	0.007	0.008	0.009	0.004	0.005	0.007	0.007	0.008	0.004	0.005	0.006	0.006	0.006
Green waste: Compensation areas	32	0.005	0.007	0.008	0.009	0.009	0.005	0.006	0.007	0.008	0.008	0.005	0.005	0.006	0.006	0.007
Biomass: Habitat-connectivity areas	31	0.005	0.006	0.008	0.008	0.009	0.005	0.006	0.007	0.007	0.008	0.005	0.005	0.006	0.006	0.007
Green waste: Extensive grassland	31	0.005	0.006	0.008	0.008	0.009	0.005	0.006	0.007	0.007	0.008	0.005	0.005	0.006	0.006	0.007
Short-rotation coppice: Erosion areas	25	0.004	0.005	0.006	0.007	0.007	0.004	0.004	0.005	0.006	0.006	0.004	0.004	0.005	0.005	0.005
Solid cattle manure	47	0.007	0.010	0.012	0.013	0.013	0.007	0.008	0.010	0.011	0.012	0.007	0.008	0.009	0.009	0.010
Solid swine manure	47	0.007	0.010	0.012	0.013	0.013	0.007	0.008	0.010	0.011	0.012	0.007	0.008	0.009	0.009	0.010
Solid poultry manure	44	0.007	0.009	0.011	0.012	0.013	0.007	0.008	0.010	0.010	0.011	0.007	0.007	0.009	0.009	0.009
Commercial and industrial waste	37	0.005	0.008	0.009	0.010	0.011	0.005	0.007	0.008	0.009	0.009	0.005	0.006	0.007	0.007	0.008
Organic municipal solid waste	45	0.007	0.009	0.011	0.012	0.013	0.007	0.008	0.010	0.011	0.011	0.007	0.007	0.009	0.009	0.009

Sources:

a) Teichmann (2014a: Table 8, column 6). The char yields are based on feedstock dry weight. No differentiation takes place between biochar fresh weight and biochar dry weight.

b) Own calculation, transforming the values from Table S.38, row K (referring to the transportation of biochar) into t_{DM}-feedstock basis using the char yields from column 1, e.g., (2) = Table S.38 (row K, column 1) · (1)/100.

c) Own calculation, transforming the values from Table S.38, row L (referring to the transportation of biochar) into t_{DM}-feedstock basis using the char yields from column 1, e.g., (7) = Table S.38 (row L, column 1) · (1)/100.

d) Own calculation, transforming the values from Table S.38, row M (referring to the transportation of biochar) into t_{DM}-feedstock basis using the char yields from column 1, e.g., (12) = Table S.38 (row M, column 1) · (1)/100.

Notes: Values rounded. DM = dry mass. t = tonne. wt% = weight percent. db = dry base. km = kilometer.

Table S.56: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path A, Scenario *Max 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.030	0.031	0.026	0.028	0.029	0.085	0.086	0.073	0.079	0.083	0.288	0.294	0.249	0.269	0.283
Forestry residues	0.026	0.027	0.023	0.025	0.026	0.075	0.076	0.065	0.070	0.074	0.254	0.259	0.220	0.237	0.250
Open-country biomass residues	0.027	0.028	0.024	0.025	0.027	0.077	0.079	0.067	0.072	0.076	0.262	0.268	0.227	0.245	0.258
Industrial wood waste	0.026	0.026	0.022	0.024	0.025	0.072	0.074	0.063	0.067	0.071	0.245	0.251	0.213	0.229	0.242
Wood in municipal solid waste	0.026	0.027	0.023	0.025	0.026	0.075	0.076	0.065	0.070	0.074	0.254	0.259	0.220	0.237	0.250
Green waste: Compensation areas	0.028	0.029	0.024	0.026	0.028	0.080	0.081	0.069	0.074	0.078	0.271	0.277	0.235	0.253	0.266
Biomass: Habitat-connectivity areas	0.027	0.028	0.024	0.025	0.027	0.077	0.079	0.067	0.072	0.076	0.262	0.268	0.227	0.245	0.258
Green waste: Extensive grassland	0.027	0.028	0.024	0.025	0.027	0.077	0.079	0.067	0.072	0.076	0.262	0.268	0.227	0.245	0.258
Short-rotation coppice: Erosion areas	0.022	0.022	0.019	0.021	0.022	0.062	0.064	0.054	0.058	0.061	0.211	0.216	0.183	0.198	0.208
Solid cattle manure	0.041	0.042	0.036	0.039	0.041	0.117	0.119	0.101	0.109	0.115	0.398	0.406	0.345	0.371	0.391
Solid swine manure	0.041	0.042	0.036	0.039	0.041	0.117	0.119	0.101	0.109	0.115	0.398	0.406	0.345	0.371	0.391
Solid poultry manure	0.039	0.040	0.034	0.036	0.038	0.110	0.112	0.095	0.102	0.108	0.372	0.380	0.323	0.348	0.366
Commercial and industrial waste	0.033	0.033	0.028	0.030	0.032	0.092	0.094	0.080	0.086	0.091	0.313	0.320	0.271	0.292	0.308
Organic municipal solid waste	0.040	0.040	0.034	0.037	0.039	0.112	0.114	0.097	0.105	0.110	0.381	0.389	0.330	0.356	0.375

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 2-6 by the respective mean transport distances of scenario *Max 1* given in Table S.32, row A.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.57: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path A, Scenario *Min 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.030	0.039	0.042	0.046	0.048	0.085	0.112	0.120	0.129	0.136	0.288	0.379	0.407	0.439	0.462
Forestry residues	0.026	0.035	0.037	0.040	0.042	0.075	0.098	0.106	0.114	0.120	0.254	0.335	0.359	0.387	0.408
Open-country biomass residues	0.027	0.036	0.039	0.042	0.044	0.077	0.102	0.109	0.118	0.124	0.262	0.346	0.371	0.400	0.422
Industrial wood waste	0.026	0.034	0.036	0.039	0.041	0.072	0.095	0.102	0.110	0.116	0.245	0.324	0.347	0.374	0.394
Wood in municipal solid waste	0.026	0.035	0.037	0.040	0.042	0.075	0.098	0.106	0.114	0.120	0.254	0.335	0.359	0.387	0.408
Green waste: Compensation areas	0.028	0.037	0.040	0.043	0.045	0.080	0.105	0.113	0.121	0.128	0.271	0.357	0.383	0.413	0.435
Biomass: Habitat-connectivity areas	0.027	0.036	0.039	0.042	0.044	0.077	0.102	0.109	0.118	0.124	0.262	0.346	0.371	0.400	0.422
Green waste: Extensive grassland	0.027	0.036	0.039	0.042	0.044	0.077	0.102	0.109	0.118	0.124	0.262	0.346	0.371	0.400	0.422
Short-rotation coppice: Erosion areas	0.022	0.029	0.031	0.034	0.035	0.062	0.082	0.088	0.095	0.100	0.211	0.279	0.299	0.323	0.340
Solid cattle manure	0.041	0.055	0.059	0.063	0.066	0.117	0.154	0.166	0.178	0.188	0.398	0.524	0.563	0.606	0.639
Solid swine manure	0.041	0.055	0.059	0.063	0.066	0.117	0.154	0.166	0.178	0.188	0.398	0.524	0.563	0.606	0.639
Solid poultry manure	0.039	0.051	0.055	0.059	0.062	0.110	0.144	0.155	0.167	0.176	0.372	0.491	0.527	0.568	0.598
Commercial and industrial waste	0.033	0.043	0.046	0.050	0.052	0.092	0.121	0.130	0.140	0.148	0.313	0.413	0.443	0.477	0.503
Organic municipal solid waste	0.040	0.052	0.056	0.060	0.064	0.112	0.148	0.159	0.171	0.180	0.381	0.502	0.539	0.581	0.612

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 2-6 by the respective mean transport distances of scenario *Min 1* given in Table S.32, row B.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.58: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path A, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.032	0.034	0.029	0.031	0.032	0.091	0.097	0.081	0.087	0.092	0.309	0.329	0.274	0.296	0.312
Forestry residues	0.028	0.030	0.025	0.027	0.029	0.080	0.085	0.071	0.077	0.081	0.273	0.290	0.242	0.261	0.275
Open-country biomass residues	0.029	0.031	0.026	0.028	0.030	0.083	0.088	0.074	0.079	0.084	0.282	0.300	0.250	0.270	0.284
Industrial wood waste	0.027	0.029	0.024	0.026	0.028	0.078	0.082	0.069	0.074	0.078	0.264	0.280	0.234	0.252	0.266
Wood in municipal solid waste	0.028	0.030	0.025	0.027	0.029	0.080	0.085	0.071	0.077	0.081	0.273	0.290	0.242	0.261	0.275
Green waste: Compensation areas	0.030	0.032	0.027	0.029	0.031	0.086	0.091	0.076	0.082	0.086	0.291	0.309	0.258	0.279	0.293
Biomass: Habitat-connectivity areas	0.029	0.031	0.026	0.028	0.030	0.083	0.088	0.074	0.079	0.084	0.282	0.300	0.250	0.270	0.284
Green waste: Extensive grassland	0.029	0.031	0.026	0.028	0.030	0.083	0.088	0.074	0.079	0.084	0.282	0.300	0.250	0.270	0.284
Short-rotation coppice: Erosion areas	0.024	0.025	0.021	0.023	0.024	0.067	0.071	0.059	0.064	0.067	0.227	0.242	0.202	0.218	0.229

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 2-6 by the respective mean transport distances of scenario *Max 2* given in Table S.32, row C.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.59: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path A, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.032	0.042	0.043	0.046	0.049	0.091	0.118	0.121	0.131	0.138	0.309	0.402	0.412	0.444	0.468
Forestry residues	0.028	0.037	0.038	0.041	0.043	0.080	0.104	0.107	0.115	0.121	0.273	0.355	0.363	0.392	0.413
Open-country biomass residues	0.029	0.038	0.039	0.042	0.044	0.083	0.108	0.110	0.119	0.125	0.282	0.367	0.375	0.405	0.426
Industrial wood waste	0.027	0.036	0.037	0.039	0.042	0.078	0.101	0.103	0.111	0.117	0.264	0.343	0.351	0.379	0.399
Wood in municipal solid waste	0.028	0.037	0.038	0.041	0.043	0.080	0.104	0.107	0.115	0.121	0.273	0.355	0.363	0.392	0.413
Green waste: Compensation areas	0.030	0.039	0.040	0.043	0.046	0.086	0.111	0.114	0.123	0.130	0.291	0.379	0.387	0.418	0.440
Biomass: Habitat-connectivity areas	0.029	0.038	0.039	0.042	0.044	0.083	0.108	0.110	0.119	0.125	0.282	0.367	0.375	0.405	0.426
Green waste: Extensive grassland	0.029	0.038	0.039	0.042	0.044	0.083	0.108	0.110	0.119	0.125	0.282	0.367	0.375	0.405	0.426
Short-rotation coppice: Erosion areas	0.024	0.031	0.031	0.034	0.036	0.067	0.087	0.089	0.096	0.101	0.227	0.296	0.303	0.326	0.344

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 2-6 by the respective mean transport distances of scenario *Min 2* given in Table S.32, row D.
Notes: Values rounded. DM = dry mass. t = tonne.

Table S.60: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path B, Scenario *Min 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.030	0.034	0.037	0.040	0.042	0.085	0.096	0.106	0.112	0.119	0.288	0.328	0.360	0.382	0.405
Forestry residues	0.026	0.030	0.033	0.035	0.037	0.075	0.085	0.093	0.099	0.105	0.254	0.289	0.317	0.337	0.357
Open-country biomass residues	0.027	0.031	0.034	0.036	0.038	0.077	0.088	0.096	0.103	0.109	0.262	0.299	0.328	0.349	0.369
Industrial wood waste	0.026	0.029	0.032	0.034	0.036	0.072	0.082	0.090	0.096	0.102	0.245	0.279	0.307	0.326	0.345
Wood in municipal solid waste	0.026	0.030	0.033	0.035	0.037	0.075	0.085	0.093	0.099	0.105	0.254	0.289	0.317	0.337	0.357
Green waste: Compensation areas	0.028	0.032	0.035	0.037	0.040	0.080	0.091	0.100	0.106	0.112	0.271	0.308	0.339	0.360	0.381
Biomass: Habitat-connectivity areas	0.027	0.031	0.034	0.036	0.038	0.077	0.088	0.096	0.103	0.109	0.262	0.299	0.328	0.349	0.369
Green waste: Extensive grassland	0.027	0.031	0.034	0.036	0.038	0.077	0.088	0.096	0.103	0.109	0.262	0.299	0.328	0.349	0.369
Short-rotation coppice: Erosion areas	0.022	0.025	0.028	0.029	0.031	0.062	0.071	0.078	0.083	0.088	0.211	0.241	0.264	0.281	0.297
Solid cattle manure	0.041	0.047	0.052	0.055	0.058	0.117	0.133	0.146	0.156	0.165	0.398	0.453	0.497	0.528	0.559
Solid swine manure	0.041	0.047	0.052	0.055	0.058	0.117	0.133	0.146	0.156	0.165	0.398	0.453	0.497	0.528	0.559
Solid poultry manure	0.039	0.044	0.048	0.051	0.054	0.110	0.125	0.137	0.146	0.154	0.372	0.424	0.465	0.495	0.524
Commercial and industrial waste	0.033	0.037	0.041	0.043	0.046	0.092	0.105	0.115	0.122	0.130	0.313	0.356	0.391	0.416	0.440
Organic municipal solid waste	0.040	0.045	0.050	0.053	0.056	0.112	0.128	0.140	0.149	0.158	0.381	0.434	0.476	0.506	0.535

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 7-11 by the respective mean transport distances of scenario *Min 1* given in Table S.32, row B.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.61: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path B, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.032	0.030	0.025	0.027	0.028	0.091	0.083	0.071	0.076	0.080	0.309	0.284	0.242	0.258	0.273
Forestry residues	0.028	0.026	0.022	0.024	0.025	0.080	0.074	0.063	0.067	0.071	0.273	0.250	0.214	0.228	0.241
Open-country biomass residues	0.029	0.027	0.023	0.024	0.026	0.083	0.076	0.065	0.069	0.073	0.282	0.259	0.221	0.235	0.249
Industrial wood waste	0.027	0.025	0.022	0.023	0.024	0.078	0.071	0.061	0.065	0.068	0.264	0.242	0.207	0.220	0.233
Wood in municipal solid waste	0.028	0.026	0.022	0.024	0.025	0.080	0.074	0.063	0.067	0.071	0.273	0.250	0.214	0.228	0.241
Green waste: Compensation areas	0.030	0.028	0.024	0.025	0.027	0.086	0.079	0.067	0.071	0.076	0.291	0.267	0.228	0.243	0.257
Biomass: Habitat-connectivity areas	0.029	0.027	0.023	0.024	0.026	0.083	0.076	0.065	0.069	0.073	0.282	0.259	0.221	0.235	0.249
Green waste: Extensive grassland	0.029	0.027	0.023	0.024	0.026	0.083	0.076	0.065	0.069	0.073	0.282	0.259	0.221	0.235	0.249
Short-rotation coppice: Erosion areas	0.024	0.022	0.019	0.020	0.021	0.067	0.061	0.052	0.056	0.059	0.227	0.209	0.178	0.190	0.201

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 7-11 by the respective mean transport distances of scenario *Max 2* given in Table S.32, row C.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.62: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path B, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.032	0.036	0.038	0.040	0.043	0.091	0.102	0.107	0.114	0.120	0.309	0.347	0.364	0.387	0.409
Forestry residues	0.028	0.032	0.033	0.036	0.038	0.080	0.090	0.094	0.100	0.106	0.273	0.307	0.321	0.341	0.361
Open-country biomass residues	0.029	0.033	0.034	0.037	0.039	0.083	0.093	0.098	0.104	0.110	0.282	0.317	0.331	0.353	0.373
Industrial wood waste	0.027	0.031	0.032	0.034	0.036	0.078	0.087	0.091	0.097	0.103	0.264	0.296	0.310	0.330	0.349
Wood in municipal solid waste	0.028	0.032	0.033	0.036	0.038	0.080	0.090	0.094	0.100	0.106	0.273	0.307	0.321	0.341	0.361
Green waste: Compensation areas	0.030	0.034	0.036	0.038	0.040	0.086	0.096	0.101	0.107	0.113	0.291	0.327	0.342	0.364	0.385
Biomass: Habitat-connectivity areas	0.029	0.033	0.034	0.037	0.039	0.083	0.093	0.098	0.104	0.110	0.282	0.317	0.331	0.353	0.373
Green waste: Extensive grassland	0.029	0.033	0.034	0.037	0.039	0.083	0.093	0.098	0.104	0.110	0.282	0.317	0.331	0.353	0.373
Short-rotation coppice: Erosion areas	0.024	0.027	0.028	0.030	0.031	0.067	0.075	0.079	0.084	0.089	0.227	0.255	0.267	0.284	0.301

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 7-11 by the respective mean transport distances of scenario *Min 2* given in Table S.32, row D.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.63: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path C, Scenario *Max 1*

Feedstocks	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.030	0.024	0.020	0.021	0.022	0.085	0.069	0.057	0.059	0.061	0.288	0.234	0.195	0.201	0.209
Forestry residues	0.026	0.021	0.018	0.018	0.019	0.075	0.061	0.051	0.052	0.054	0.254	0.206	0.172	0.178	0.184
Open-country biomass residues	0.027	0.022	0.019	0.019	0.020	0.077	0.063	0.052	0.054	0.056	0.262	0.213	0.178	0.184	0.190
Industrial wood waste	0.026	0.021	0.017	0.018	0.019	0.072	0.059	0.049	0.051	0.052	0.245	0.199	0.167	0.172	0.178
Wood in municipal solid waste	0.026	0.021	0.018	0.018	0.019	0.075	0.061	0.051	0.052	0.054	0.254	0.206	0.172	0.178	0.184
Green waste: Compensation areas	0.028	0.023	0.019	0.020	0.020	0.080	0.065	0.054	0.056	0.058	0.271	0.220	0.184	0.190	0.197
Biomass: Habitat-connectivity areas	0.027	0.022	0.019	0.019	0.020	0.077	0.063	0.052	0.054	0.056	0.262	0.213	0.178	0.184	0.190
Green waste: Extensive grassland	0.027	0.022	0.019	0.019	0.020	0.077	0.063	0.052	0.054	0.056	0.262	0.213	0.178	0.184	0.190
Short-rotation coppice: Erosion areas	0.022	0.018	0.015	0.015	0.016	0.062	0.051	0.042	0.044	0.045	0.211	0.172	0.144	0.148	0.154
Solid cattle manure	0.041	0.034	0.028	0.029	0.030	0.117	0.095	0.079	0.082	0.085	0.398	0.323	0.270	0.279	0.289
Solid swine manure	0.041	0.034	0.028	0.029	0.030	0.117	0.095	0.079	0.082	0.085	0.398	0.323	0.270	0.279	0.289
Solid poultry manure	0.039	0.031	0.026	0.027	0.028	0.110	0.089	0.074	0.077	0.080	0.372	0.302	0.253	0.261	0.270
Commercial and industrial waste	0.033	0.026	0.022	0.023	0.024	0.092	0.075	0.063	0.065	0.067	0.313	0.254	0.213	0.219	0.227
Organic municipal solid waste	0.040	0.032	0.027	0.028	0.029	0.112	0.091	0.076	0.078	0.081	0.381	0.309	0.259	0.267	0.276

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 12-16 by the respective mean transport distances of scenario *Max 1* given in Table S.32, row A.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.64: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path C, Scenario *Min 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.030	0.031	0.033	0.034	0.035	0.085	0.089	0.094	0.097	0.100	0.288	0.302	0.319	0.329	0.341
Forestry residues	0.026	0.028	0.029	0.030	0.031	0.075	0.078	0.083	0.085	0.089	0.254	0.266	0.281	0.290	0.301
Open-country biomass residues	0.027	0.029	0.030	0.031	0.032	0.077	0.081	0.086	0.088	0.091	0.262	0.275	0.291	0.300	0.311
Industrial wood waste	0.026	0.027	0.028	0.029	0.030	0.072	0.076	0.080	0.083	0.086	0.245	0.257	0.272	0.281	0.291
Wood in municipal solid waste	0.026	0.028	0.029	0.030	0.031	0.075	0.078	0.083	0.085	0.089	0.254	0.266	0.281	0.290	0.301
Green waste: Compensation areas	0.028	0.030	0.031	0.032	0.033	0.080	0.084	0.088	0.091	0.094	0.271	0.284	0.300	0.310	0.321
Biomass: Habitat-connectivity areas	0.027	0.029	0.030	0.031	0.032	0.077	0.081	0.086	0.088	0.091	0.262	0.275	0.291	0.300	0.311
Green waste: Extensive grassland	0.027	0.029	0.030	0.031	0.032	0.077	0.081	0.086	0.088	0.091	0.262	0.275	0.291	0.300	0.311
Short-rotation coppice: Erosion areas	0.022	0.023	0.024	0.025	0.026	0.062	0.065	0.069	0.071	0.074	0.211	0.222	0.235	0.242	0.251
Solid cattle manure	0.041	0.043	0.046	0.047	0.049	0.117	0.123	0.130	0.134	0.139	0.398	0.417	0.441	0.455	0.471
Solid swine manure	0.041	0.043	0.046	0.047	0.049	0.117	0.123	0.130	0.134	0.139	0.398	0.417	0.441	0.455	0.471
Solid poultry manure	0.039	0.041	0.043	0.044	0.046	0.110	0.115	0.121	0.125	0.130	0.372	0.390	0.413	0.426	0.441
Commercial and industrial waste	0.033	0.034	0.036	0.037	0.039	0.092	0.097	0.102	0.105	0.109	0.313	0.328	0.347	0.358	0.371
Organic municipal solid waste	0.040	0.042	0.044	0.045	0.047	0.112	0.117	0.124	0.128	0.133	0.381	0.399	0.422	0.435	0.451

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 12-16 by the respective mean transport distances of scenario *Min 1* given in Table S.32, row B.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.65: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path C, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.032	0.027	0.022	0.023	0.024	0.091	0.077	0.063	0.065	0.068	0.309	0.261	0.215	0.222	0.230
Forestry residues	0.028	0.024	0.020	0.020	0.021	0.080	0.068	0.056	0.058	0.060	0.273	0.231	0.190	0.196	0.203
Open-country biomass residues	0.029	0.025	0.020	0.021	0.022	0.083	0.070	0.058	0.060	0.062	0.282	0.238	0.196	0.202	0.210
Industrial wood waste	0.027	0.023	0.019	0.020	0.020	0.078	0.066	0.054	0.056	0.058	0.264	0.223	0.183	0.189	0.196
Wood in municipal solid waste	0.028	0.024	0.020	0.020	0.021	0.080	0.068	0.056	0.058	0.060	0.273	0.231	0.190	0.196	0.203
Green waste: Compensation areas	0.030	0.026	0.021	0.022	0.023	0.086	0.072	0.060	0.061	0.064	0.291	0.246	0.202	0.209	0.216
Biomass: Habitat-connectivity areas	0.029	0.025	0.020	0.021	0.022	0.083	0.070	0.058	0.060	0.062	0.282	0.238	0.196	0.202	0.210
Green waste: Extensive grassland	0.029	0.025	0.020	0.021	0.022	0.083	0.070	0.058	0.060	0.062	0.282	0.238	0.196	0.202	0.210
Short-rotation coppice: Erosion areas	0.024	0.020	0.016	0.017	0.018	0.067	0.057	0.046	0.048	0.050	0.227	0.192	0.158	0.163	0.169

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 12-16 by the respective mean transport distances of scenario *Max 2* given in Table S.32, row C.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.66: Transport Fuel Costs for Biochar Transportation, Germany, 2015-2050 – Price Path C, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	0.032	0.033	0.034	0.035	0.036	0.091	0.094	0.095	0.098	0.102	0.309	0.320	0.322	0.333	0.345
Forestry residues	0.028	0.029	0.030	0.031	0.032	0.080	0.083	0.084	0.086	0.090	0.273	0.282	0.284	0.294	0.304
Open-country biomass residues	0.029	0.030	0.031	0.032	0.033	0.083	0.086	0.086	0.089	0.093	0.282	0.292	0.294	0.304	0.315
Industrial wood waste	0.027	0.028	0.029	0.030	0.031	0.078	0.080	0.081	0.084	0.087	0.264	0.273	0.275	0.284	0.294
Wood in municipal solid waste	0.028	0.029	0.030	0.031	0.032	0.080	0.083	0.084	0.086	0.090	0.273	0.282	0.284	0.294	0.304
Green waste: Compensation areas	0.030	0.031	0.032	0.033	0.034	0.086	0.089	0.089	0.092	0.096	0.291	0.301	0.303	0.313	0.325
Biomass: Habitat-connectivity areas	0.029	0.030	0.031	0.032	0.033	0.083	0.086	0.086	0.089	0.093	0.282	0.292	0.294	0.304	0.315
Green waste: Extensive grassland	0.029	0.030	0.031	0.032	0.033	0.083	0.086	0.086	0.089	0.093	0.282	0.292	0.294	0.304	0.315
Short-rotation coppice: Erosion areas	0.024	0.024	0.025	0.025	0.026	0.067	0.069	0.070	0.072	0.075	0.227	0.235	0.237	0.245	0.254

Sources: Own calculation, multiplying the transport fuel costs for biochar transports from Table S.55, columns 12-16 by the respective mean transport distances of scenario *Min 2* given in Table S.32, row D.

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.67: Time-Constant Net Costs of Biochar, Germany, 2015-2050

	Net feedstock costs[a]	Other operational costs for pyrolysis			Avoided costs of		Net loading costs for biomass transports[g]	Avoided equipment and labor costs of		Net unloading costs of biochar[j]	Costs of biochar storage			Net equipment and labor costs for biochar soil addition[n]	Total time-constant net costs of biochar		
		S[b]	M[c]	L[d]	Manure management[e]	Composting[f]		Biomass transports[h]	Transports of composts[i]		S[k]	M[l]	L[m]		Small-scale pyrolysis units[o]	Medium-scale pyrolysis units[p]	Large-scale pyrolysis units[q]
	€$_{2012}$/t$_{DM}$ feedstock	€$_{2012}$/t$_{DM}$ feedstock			€$_{2012}$/t$_{DM}$ feedstock		€$_{2012}$/t$_{DM}$ feedstock	€$_{2012}$/t$_{DM}$ feedstock		€$_{2012}$/t$_{DM}$ feedstock	€$_{2012}$/t$_{DM}$ feedstock			€$_{2012}$/t$_{DM}$ feedstock	€$_{2012}$/t$_{DM}$ feedstock		
Feedstocks	(1)	(2a)	(2b)	(2c)	(3)	(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(9c)	(10)	(11a)	(11b)	(11c)
Cereal straw	44.2	38.8	44.1	3.6	-	-	3.6	-	-	1.1	2.9	6.1	4.1	2.1	**92.7**	**101.3**	**58.7**
Forestry residues	129.7	38.8	44.1	3.6	-	-	0	-	-	1.0	2.5	5.4	3.6	1.9	**174.0**	**182.1**	**139.8**
Open-country biomass residues	0	38.8	44.1	3.6	-	-20.0	0	-9.8	-9.6	-2.5	2.6	5.6	3.7	-4.7	**-5.1**	**3.1**	**-39.2**
Industrial wood waste	0	38.8	44.1	3.6	-	-	0	-9.8	-	1.0	2.4	5.2	3.5	1.8	**34.2**	**42.3**	**0.1**
Wood in municipal solid waste	0	38.8	44.1	3.6	-	-20.7	0	-10.1	-9.6	-2.5	2.5	5.4	3.6	-4.8	**-6.3**	**1.8**	**-40.5**
Green waste: Compensation areas	43.5	38.8	44.1	3.6	-	-	3.5	-	-	1.1	2.7	5.8	3.8	2.0	**91.6**	**99.9**	**57.5**
Biomass: Habitat-connectivity areas	0	38.8	44.1	3.6	-	-20.0	0	-9.8	-9.6	-2.5	2.6	5.6	3.7	-4.7	**-5.1**	**3.1**	**-39.2**
Green waste: Extensive grassland	0	38.8	44.1	3.6	-	-20.0	0	-9.8	-9.6	-2.5	2.6	5.6	3.7	-4.7	**-5.1**	**3.1**	**-39.2**
Short-rotation coppice: Erosion areas	0	38.8	44.1	3.6	-	-	0	-11.0	-	0.8	2.1	4.5	3.0	1.6	**32.4**	**40.0**	**-2.0**
Solid cattle manure	0	38.8	44.1	3.6	-1.8	-	9.1	-	-	1.6	3.9	8.5	5.6	-9.1	**42.6**	**52.3**	**9.0**
Solid swine manure	0	38.8	44.1	3.6	-30.0	-	15.3	-	-	1.6	3.9	8.5	5.6	-17.4	**12.3**	**22.1**	**-21.2**
Solid poultry manure	0	38.8	44.1	3.6	-0	-	3.8	-	-	1.5	3.7	7.9	5.3	-2.3	**45.5**	**55.0**	**11.9**
Commercial and industrial waste	0	38.8	44.1	3.6	-	-149.6	0	-23.3	-9.6	-2.3	3.1	6.7	4.4	-4.3	**-147.2**	**-138.4**	**-181.1**
Organic municipal solid waste	0	38.8	44.1	3.6	-	-199.0	0	-30.9	-9.6	-2.0	3.8	8.1	5.4	-3.8	**-202.8**	**-193.2**	**-236.4**

Sources:
a) Table 12, column 3.
b) Table 18, row A, column 4.
c) Table 18, row B, column 4.
d) Table 18, row C, column 4.
e) Table 20, column 6; shown as negative value.
f) Table 21, column 3; shown as negative value.
g) Table 23, column 4.
h) Table 25, column 2; shown as negative value.
i) Table 29, column 1; shown as negative value.
j) Table 32, column 4.
k) Table 33, column 2.
l) Table 33, column 3.
m) Table 33, column 4.
n) Table 34, column 5.
o) (11a) = (1) + (2a) + (3) + (4) + (5) + (6) + (7) + (8) + (9a) + (10)
p) (11b) = (1) + (2b) + (3) + (4) + (5) + (6) + (7) + (8) + (9b) + (10)
q) (11c) = (1) + (2c) + (3) + (4) + (5) + (6) + (7) + (8) + (9c) + (10)

Notes: Values rounded. DM = dry mass. t = tonne. S = small-scale pyrolysis units. M = medium-scale pyrolysis units. L = large-scale pyrolysis units. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.68: Fossil-Fuel Dependent Net Costs of Biochar When Process Heat is Not Recovered, Germany, 2015-2050 – Price Path A

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€2012/tDM feedstock					€2012/tDM feedstock					€2012/tDM feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	105.6	92.7	84.1	77.0	68.4	89.2	74.0	56.5	39.5	20.9	60.2	40.6	11.7	-16.4	-45.3
Forestry residues	119.4	104.6	94.8	86.7	76.7	100.6	83.1	63.1	43.6	22.3	67.2	44.7	11.6	-20.6	-53.8
Open-country biomass residues	104.8	91.9	83.3	76.2	67.5	88.6	73.3	55.9	39.0	20.5	59.9	40.2	11.6	-16.3	-45.0
Industrial wood waste	40.3	66.2	85.5	100.9	119.8	78.1	109.6	147.5	184.6	225.1	148.6	189.7	253.4	315.5	379.4
Wood in municipal solid waste	119.0	104.1	94.1	86.0	76.0	100.2	82.6	62.5	42.9	21.6	66.9	44.2	11.0	-21.2	-54.4
Green waste: Compensation areas	96.6	85.0	77.4	71.1	63.4	82.0	68.4	52.9	37.7	21.1	56.4	38.8	13.2	-11.8	-37.6
Biomass: Habitat-connectivity areas	104.8	91.9	83.3	76.2	67.5	88.6	73.3	55.9	39.0	20.5	59.9	40.2	11.6	-16.3	-45.0
Green waste: Extensive grassland	104.8	91.9	83.3	76.2	67.5	88.6	73.3	55.9	39.0	20.5	59.9	40.2	11.6	-16.3	-45.0
Short-rotation coppice: Erosion areas	55.7	80.1	98.6	113.3	131.4	91.9	121.9	158.0	193.4	232.0	159.9	199.0	259.9	319.2	380.3
Solid cattle manure	110.0	111.7	115.9	118.5	121.8	119.1	122.6	129.2	135.7	142.8	140.8	145.8	158.2	170.2	182.7
Solid swine manure	153.2	165.3	179.7	190.0	202.6	182.9	200.3	225.7	250.5	277.6	246.8	270.5	315.3	359.0	404.0
Solid poultry manure	87.0	77.5	71.4	66.3	60.1	75.5	64.4	51.9	39.7	26.4	55.6	41.3	20.7	0.7	-19.9
Commercial and industrial waste	127.1	124.4	125.2	125.2	125.3	129.9	128.0	128.1	128.4	128.7	139.6	137.6	139.2	140.8	142.5
Organic municipal solid waste	101.5	110.7	121.2	128.8	138.2	123.4	136.5	155.2	173.7	193.9	170.3	187.9	221.1	253.5	286.9

Sources:

a) Own calculation, Table S.68 (columns 1-5) = Table S.11 (columns 1-5) + Table S.15 (columns 1-5) + Table 19 (rows A and D, respectively, columns 1-5) – Table S.30 (columns 1-5) – Table 27 (columns 2-6) – Table 31 (columns 1-5) + Table 35 (columns 2-6) – Table 36 (columns 2-6).

b) Own calculation, Table S.68 (columns 6-10) = Table S.11 (columns 6-10) + Table S.15 (columns 6-10) + Table 19 (rows A and D, respectively, columns 6-10) – Table S.30 (columns 6-10) – Table 27 (columns 2-6) – Table 31 (columns 1-5) + Table 35 (columns 2-6) – Table 36 (columns 2-6).

c) Own calculation, Table S.68 (columns 11-15) = Table S.11 (columns 11-15) + Table S.15 (columns 11-15) + Table 19 (rows A and D, respectively, columns 11-15) – Table S.30 (columns 11-15) – Table 27 (columns 2-6) – Table 31 (columns 1-5) + Table 35 (columns 2-6) – Table 36 (columns 2-6).

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.69: Fossil-Fuel Dependent Net Costs of Biochar When Process Heat is Not Recovered, Germany, 2015-2050 – Price Path B

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	105.6	94.6	89.3	84.1	76.9	90.8	79.5	68.0	56.5	47.0	66.1	50.0	30.4	14.3	1.2
Forestry residues	119.4	106.8	100.8	94.8	86.5	102.4	89.5	76.3	63.1	52.2	74.0	55.5	33.1	14.5	-0.4
Open-country biomass residues	104.8	93.8	88.5	83.3	76.1	90.1	78.9	67.4	56.0	46.5	65.8	49.6	30.2	14.1	1.2
Industrial wood waste	40.3	62.1	74.2	85.5	101.3	74.6	97.6	122.5	147.5	168.2	135.6	169.0	212.1	247.8	276.6
Wood in municipal solid waste	119.0	106.3	100.2	94.2	85.8	102.0	89.0	75.7	62.5	51.6	73.6	55.0	32.5	14.0	-1.0
Green waste: Compensation areas	96.6	86.7	82.0	77.4	70.9	83.4	73.3	63.1	52.9	44.4	61.6	47.2	29.8	15.4	3.8
Biomass: Habitat-connectivity areas	104.8	93.8	88.5	83.3	76.1	90.1	78.9	67.4	56.0	46.5	65.8	49.6	30.2	14.1	1.2
Green waste: Extensive grassland	104.8	93.8	88.5	83.3	76.1	90.1	78.9	67.4	56.0	46.5	65.8	49.6	30.2	14.1	1.2
Short-rotation coppice: Erosion areas	55.7	76.2	87.8	98.6	113.7	88.6	110.4	134.2	158.0	177.8	147.5	179.2	220.4	254.5	282.1
Solid cattle manure	110.0	111.0	113.9	115.9	118.6	118.5	120.5	124.8	129.2	132.8	138.3	141.8	150.2	157.1	162.7
Solid swine manure	153.2	162.6	172.1	179.7	190.3	180.6	192.3	209.0	225.7	239.5	237.7	255.9	286.3	311.4	331.6
Solid poultry manure	87.0	78.9	75.2	71.4	66.2	76.6	68.3	60.1	51.9	45.1	59.8	48.0	34.1	22.5	13.3
Commercial and industrial waste	127.1	124.4	125.2	125.2	125.3	129.8	128.0	128.0	128.2	128.3	139.2	137.2	138.2	139.1	139.8
Organic municipal solid waste	101.5	108.7	115.6	121.2	129.1	121.7	130.6	142.9	155.3	165.6	163.4	177.2	199.6	218.2	233.3

Sources:

a) Own calculation, Table S.69 (columns 1-5) = Table 14 (columns 1-5) + Table 16 (columns 1-5) + Table 19 (rows B and E, respectively, columns 1-5) – Table 22 (columns 1-5) – Table 27 (columns 7-11) – Table 31 (columns 6-10) + Table 35 (columns 7-11) – Table 36 (columns 7-11).

b) Own calculation, Table S.69 (columns 6-10) = Table 14 (columns 6-10) + Table 16 (columns 6-10) + Table 19 (rows B and E, respectively, columns 6-10) – Table 22 (columns 6-10) – Table 27 (columns 7-11) – Table 31 (columns 6-10) + Table 35 (columns 7-11) – Table 36 (columns 7-11).

c) Own calculation, Table S.69 (columns 11-15) = Table 14 (columns 11-15) + Table 16 (columns 11-15) + Table 19 (rows B and E, respectively, columns 11-15) – Table 22 (columns 11-15) – Table 27 (columns 7-11) – Table 31 (columns 6-10) + Table 35 (columns 7-11) – Table 36 (columns 7-11).

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading ‘S.’ refer to Teichmann (2015).

Table S.70: Fossil-Fuel Dependent Net Costs of Biochar When Process Heat is Not Recovered, Germany, 2015-2050 – Price Path C

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	105.6	96.0	93.1	88.4	82.5	94.0	83.8	78.3	70.4	63.7	70.4	60.0	46.7	37.5	28.6
Forestry residues	119.4	108.4	105.1	99.7	93.0	106.0	94.4	88.1	79.0	71.3	78.8	66.9	51.7	41.2	31.0
Open-country biomass residues	104.8	95.2	92.3	87.6	81.8	93.3	83.2	77.6	69.8	63.1	69.9	59.6	46.4	37.3	28.4
Industrial wood waste	40.3	59.0	65.9	76.2	88.9	67.7	88.1	100.1	117.4	132.0	126.3	146.9	176.2	196.4	216.2
Wood in municipal solid waste	119.0	108.0	104.6	99.1	92.4	105.6	94.0	87.6	78.5	70.8	78.5	66.5	51.3	40.7	30.5
Green waste: Compensation areas	96.6	88.0	85.4	81.2	76.0	86.2	77.2	72.3	65.2	59.2	65.4	56.1	44.3	36.1	28.2
Biomass: Habitat-connectivity areas	104.8	95.2	92.3	87.6	81.8	93.3	83.2	77.6	69.8	63.1	69.9	59.6	46.4	37.3	28.4
Green waste: Extensive grassland	104.8	95.2	92.3	87.6	81.8	93.3	83.2	77.6	69.8	63.1	69.9	59.6	46.4	37.3	28.4
Short-rotation coppice: Erosion areas	55.7	73.3	80.0	89.8	101.9	82.0	101.3	112.8	129.3	143.2	138.6	158.1	186.0	205.4	224.3
Solid cattle manure	110.0	110.5	112.5	114.3	116.5	117.3	118.8	120.9	124.0	126.5	136.5	137.5	143.2	147.2	151.0
Solid swine manure	153.2	160.6	166.7	173.6	182.1	175.9	186.0	194.0	205.5	215.3	231.1	240.4	261.0	275.2	289.1
Solid poultry manure	87.0	79.9	77.9	74.5	70.3	78.9	71.5	67.5	61.8	57.0	62.8	55.1	45.7	39.1	32.8
Commercial and industrial waste	127.1	124.5	125.2	125.3	125.4	129.8	127.9	127.9	128.0	128.1	139.0	136.6	137.3	137.8	138.3
Organic municipal solid waste	101.5	107.3	111.6	116.7	123.1	118.3	125.9	131.8	140.4	147.6	158.6	165.7	180.9	191.5	201.8

Sources:
a) Own calculation, Table S.70 (columns 1-5) = Table S.12 (columns 1-5) + Table S.16 (columns 1-5) + Table 19 (rows C and F, respectively, columns 1-5) – Table S.31 (columns 1-5) – Table 27 (columns 12-16) – Table 31 (columns 11-15) + Table 35 (columns 12-16) – Table 36 (columns 12-16).
b) Own calculation, Table S.70 (columns 6-10) = Table S.12 (columns 6-10) + Table S.16 (columns 6-10) + Table 19 (rows C and F, respectively, columns 6-10) – Table S.31 (columns 6-10) – Table 27 (columns 12-16) – Table 31 (columns 11-15) + Table 35 (columns 12-16) – Table 36 (columns 12-16).
c) Own calculation, Table S.70 (columns 11-15) = Table S.12 (columns 11-15) + Table S.16 (columns 11-15) + Table 19 (rows C and F, respectively, columns 11-15) – Table S.31 (columns 11-15) – Table 27 (columns 12-16) – Table 31 (columns 10-15) + Table 35 (columns 12-16) – Table 36 (columns 12-16).

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.71: Fossil-Fuel Dependent Net Costs of Biochar When Process Heat is Recovered, Germany, 2015-2050 – Price Path A

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€2012/tDM feedstock					€2012/tDM feedstock					€2012/tDM feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	102.3	86.7	75.7	66.7	55.8	81.0	62.3	40.3	18.8	-4.7	42.3	18.0	-18.7	-54.4	-91.1
Forestry residues	116.0	98.4	86.1	76.0	63.7	92.1	71.0	46.3	22.2	-4.2	48.7	21.3	-19.8	-59.9	-101.2
Open-country biomass residues	101.5	85.7	74.7	65.7	54.8	80.3	61.4	39.5	18.0	-5.4	41.8	17.4	-19.2	-54.8	-91.5
Industrial wood waste	36.9	59.9	76.7	90.2	106.8	69.6	97.5	130.7	163.1	198.6	130.1	166.4	222.0	276.2	332.0
Wood in municipal solid waste	115.6	97.8	85.4	75.3	63.0	91.7	70.5	45.7	21.5	-4.9	48.3	20.9	-20.4	-60.5	-101.8
Green waste: Compensation areas	93.3	79.0	68.9	60.8	50.8	73.8	56.7	36.6	17.0	-4.5	38.4	16.2	-17.3	-49.9	-83.5
Biomass: Habitat-connectivity areas	101.5	85.7	74.7	65.7	54.8	80.3	61.4	39.5	18.0	-5.4	41.8	17.4	-19.2	-54.8	-91.5
Green waste: Extensive grassland	101.5	85.7	74.7	65.7	54.8	80.3	61.4	39.5	18.0	-5.4	41.8	17.4	-19.2	-54.8	-91.5
Short-rotation coppice: Erosion areas	52.3	73.9	89.9	102.7	118.4	83.5	109.8	141.3	172.0	205.7	141.5	175.7	228.5	280.0	333.0
Solid cattle manure	106.9	106.0	107.9	108.8	110.0	111.4	111.5	113.9	116.2	118.7	123.9	124.5	129.5	134.4	139.4
Solid swine manure	150.1	159.7	171.8	180.4	190.9	175.3	189.5	210.6	231.3	253.9	230.2	249.6	287.1	323.7	361.4
Solid poultry manure	84.0	72.0	63.7	56.9	48.6	68.0	53.7	37.0	20.8	3.0	39.2	20.6	-7.1	-34.1	-61.8
Commercial and industrial waste	123.8	118.3	116.7	114.9	112.7	121.7	116.2	111.8	107.6	103.0	121.6	115.0	108.7	102.7	96.5
Organic municipal solid waste	98.5	105.2	113.5	119.4	126.7	116.0	125.8	140.5	154.9	170.6	154.0	167.4	193.5	219.0	245.3

Sources:

a) Own calculation, Table S.71 (columns 1-5) = Table S.13 (columns 1-5) + Table S.17 (columns 1-5) + Table 19 (rows A and D, respectively, columns 1-5) – Table S.30 (columns 1-5) – Table 27 (columns 2-6) – Table 31 (columns 1-5) + Table 35 (columns 2-6) – Table 36 (columns 2-6).

b) Own calculation, Table S.71 (columns 6-10) = Table S.13 (columns 6-10) + Table S.17 (columns 6-10) + Table 19 (rows A and D, respectively, columns 6-10) – Table S.30 (columns 6-10) – Table 27 (columns 2-6) – Table 31 (columns 1-5) + Table 35 (columns 2-6) – Table 36 (columns 2-6).

c) Own calculation, Table S.71 (columns 11-15) = Table S.13 (columns 11-15) + Table S.17 (columns 11-15) + Table 19 (rows A and D, respectively, columns 11-15) – Table S.30 (columns 11-15) – Table 27 (columns 2-6) – Table 31 (columns 1-5) + Table 35 (columns 2-6) – Table 36 (columns 2-6).

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.72: Fossil-Fuel Dependent Net Costs of Biochar When Process Heat is Recovered, Germany, 2015-2050 – Price Path B

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	102.3	89.1	82.2	75.7	66.5	83.0	69.2	54.8	40.3	28.3	49.8	29.9	5.1	-15.4	-32.0
Forestry residues	116.0	101.1	93.4	86.0	75.8	94.4	78.9	62.6	46.3	32.9	57.1	34.8	6.9	-16.2	-34.8
Open-country biomass residues	101.5	88.2	81.3	74.7	65.6	82.3	68.5	54.0	39.5	27.5	49.2	29.3	4.5	-16.0	-32.5
Industrial wood waste	36.9	56.4	66.8	76.7	90.6	66.6	87.0	108.8	130.7	148.8	118.7	148.3	185.9	217.1	242.3
Wood in municipal solid waste	115.6	100.6	92.8	85.4	75.1	94.0	78.4	62.0	45.7	32.2	56.8	34.3	6.4	-16.7	-35.4
Green waste: Compensation areas	93.3	81.2	74.9	68.9	60.6	75.6	63.0	49.8	36.6	25.6	45.3	27.1	4.4	-14.3	-29.5
Biomass: Habitat-connectivity areas	101.5	88.2	81.3	74.7	65.6	82.3	68.5	54.0	39.5	27.5	49.2	29.3	4.5	-16.0	-32.5
Green waste: Extensive grassland	101.5	88.2	81.3	74.7	65.6	82.3	68.5	54.0	39.5	27.5	49.2	29.3	4.5	-16.0	-32.5
Short-rotation coppice: Erosion areas	52.3	70.5	80.5	89.9	103.0	80.6	99.8	120.5	141.3	158.4	130.6	158.5	194.3	223.9	247.8
Solid cattle manure	106.9	105.8	107.2	107.9	108.8	111.2	110.8	112.3	113.9	115.2	122.9	122.9	126.3	129.1	131.3
Solid swine manure	150.1	157.5	165.6	171.9	180.7	173.4	182.8	196.7	210.6	222.2	222.5	237.4	262.8	283.8	300.8
Solid poultry manure	84.0	73.8	68.7	63.7	56.7	69.5	59.0	48.0	37.0	27.9	44.8	29.6	10.9	-4.6	-17.2
Commercial and industrial waste	123.8	118.9	118.1	116.7	114.9	122.0	117.7	114.7	111.9	109.5	122.8	117.1	112.8	109.3	106.5
Organic municipal solid waste	98.5	103.7	109.2	113.5	119.6	114.6	121.2	130.8	140.5	148.6	148.6	159.0	176.6	191.3	203.1

Sources:

a) Own calculation, Table S.72 (columns 1-5) = Table 15 (columns 1-5) + Table 17 (columns 1-5) + Table 19 (rows B and E, respectively, columns 1-5) – Table 22 (columns 1-5) – Table 27 (columns 7-11) – Table 31 (columns 6-10) + Table 35 (columns 7-11) – Table 36 (columns 7-11).

b) Own calculation, Table S.72 (columns 6-10) = Table 15 (columns 6-10) + Table 17 (columns 6-10) + Table 19 (rows B and E, respectively, columns 6-10) – Table 22 (columns 6-10) – Table 27 (columns 7-11) – Table 31 (columns 6-10) + Table 35 (columns 7-11) – Table 36 (columns 7-11).

c) Own calculation, Table S.72 (columns 11-15) = Table 15 (columns 11-15) + Table 17 (columns 11-15) + Table 19 (rows B and E, respectively, columns 11-15) – Table 22 (columns 11-15) – Table 27 (columns 7-11) – Table 31 (columns 6-10) + Table 35 (columns 7-11) – Table 36 (columns 7-11).

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading ‘S.’ refer to Teichmann (2015).

Table S.73: Fossil-Fuel Dependent Net Costs of Biochar When Process Heat is Recovered, Germany, 2015-2050 – Price Path C

	Lignite[a]					Hard coal[b]					Natural gas[c]				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	102.3	90.8	87.0	81.0	73.7	87.0	74.7	67.8	57.8	49.3	55.2	42.6	25.8	14.1	2.8
Forestry residues	116.0	103.1	98.8	92.1	83.8	98.8	85.0	77.2	66.0	56.4	63.1	49.0	30.1	17.0	4.3
Open-country biomass residues	101.5	90.0	86.1	80.1	72.8	86.3	74.0	67.0	57.0	48.5	54.6	42.0	25.2	13.6	2.2
Industrial wood waste	36.9	53.7	59.6	68.6	79.8	60.6	78.7	89.2	104.3	117.1	110.6	129.0	154.5	172.2	189.5
Wood in municipal solid waste	115.6	102.6	98.3	91.5	83.2	98.5	84.6	76.7	65.4	55.9	62.8	48.6	29.7	16.5	3.8
Green waste: Compensation areas	93.3	82.8	79.3	73.8	67.1	79.3	68.1	61.7	52.6	44.8	50.2	38.7	23.3	12.7	2.3
Biomass: Habitat-connectivity areas	101.5	90.0	86.1	80.1	72.8	86.3	74.0	67.0	57.0	48.5	54.6	42.0	25.2	13.6	2.2
Green waste: Extensive grassland	101.5	90.0	86.1	80.1	72.8	86.3	74.0	67.0	57.0	48.5	54.6	42.0	25.2	13.6	2.2
Short-rotation coppice: Erosion areas	52.3	68.0	73.7	82.2	92.8	74.9	91.9	101.9	116.2	128.4	122.9	140.2	164.5	181.3	197.6
Solid cattle manure	106.9	105.6	106.7	107.3	108.1	110.8	110.3	111.0	112.0	112.9	122.1	121.2	123.5	125.1	126.6
Solid swine manure	150.1	155.8	161.0	166.7	173.8	169.5	177.5	184.2	193.8	202.0	217.0	224.3	241.6	253.5	265.2
Solid poultry manure	84.0	75.2	72.3	67.8	62.2	72.5	63.1	57.8	50.3	43.8	48.9	39.3	26.5	17.7	9.1
Commercial and industrial waste	123.8	119.3	119.1	117.9	116.4	122.8	118.8	117.3	115.4	113.7	123.7	119.3	116.3	114.3	112.4
Organic municipal solid waste	98.5	102.6	106.1	110.1	115.0	111.9	117.6	122.2	128.9	134.6	144.8	150.0	161.9	170.2	178.3

Sources:

a) Own calculation, Table S.73 (columns 1-5) = Table S.14 (columns 1-5) + Table S.18 (columns 1-5) + Table 19 (rows C and F, respectively, columns 1-5) – Table S.31 (columns 1-5) – Table 27 (columns 12-16) – Table 31 (columns 11-15) + Table 35 (columns 12-16) – Table 36 (columns 12-16).

b) Own calculation, Table S.73 (columns 6-10) = Table S.14 (columns 6-10) + Table S.18 (columns 6-10) + Table 19 (rows C and F, respectively, columns 6-10) – Table S.31 (columns 6-10) – Table 27 (columns 12-16) – Table 31 (columns 11-15) + Table 35 (columns 12-16) – Table 36 (columns 12-16).

c) Own calculation, Table S.73 (columns 11-15) = Table S.14 (columns 11-15) + Table S.18 (columns 11-15) + Table 19 (rows C and F, respectively, columns 11-15) – Table S.31 (columns 11-15) – Table 27 (columns 12-16) – Table 31 (columns 10-15) + Table 35 (columns 12-16) – Table 36 (columns 12-16).

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading ‘S.’ refer to Teichmann (2015).

Table S.74: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path A, Scenario *Max 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	53.8	48.1	42.6	39.7	39.0	63.1	56.0	49.1	46.0	45.2	53.2	43.7	35.3	33.9	33.5
Forestry residues	53.7	48.1	42.5	39.7	39.0	63.1	55.9	49.1	46.0	45.1	53.1	43.7	35.3	33.8	33.4
Open-country biomass residues	53.5	47.9	42.4	39.6	38.8	62.7	55.7	48.9	45.8	45.0	52.5	43.2	34.9	33.5	33.1
Industrial wood waste	53.3	47.7	42.3	39.5	38.8	62.5	55.5	48.8	45.7	44.8	52.1	42.9	34.7	33.3	32.9
Wood in municipal solid waste	53.7	48.1	42.6	39.7	39.0	63.1	56.0	49.1	46.0	45.2	53.1	43.7	35.3	33.8	33.4
Green waste: Compensation areas	53.4	47.8	42.4	39.5	38.8	62.6	55.6	48.9	45.7	44.9	52.3	43.1	34.8	33.4	33.0
Biomass: Habitat-connectivity areas	53.5	47.9	42.4	39.6	38.8	62.7	55.7	48.9	45.8	45.0	52.5	43.2	34.9	33.5	33.1
Green waste: Extensive grassland	53.5	47.9	42.4	39.6	38.8	62.7	55.7	48.9	45.8	45.0	52.5	43.2	34.9	33.5	33.1
Short-rotation coppice: Erosion areas	54.2	48.4	42.8	40.0	39.2	63.7	56.4	49.4	46.3	45.5	54.2	44.5	35.8	34.4	34.0
Solid cattle manure	72.0	61.6	52.1	49.2	48.4	87.6	74.2	62.0	58.8	57.9	95.6	75.4	57.9	56.3	55.8
Solid swine manure	91.4	75.9	62.2	59.2	58.4	113.6	93.5	75.7	72.4	71.4	140.6	109.1	81.9	80.2	79.6
Solid poultry manure	55.5	49.4	43.5	40.6	39.9	65.4	57.7	50.3	47.2	46.4	57.2	46.7	37.4	36.0	35.6
Commercial and industrial waste	69.3	59.6	50.7	47.8	47.0	84.0	71.5	60.1	56.9	56.0	89.3	70.8	54.6	53.0	52.5
Organic municipal solid waste	78.8	66.6	55.7	52.7	51.9	96.8	81.0	66.8	63.6	62.7	111.4	87.3	66.3	64.7	64.2

Sources: Own calculation, Table S.74 = Table 13 (row A, applied to all feedstocks) + Table 24 + Table S.40 + Table 28 + Table S.56.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading ‘S.’ refer to Teichmann (2015).

Table S.75: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path A, Scenario *Min 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	53.8	53.1	51.3	48.7	48.3	63.1	62.2	60.0	57.1	56.6	53.2	52.0	48.6	47.3	47.0
Forestry residues	53.7	53.0	51.2	48.7	48.3	63.1	62.2	59.9	57.1	56.6	53.1	51.9	48.5	47.2	46.9
Open-country biomass residues	53.5	52.8	51.0	48.5	48.0	62.7	61.8	59.6	56.8	56.3	52.5	51.3	48.0	46.6	46.3
Industrial wood waste	53.3	52.6	50.9	48.3	47.9	62.5	61.6	59.4	56.6	56.1	52.1	50.9	47.6	46.3	46.0
Wood in municipal solid waste	53.7	53.0	51.2	48.7	48.3	63.1	62.2	59.9	57.1	56.6	53.1	51.9	48.5	47.2	46.9
Green waste: Compensation areas	53.4	52.7	50.9	48.4	48.0	62.6	61.7	59.5	56.7	56.2	52.3	51.1	47.8	46.5	46.2
Biomass: Habitat-connectivity areas	53.5	52.8	51.0	48.5	48.0	62.7	61.8	59.6	56.8	56.3	52.5	51.3	48.0	46.6	46.3
Green waste: Extensive grassland	53.5	52.8	51.0	48.5	48.0	62.7	61.8	59.6	56.8	56.3	52.5	51.3	48.0	46.6	46.3
Short-rotation coppice: Erosion areas	54.2	53.5	51.6	49.1	48.7	63.7	62.8	60.5	57.6	57.1	54.2	53.0	49.5	48.1	47.8
Solid cattle manure	72.0	70.5	66.8	64.2	63.6	87.6	85.7	81.0	78.0	77.4	95.6	92.9	85.5	83.9	83.5
Solid swine manure	91.4	89.0	83.4	80.5	79.9	113.6	110.7	103.4	100.2	99.5	140.6	136.4	124.6	122.9	122.4
Solid poultry manure	55.5	54.7	52.7	50.2	49.7	65.4	64.5	62.0	59.1	58.6	57.2	55.9	52.1	50.7	50.4
Commercial and industrial waste	69.3	67.9	64.6	61.9	61.4	84.0	82.3	77.9	75.0	74.4	89.3	86.9	80.1	78.5	78.2
Organic municipal solid waste	78.8	77.0	72.7	69.9	69.4	96.8	94.5	88.9	85.8	85.2	111.4	108.2	99.2	97.6	97.2

Sources: Own calculation, Table S.75 = Table 13 (row B, applied to all feedstocks) + Table S.35 + Table S.41 + Table S.52 + Table S.57.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.76: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path A, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	54.9	49.8	43.6	40.9	40.1	64.6	58.1	50.5	47.4	46.6	55.7	46.9	37.3	35.9	35.4
Forestry residues	54.8	49.7	43.6	40.9	40.1	64.5	58.1	50.5	47.4	46.6	55.6	46.8	37.2	35.8	35.4
Open-country biomass residues	54.5	49.5	43.5	40.7	39.9	64.1	57.8	50.3	47.2	46.4	55.0	46.3	36.8	35.4	35.0
Industrial wood waste	54.3	49.4	43.4	40.6	39.8	63.9	57.6	50.1	47.1	46.2	54.5	46.0	36.6	35.2	34.8
Wood in municipal solid waste	54.8	49.7	43.6	40.9	40.1	64.5	58.1	50.5	47.4	46.6	55.7	46.9	37.2	35.8	35.4
Green waste: Compensation areas	54.4	49.4	43.4	40.7	39.9	64.0	57.7	50.2	47.1	46.3	54.8	46.2	36.7	35.3	34.9
Biomass: Habitat-connectivity areas	54.5	49.5	43.5	40.7	39.9	64.1	57.8	50.3	47.2	46.4	55.0	46.3	36.8	35.4	35.0
Green waste: Extensive grassland	54.5	49.5	43.5	40.7	39.9	64.1	57.8	50.3	47.2	46.4	55.0	46.3	36.8	35.4	35.0
Short-rotation coppice: Erosion areas	55.3	50.1	43.9	41.1	40.4	65.2	58.6	50.8	47.8	46.9	56.8	47.8	37.9	36.4	36.0

Sources: Own calculation, Table S.76 = Table 13 (row C, applied to all feedstocks) + Table S.36 + Table S.42 + Table S.53 + Table S.58.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.77: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path A, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	54.9	53.9	51.1	48.5	48.0	64.6	63.3	59.8	56.9	56.3	55.7	54.0	48.8	47.4	47.1
Forestry residues	54.8	53.8	51.1	48.5	47.9	64.5	63.3	59.8	56.9	56.3	55.6	53.8	48.7	47.3	47.0
Open-country biomass residues	54.5	53.5	50.8	48.3	47.7	64.1	62.9	59.4	56.6	56.0	55.0	53.2	48.1	46.8	46.5
Industrial wood waste	54.3	53.4	50.7	48.1	47.6	63.9	62.7	59.2	56.4	55.8	54.5	52.8	47.8	46.4	46.1
Wood in municipal solid waste	54.8	53.8	51.1	48.5	47.9	64.5	63.3	59.8	56.9	56.3	55.7	53.9	48.7	47.4	47.0
Green waste: Compensation areas	54.4	53.5	50.8	48.2	47.6	64.0	62.8	59.4	56.5	55.9	54.8	53.0	48.0	46.6	46.3
Biomass: Habitat-connectivity areas	54.5	53.5	50.8	48.3	47.7	64.1	62.9	59.4	56.6	56.0	55.0	53.2	48.1	46.8	46.5
Green waste: Extensive grassland	54.5	53.5	50.8	48.3	47.7	64.1	62.9	59.4	56.6	56.0	55.0	53.2	48.1	46.8	46.5
Short-rotation coppice: Erosion areas	55.3	54.3	51.5	48.9	48.3	65.2	63.9	60.3	57.4	56.8	56.8	55.0	49.7	48.3	48.0

Sources: Own calculation, Table S.77 = Table 13 (row D, applied to all feedstocks) + Table S.37 + Table S.43 + Table S.54 + Table S.59.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.78: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path B, Scenario *Max 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050	2015	2020	2030	2040	2050
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	53.8	48.1	42.6	39.7	39.0	63.1	55.9	49.1	46.0	45.1	53.2	43.6	35.2	33.7	33.3
Forestry residues	53.7	48.0	42.5	39.7	39.0	63.1	55.9	49.1	45.9	45.1	53.1	43.5	35.1	33.6	33.2
Open-country biomass residues	53.5	47.8	42.4	39.6	38.8	62.7	55.6	48.9	45.7	44.9	52.5	43.0	34.8	33.3	32.9
Industrial wood waste	53.3	47.7	42.3	39.5	38.7	62.5	55.5	48.8	45.6	44.8	52.1	42.7	34.6	33.1	32.7
Wood in municipal solid waste	53.7	48.1	42.5	39.7	39.0	63.1	55.9	49.1	45.9	45.1	53.1	43.5	35.1	33.7	33.3
Green waste: Compensation areas	53.4	47.8	42.4	39.5	38.8	62.6	55.6	48.8	45.7	44.9	52.3	42.9	34.7	33.2	32.8
Biomass: Habitat-connectivity areas	53.5	47.8	42.4	39.6	38.8	62.7	55.6	48.9	45.7	44.9	52.5	43.0	34.8	33.3	32.9
Green waste: Extensive grassland	53.5	47.8	42.4	39.6	38.8	62.7	55.6	48.9	45.7	44.9	52.5	43.0	34.8	33.3	32.9
Short-rotation coppice: Erosion areas	54.2	48.4	42.8	40.0	39.2	63.7	56.4	49.4	46.3	45.4	54.2	44.3	35.7	34.2	33.8
Solid cattle manure	72.0	61.5	52.1	49.2	48.4	87.6	74.1	61.9	58.7	57.8	95.6	75.0	57.6	56.0	55.5
Solid swine manure	91.4	75.8	62.2	59.2	58.3	113.6	93.3	75.6	72.2	71.3	140.6	108.5	81.4	79.6	79.1
Solid poultry manure	55.5	49.3	43.5	40.6	39.9	65.4	57.7	50.3	47.2	46.3	57.2	46.5	37.3	35.8	35.4
Commercial and industrial waste	69.3	59.6	50.7	47.8	47.0	84.0	71.4	60.1	56.8	55.9	89.3	70.4	54.3	52.7	52.2
Organic municipal solid waste	78.8	66.6	55.6	52.7	51.9	96.8	80.8	66.7	63.4	62.5	111.4	86.8	66.0	64.3	63.8

Sources: Own calculation, Table S.78 = Table 13 (row A, applied to all feedstocks) + Table 24 + Table 26 + Table 28 + Table 30.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.79: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path B, Scenario *Min 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	53.8	53.0	51.3	48.7	48.3	63.1	62.2	59.9	57.1	56.6	53.2	51.8	48.4	47.0	46.7
Forestry residues	53.7	53.0	51.2	48.7	48.2	63.1	62.1	59.9	57.0	56.5	53.1	51.7	48.3	46.9	46.6
Open-country biomass residues	53.5	52.7	51.0	48.4	48.0	62.7	61.8	59.5	56.7	56.2	52.5	51.1	47.8	46.4	46.1
Industrial wood waste	53.3	52.6	50.8	48.3	47.9	62.5	61.6	59.4	56.5	56.0	52.1	50.7	47.4	46.1	45.8
Wood in municipal solid waste	53.7	53.0	51.2	48.7	48.2	63.1	62.1	59.9	57.0	56.5	53.1	51.7	48.3	46.9	46.7
Green waste: Compensation areas	53.4	52.7	50.9	48.4	47.9	62.6	61.7	59.5	56.6	56.1	52.3	50.9	47.6	46.2	46.0
Biomass: Habitat-connectivity areas	53.5	52.7	51.0	48.4	48.0	62.7	61.8	59.5	56.7	56.2	52.5	51.1	47.8	46.4	46.1
Green waste: Extensive grassland	53.5	52.7	51.0	48.4	48.0	62.7	61.8	59.5	56.7	56.2	52.5	51.1	47.8	46.4	46.1
Short-rotation coppice: Erosion areas	54.2	53.4	51.6	49.1	48.6	63.7	62.7	60.4	57.6	57.1	54.2	52.7	49.3	47.9	47.6
Solid cattle manure	72.0	70.4	66.8	64.1	63.6	87.6	85.6	80.9	77.9	77.3	95.6	92.4	85.0	83.4	83.0
Solid swine manure	91.4	88.9	83.3	80.5	79.8	113.6	110.4	103.2	100.0	99.3	140.6	135.6	123.9	122.0	121.5
Solid poultry manure	55.5	54.7	52.7	50.2	49.7	65.4	64.4	61.9	59.0	58.5	57.2	55.6	51.9	50.4	50.2
Commercial and industrial waste	69.3	67.9	64.5	61.8	61.3	84.0	82.1	77.8	74.8	74.2	89.3	86.4	79.6	78.0	77.7
Organic municipal solid waste	78.8	76.9	72.6	69.8	69.3	96.8	94.3	88.7	85.6	85.0	111.4	107.6	98.7	97.0	96.5

Sources: Own calculation, Table S.79 = Table 13 (row B, applied to all feedstocks) + Table S.35 + Table S.44 + Table S.52 + Table S.60.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.80: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path B, Scenario *Max 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	54.9	49.7	43.6	40.9	40.1	64.6	58.1	50.5	47.4	46.5	55.7	46.7	37.1	35.7	35.3
Forestry residues	54.8	49.7	43.6	40.8	40.1	64.5	58.0	50.4	47.4	46.5	55.6	46.6	37.1	35.6	35.2
Open-country biomass residues	54.5	49.5	43.4	40.7	39.9	64.1	57.7	50.2	47.2	46.3	55.0	46.1	36.7	35.3	34.8
Industrial wood waste	54.3	49.3	43.3	40.6	39.8	63.9	57.5	50.1	47.0	46.2	54.5	45.8	36.5	35.0	34.6
Wood in municipal solid waste	54.8	49.7	43.6	40.9	40.1	64.5	58.0	50.4	47.4	46.5	55.7	46.7	37.1	35.6	35.2
Green waste: Compensation areas	54.4	49.4	43.4	40.7	39.9	64.0	57.6	50.2	47.1	46.2	54.8	46.0	36.6	35.2	34.7
Biomass: Habitat-connectivity areas	54.5	49.5	43.4	40.7	39.9	64.1	57.7	50.2	47.2	46.3	55.0	46.1	36.7	35.3	34.8
Green waste: Extensive grassland	54.5	49.5	43.4	40.7	39.9	64.1	57.7	50.2	47.2	46.3	55.0	46.1	36.7	35.3	34.8
Short-rotation coppice: Erosion areas	55.3	50.1	43.9	41.1	40.3	65.2	58.6	50.8	47.7	46.9	56.8	47.6	37.7	36.3	35.8

Sources: Own calculation, Table S.80 = Table 13 (row C, applied to all feedstocks) + Table S.36 + Table S.45 + Table S.53 + Table S.61.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.81: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path B, Scenario *Min 2*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	54.9	53.8	51.1	48.5	47.9	64.6	63.3	59.8	56.9	56.3	55.7	53.7	48.6	47.2	46.8
Forestry residues	54.8	53.8	51.0	48.5	47.9	64.5	63.2	59.7	56.8	56.2	55.6	53.6	48.5	47.1	46.8
Open-country biomass residues	54.5	53.5	50.8	48.2	47.7	64.1	62.8	59.4	56.5	55.9	55.0	53.0	47.9	46.5	46.2
Industrial wood waste	54.3	53.3	50.7	48.1	47.5	63.9	62.6	59.2	56.3	55.7	54.5	52.6	47.6	46.2	45.9
Wood in municipal solid waste	54.8	53.8	51.1	48.5	47.9	64.5	63.2	59.7	56.8	56.2	55.7	53.6	48.5	47.1	46.8
Green waste: Compensation areas	54.4	53.4	50.8	48.2	47.6	64.0	62.7	59.3	56.4	55.8	54.8	52.8	47.8	46.4	46.1
Biomass: Habitat-connectivity areas	54.5	53.5	50.8	48.2	47.7	64.1	62.8	59.4	56.5	55.9	55.0	53.0	47.9	46.5	46.2
Green waste: Extensive grassland	54.5	53.5	50.8	48.2	47.7	64.1	62.8	59.4	56.5	55.9	55.0	53.0	47.9	46.5	46.2
Short-rotation coppice: Erosion areas	55.3	54.3	51.5	48.9	48.3	65.2	63.9	60.3	57.4	56.7	56.8	54.7	49.5	48.1	47.7

Sources: Own calculation, Table S.81 = Table 13 (row D, applied to all feedstocks) + Table S.37 + Table S.46 + Table S.54 + Table S.62.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.82: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path C, Scenario *Max 1*

	Small-scale pyrolysis units					Medium-scale pyrolysis units					Large-scale pyrolysis units				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	53.8	48.1	42.5	39.7	39.0	63.1	55.9	49.1	45.9	45.1	53.2	43.5	35.1	33.6	33.1
Forestry residues	53.7	48.0	42.5	39.7	39.0	63.1	55.9	49.0	45.9	45.1	53.1	43.4	35.0	33.5	33.1
Open-country biomass residues	53.5	47.8	42.4	39.6	38.8	62.7	55.6	48.8	45.7	44.9	52.5	42.9	34.7	33.2	32.8
Industrial wood waste	53.3	47.7	42.3	39.5	38.7	62.5	55.4	48.7	45.6	44.7	52.1	42.7	34.5	33.0	32.6
Wood in municipal solid waste	53.7	48.0	42.5	39.7	39.0	63.1	55.9	49.0	45.9	45.1	53.1	43.4	35.0	33.5	33.1
Green waste: Compensation areas	53.4	47.8	42.3	39.5	38.8	62.6	55.5	48.8	45.6	44.8	52.3	42.8	34.6	33.1	32.7
Biomass: Habitat-connectivity areas	53.5	47.8	42.4	39.6	38.8	62.7	55.6	48.8	45.7	44.9	52.5	42.9	34.7	33.2	32.8
Green waste: Extensive grassland	53.5	47.8	42.4	39.6	38.8	62.7	55.6	48.8	45.7	44.9	52.5	42.9	34.7	33.2	32.8
Short-rotation coppice: Erosion areas	54.2	48.4	42.8	39.9	39.2	63.7	56.3	49.4	46.2	45.4	54.2	44.2	35.6	34.1	33.7
Solid cattle manure	72.0	61.5	52.1	49.1	48.3	87.6	74.0	61.9	58.6	57.7	95.6	74.9	57.4	55.7	55.1
Solid swine manure	91.4	75.8	62.2	59.1	58.3	113.6	93.2	75.5	72.1	71.1	140.6	108.2	81.0	79.1	78.5
Solid poultry manure	55.5	49.3	43.4	40.6	39.9	65.4	57.6	50.3	47.1	46.3	57.2	46.5	37.2	35.7	35.2
Commercial and industrial waste	69.3	59.5	50.7	47.7	47.0	84.0	71.4	60.0	56.7	55.8	89.3	70.2	54.1	52.4	51.9
Organic municipal solid waste	78.8	66.5	55.6	52.6	51.8	96.8	80.8	66.7	63.3	62.4	111.4	86.6	65.7	63.9	63.3

Sources: Own calculation, Table S.82 = Table 13 (row A, applied to all feedstocks) + Table 24 + Table S.47 + Table 28 + Table S.63.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading ‘S.’ refer to Teichmann (2015).

Table S.83: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path C, Scenario *Min 1*

	Small-scale pyrolysis units					**Medium-scale pyrolysis units**					**Large-scale pyrolysis units**				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock					€$_{2012}$/t$_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	53.8	53.0	51.2	48.7	48.2	63.1	62.2	59.9	57.0	56.5	53.2	51.7	48.2	46.8	46.5
Forestry residues	53.7	53.0	51.2	48.6	48.2	63.1	62.1	59.8	56.9	56.4	53.1	51.6	48.2	46.7	46.4
Open-country biomass residues	53.5	52.7	51.0	48.4	48.0	62.7	61.7	59.5	56.6	56.1	52.5	51.0	47.6	46.2	45.9
Industrial wood waste	53.3	52.6	50.8	48.3	47.8	62.5	61.5	59.3	56.4	55.9	52.1	50.6	47.3	45.8	45.5
Wood in municipal solid waste	53.7	53.0	51.2	48.7	48.2	63.1	62.1	59.8	57.0	56.5	53.1	51.6	48.2	46.7	46.4
Green waste: Compensation areas	53.4	52.6	50.9	48.4	47.9	62.6	61.6	59.4	56.6	56.1	52.3	50.8	47.5	46.0	45.7
Biomass: Habitat-connectivity areas	53.5	52.7	51.0	48.4	48.0	62.7	61.7	59.5	56.6	56.1	52.5	51.0	47.6	46.2	45.9
Green waste: Extensive grassland	53.5	52.7	51.0	48.4	48.0	62.7	61.7	59.5	56.6	56.1	52.5	51.0	47.6	46.2	45.9
Short-rotation coppice: Erosion areas	54.2	53.4	51.6	49.0	48.6	63.7	62.7	60.4	57.5	57.0	54.2	52.6	49.1	47.6	47.3
Solid cattle manure	72.0	70.4	66.8	64.0	63.5	87.6	85.5	80.8	77.7	77.1	95.6	92.2	84.6	82.9	82.4
Solid swine manure	91.4	88.8	83.3	80.4	79.7	113.6	110.3	103.0	99.7	99.0	140.6	135.2	123.3	121.2	120.5
Solid poultry manure	55.5	54.7	52.7	50.1	49.7	65.4	64.4	61.8	59.0	58.4	57.2	55.5	51.7	50.2	49.9
Commercial and industrial waste	69.3	67.8	64.5	61.8	61.3	84.0	82.1	77.7	74.7	74.1	89.3	86.2	79.3	77.6	77.1
Organic municipal solid waste	78.8	76.9	72.6	69.8	69.2	96.8	94.2	88.6	85.5	84.8	111.4	107.3	98.2	96.3	95.8

Sources: Own calculation, Table S.83 = Table 13 (row B, applied to all feedstocks) + Table S.35 + Table S.48 + Table S.52 + Table S.64.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading 'S.' refer to Teichmann (2015).

Table S.84: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path C, Scenario *Max 2*

	Small-scale pyrolysis units					**Medium-scale pyrolysis units**					**Large-scale pyrolysis units**				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	54.9	49.7	43.6	40.9	40.1	64.6	58.1	50.4	47.4	46.5	55.7	46.6	37.0	35.5	35.1
Forestry residues	54.8	49.7	43.6	40.8	40.1	64.5	58.0	50.4	47.3	46.5	55.6	46.5	37.0	35.5	35.0
Open-country biomass residues	54.5	49.5	43.4	40.7	39.9	64.1	57.7	50.2	47.1	46.3	55.0	46.0	36.6	35.1	34.7
Industrial wood waste	54.3	49.3	43.3	40.6	39.8	63.9	57.5	50.0	47.0	46.1	54.5	45.7	36.4	34.9	34.4
Wood in municipal solid waste	54.8	49.7	43.6	40.8	40.1	64.5	58.0	50.4	47.3	46.5	55.7	46.6	37.0	35.5	35.0
Green waste: Compensation areas	54.4	49.4	43.4	40.6	39.9	64.0	57.6	50.1	47.1	46.2	54.8	45.9	36.5	35.0	34.6
Biomass: Habitat-connectivity areas	54.5	49.5	43.4	40.7	39.9	64.1	57.7	50.2	47.1	46.3	55.0	46.0	36.6	35.1	34.7
Green waste: Extensive grassland	54.5	49.5	43.4	40.7	39.9	64.1	57.7	50.2	47.1	46.3	55.0	46.0	36.6	35.1	34.7
Short-rotation coppice: Erosion areas	55.3	50.1	43.9	41.1	40.3	65.2	58.5	50.8	47.7	46.8	56.8	47.5	37.6	36.1	35.7

Sources: Own calculation, Table S.84 = Table 13 (row C, applied to all feedstocks) + Table S.36 + Table S.49 + Table S.53 + Table S.65.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading ‘S.’ refer to Teichmann (2015).

Table S.85: Biomass-Scenario Dependent Net Costs of Biochar, Germany, 2015-2050 – Price Path C, Scenario *Min 2*

	Small-scale pyrolysis units					**Medium-scale pyrolysis units**					**Large-scale pyrolysis units**				
	2015	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**	**2015**	**2020**	**2030**	**2040**	**2050**
	$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock					$€_{2012}/t_{DM}$ feedstock				
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Cereal straw	54.9	53.8	51.1	48.5	47.9	64.6	63.2	59.7	56.8	56.2	55.7	53.6	48.4	47.0	46.6
Forestry residues	54.8	53.8	51.0	48.4	47.9	64.5	63.2	59.6	56.7	56.1	55.6	53.5	48.3	46.9	46.5
Open-country biomass residues	54.5	53.5	50.8	48.2	47.7	64.1	62.8	59.3	56.4	55.8	55.0	52.9	47.8	46.3	45.9
Industrial wood waste	54.3	53.3	50.7	48.1	47.5	63.9	62.6	59.1	56.2	55.6	54.5	52.5	47.4	46.0	45.6
Wood in municipal solid waste	54.8	53.8	51.0	48.4	47.9	64.5	63.2	59.7	56.8	56.1	55.7	53.5	48.3	46.9	46.5
Green waste: Compensation areas	54.4	53.4	50.7	48.1	47.6	64.0	62.7	59.2	56.4	55.7	54.8	52.7	47.6	46.2	45.8
Biomass: Habitat-connectivity areas	54.5	53.5	50.8	48.2	47.7	64.1	62.8	59.3	56.4	55.8	55.0	52.9	47.8	46.3	45.9
Green waste: Extensive grassland	54.5	53.5	50.8	48.2	47.7	64.1	62.8	59.3	56.4	55.8	55.0	52.9	47.8	46.3	45.9
Short-rotation coppice: Erosion areas	55.3	54.3	51.4	48.8	48.3	65.2	63.8	60.2	57.3	56.7	56.8	54.6	49.3	47.8	47.4

Sources: Own calculation, Table S.85 = Table 13 (row D, applied to all feedstocks) + Table S.37 + Table S.50 + Table S.54 + Table S.66.

Notes: Values rounded. DM = dry mass. t = tonne. All tables without the leading ‘S.’ refer to Teichmann (2015).

Table S.86: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2015 – Price Path A, Scenarios *Max 1*, *Min 1**

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	252	236	207	249	228	189	270	254	225	267	245	207	218	201	172	214	193	154
Forestry residues	347	328	295	344	320	276	365	346	312	361	337	294	312	293	260	309	285	242
Open-country biomass residues	153	137	108	150	129	90	171	154	126	167	146	108	118	102	73	115	94	55
Industrial wood waste	128	166	236	124	157	218	145	183	253	142	174	235	92	130	201	89	122	182
Wood in municipal solid waste	166	148	114	163	139	96	184	165	132	181	157	113	132	113	80	128	104	61
Green waste: Compensation areas	242	227	201	238	219	183	259	244	219	256	236	201	206	192	166	203	184	148
Biomass: Habitat-connectivity areas	153	137	108	150	129	90	171	154	126	167	146	108	118	102	73	115	94	55
Green waste: Extensive grassland	153	137	108	150	129	90	171	154	126	167	146	108	118	102	73	115	94	55
Short-rotation coppice: Erosion areas	142	178	247	139	170	228	159	196	264	156	187	245	108	144	212	105	136	194
Solid cattle manure	225	234	255	221	226	238	250	259	281	247	251	264	215	224	245	212	216	229
Solid swine manure	257	287	351	254	279	334	289	319	383	286	311	366	273	302	366	269	295	350
Solid poultry manure	188	176	157	185	169	140	207	196	176	204	188	160	156	145	125	153	137	108
Commercial and industrial waste	49	52	62	46	44	44	73	76	85	69	67	67	35	38	48	32	30	30
Organic municipal solid waste	-22	-1	46	-25	-8	30	5	27	74	2	20	58	-23	-2	45	-26	-9	29

Sources:
a) (1) = Table S.67 (column 11a) + Table S.68 (column 1) + Table S.74 (column 1).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 6) + Table S.74 (column 1).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 11) + Table S.74 (column 1).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 1) + Table S.74 (column 1).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 6) + Table S.74 (column 1).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 11) + Table S.74 (column 1).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 1) + Table S.74 (column 6).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 6) + Table S.74 (column 6).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 11) + Table S.74 (column 6).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 1) + Table S.74 (column 6).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 6) + Table S.74 (column 6).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 11) + Table S.74 (column 6).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 1) + Table S.74 (column 11).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 6) + Table S.74 (column 11).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 11) + Table S.74 (column 11).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 1) + Table S.74 (column 11).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 6) + Table S.74 (column 11).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 11) + Table S.74 (column 11).

Notes: Values rounded. DM = dry mass. t = tonne.

* In 2015, the *Max 1* and *Min 1* scenarios coincide.

Table S.87: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2015 – Price Path A, Scenarios *Max 2, Min 2**

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite[a]	Hard coal[b]	Natu-ral gas[c]	Lig-nite[d]	Hard coal[e]	Natu-ral gas[f]	Lig-nite[g]	Hard coal[h]	Natu-ral gas[i]	Lig-nite[j]	Hard coal[k]	Natu-ral gas[l]	Lig-nite[m]	Hard coal[n]	Natu-ral gas[o]	Lig-nite[p]	Hard coal[q]	Natu-ral gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	253	237	208	250	229	190	271	255	226	268	247	208	220	204	175	217	196	157
Forestry residues	348	329	296	345	321	277	366	347	314	363	339	295	315	296	263	311	288	244
Open-country biomass residues	154	138	109	151	130	91	172	156	127	169	148	109	121	104	76	117	96	58
Industrial wood waste	129	167	237	125	158	219	146	184	255	143	176	236	95	133	203	91	124	185
Wood in municipal solid waste	168	149	115	164	140	97	185	167	133	182	158	115	134	115	82	131	107	64
Green waste: Compensation areas	243	228	202	239	220	184	261	246	220	257	238	202	209	194	169	206	186	151
Biomass: Habitat-connectivity areas	154	138	109	151	130	91	172	156	127	169	148	109	121	104	76	117	96	58
Green waste: Extensive grassland	154	138	109	151	130	91	172	156	127	169	148	109	121	104	76	117	96	58
Short-rotation coppice: Erosion areas	143	180	248	140	171	229	161	197	265	157	189	247	111	147	215	107	138	196

Sources:
a) (1) = Table S.67 (column 11a) + Table S.68 (column 1) + Table S.76 (column 1).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 6) + Table S.76 (column 1).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 11) + Table S.76 (column 1).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 1) + Table S.76 (column 1).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 6) + Table S.76 (column 1).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 11) + Table S.76 (column 1).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 1) + Table S.76 (column 6).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 6) + Table S.76 (column 6).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 11) + Table S.76 (column 6).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 1) + Table S.76 (column 6).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 6) + Table S.76 (column 6).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 11) + Table S.76 (column 6).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 1) + Table S.76 (column 11).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 6) + Table S.76 (column 11).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 11) + Table S.76 (column 11).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 1) + Table S.76 (column 11).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 6) + Table S.76 (column 11).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 11) + Table S.76 (column 11).

Notes: Values rounded. DM = dry mass. t = tonne.

* In 2015, the *Max 2* and *Min 2* scenarios coincide.

Table S.88: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2015 – Price Path C, Scenarios *Max 1*, *Min 1**

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	€2012/t_{DM} feedstock						€2012/t_{DM} feedstock						€2012/t_{DM} feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	252	240	217	249	234	202	270	258	235	267	251	220	218	206	182	214	199	167
Forestry residues	347	334	307	344	327	291	365	351	324	361	344	308	312	299	272	309	292	256
Open-country biomass residues	153	142	118	150	135	103	171	159	136	167	152	120	118	107	83	115	100	68
Industrial wood waste	128	155	214	124	148	198	145	172	231	142	165	215	92	120	178	89	113	163
Wood in municipal solid waste	166	153	126	163	146	110	184	171	143	181	163	128	132	118	91	128	111	75
Green waste: Compensation areas	242	231	210	238	224	195	259	249	228	256	242	213	206	196	175	203	189	160
Biomass: Habitat-connectivity areas	153	142	118	150	135	103	171	159	136	167	152	120	118	107	83	115	100	68
Green waste: Extensive grassland	153	142	118	150	135	103	171	159	136	167	152	120	118	107	83	115	100	68
Short-rotation coppice: Erosion areas	142	169	225	139	161	209	159	186	242	156	179	227	108	134	191	105	127	175
Solid cattle manure	225	232	251	221	225	237	250	257	276	247	251	262	215	222	241	212	215	227
Solid swine manure	257	280	335	254	273	321	289	312	367	286	305	353	273	295	350	269	289	336
Solid poultry manure	188	180	164	185	174	150	207	199	183	204	193	169	156	148	132	153	142	118
Commercial and industrial waste	49	52	61	46	45	46	73	75	85	69	68	69	35	38	47	32	31	32
Organic municipal solid waste	-22	-6	35	-25	-12	21	5	22	62	2	16	48	-23	-7	34	-26	-13	20

Sources:
a) (1) = Table S.67 (column 11a) + Table S.70 (column 1) + Table S.82 (column 1).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 6) + Table S.82 (column 1).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 11) + Table S.82 (column 1).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 1) + Table S.82 (column 1).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 6) + Table S.82 (column 1).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 11) + Table S.82 (column 1).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 1) + Table S.82 (column 6).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 6) + Table S.82 (column 6).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 11) + Table S.82 (column 6).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 1) + Table S.82 (column 6).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 6) + Table S.82 (column 6).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 11) + Table S.82 (column 6).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 1) + Table S.82 (column 11).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 6) + Table S.82 (column 11).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 11) + Table S.82 (column 11).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 1) + Table S.82 (column 11).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 6) + Table S.82 (column 11).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 11) + Table S.82 (column 11).

Notes: Values rounded. DM = dry mass. t = tonne.

* In 2015, the *Max 1* and *Min 1* scenarios coincide.

Table S.89: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2015 – Price Path C, Scenarios *Max 2, Min 2**

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	253	242	218	250	235	203	271	260	236	268	253	221	220	208	185	217	202	170
Forestry residues	348	335	308	345	328	292	366	353	325	363	345	310	315	301	274	311	294	259
Open-country biomass residues	154	143	119	151	136	104	172	161	137	169	154	122	121	109	86	117	102	70
Industrial wood waste	129	156	215	125	149	199	146	174	232	143	167	217	95	122	181	91	115	165
Wood in municipal solid waste	168	154	127	164	147	111	185	172	145	182	165	129	134	121	94	131	114	78
Green waste: Compensation areas	243	232	211	239	225	196	261	250	229	257	243	214	209	198	178	206	192	162
Biomass: Habitat-connectivity areas	154	143	119	151	136	104	172	161	137	169	154	122	121	109	86	117	102	70
Green waste: Extensive grassland	154	143	119	151	136	104	172	161	137	169	154	122	121	109	86	117	102	70
Short-rotation coppice: Erosion areas	143	170	226	140	163	211	161	187	244	157	180	228	111	137	193	107	130	178

Sources:

a) (1) = Table S.67 (column 11a) + Table S.70 (column 1) + Table S.84 (column 1).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 6) + Table S.84 (column 1).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 11) + Table S.84 (column 1).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 1) + Table S.84 (column 1).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 6) + Table S.84 (column 1).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 11) + Table S.84 (column 1).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 1) + Table S.84 (column 6).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 6) + Table S.84 (column 6).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 11) + Table S.84 (column 6).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 1) + Table S.84 (column 6).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 6) + Table S.84 (column 6).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 11) + Table S.84 (column 6).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 1) + Table S.84 (column 11).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 6) + Table S.84 (column 11).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 11) + Table S.84 (column 11).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 1) + Table S.84 (column 11).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 6) + Table S.84 (column 11).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 11) + Table S.84 (column 11).

Notes: Values rounded. DM = dry mass. t = tonne.

* In 2015, the *Max 2* and *Min 2* scenarios coincide.

Table S.90: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path A, Scenario *Max 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	219	192	147	211	176	117	235	207	162	226	191	132	178	151	106	170	134	75
Forestry residues	311	280	228	303	263	197	326	294	243	317	278	211	270	238	187	261	221	155
Open-country biomass residues	121	93	49	112	77	18	135	108	64	127	92	33	79	52	7	70	35	-23
Industrial wood waste	162	224	330	153	207	299	177	239	344	168	222	313	120	182	288	111	165	257
Wood in municipal solid waste	130	99	47	122	82	16	145	113	62	136	97	31	89	57	6	80	41	-26
Green waste: Compensation areas	211	187	147	203	171	117	226	202	162	218	185	131	170	145	105	161	129	75
Biomass: Habitat-connectivity areas	121	93	49	112	77	18	135	108	64	127	92	33	79	52	7	70	35	-23
Green waste: Extensive grassland	121	93	49	112	77	18	135	108	64	127	92	33	79	52	7	70	35	-23
Short-rotation coppice: Erosion areas	174	233	335	165	216	304	188	247	349	179	231	318	132	192	294	124	175	262
Solid cattle manure	211	224	253	203	209	224	230	244	273	222	228	244	183	196	225	175	181	196
Solid swine manure	254	300	390	246	285	362	278	324	413	270	308	385	240	286	376	232	271	348
Solid poultry manure	160	141	110	153	126	82	177	157	126	169	142	98	121	101	70	113	86	42
Commercial and industrial waste	29	32	43	20	15	12	47	50	61	38	34	30	-1	2	13	-10	-15	-18
Organic municipal solid waste	-26	8	74	-34	-7	46	-5	29	95	-13	14	67	-49	-15	51	-57	-30	23

Sources:

a) (1) = Table S.67 (column 11a) + Table S.68 (column 3) + Table S.74 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 8) + Table S.74 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 13) + Table S.74 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 3) + Table S.74 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 8) + Table S.74 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 13) + Table S.74 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 3) + Table S.74 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 8) + Table S.74 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 13) + Table S.74 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 3) + Table S.74 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 8) + Table S.74 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 13) + Table S.74 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 3) + Table S.74 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 8) + Table S.74 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 13) + Table S.74 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 3) + Table S.74 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 8) + Table S.74 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 13) + Table S.74 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.91: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path A, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	228	201	156	220	184	125	245	218	173	237	202	143	191	164	119	183	148	89
Forestry residues	320	288	237	311	272	205	337	305	254	328	288	222	283	251	200	274	235	169
Open-country biomass residues	129	102	58	121	85	27	146	119	74	137	102	44	92	65	20	83	48	-10
Industrial wood waste	171	233	339	162	216	307	187	249	355	178	232	324	133	195	301	124	178	270
Wood in municipal solid waste	139	107	56	130	91	25	156	124	73	147	107	41	102	71	19	93	54	-12
Green waste: Compensation areas	220	195	156	211	179	125	237	212	173	228	196	142	183	158	118	174	142	88
Biomass: Habitat-connectivity areas	129	102	58	121	85	27	146	119	74	137	102	44	92	65	20	83	48	-10
Green waste: Extensive grassland	129	102	58	121	85	27	146	119	74	137	102	44	92	65	20	83	48	-10
Short-rotation coppice: Erosion areas	183	242	344	174	225	313	199	258	360	190	242	329	146	206	307	137	189	276
Solid cattle manure	225	239	268	217	223	239	249	263	292	241	247	263	210	224	253	202	208	224
Solid swine manure	275	321	411	268	306	383	305	351	441	297	336	413	283	329	419	275	314	391
Solid poultry manure	170	150	119	162	135	91	188	169	138	181	154	110	135	116	85	128	101	57
Commercial and industrial waste	43	46	57	34	29	26	65	68	79	56	51	48	24	27	38	16	11	8
Organic municipal solid waste	-9	25	91	-17	10	63	17	51	117	9	36	89	-16	18	84	-24	3	56

Sources:
a) (1) = Table S.67 (column 11a) + Table S.68 (column 3) + Table S.75 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 8) + Table S.75 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 13) + Table S.75 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 3) + Table S.75 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 8) + Table S.75 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 13) + Table S.75 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 3) + Table S.75 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 8) + Table S.75 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 13) + Table S.75 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 3) + Table S.75 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 8) + Table S.75 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 13) + Table S.75 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 3) + Table S.75 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 8) + Table S.75 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 13) + Table S.75 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 3) + Table S.75 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 8) + Table S.75 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 13) + Table S.75 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.92: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path A, Scenario *Max 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	221	193	148	212	177	118	236	208	163	227	192	133	180	153	108	172	136	77
Forestry residues	312	281	229	304	264	198	327	296	244	319	279	213	272	240	189	263	223	157
Open-country biomass residues	122	94	50	113	78	19	137	109	65	128	93	34	81	54	9	72	37	-22
Industrial wood waste	163	225	331	154	208	300	178	240	346	169	223	314	122	184	290	113	167	259
Wood in municipal solid waste	131	100	48	123	83	17	146	115	63	138	98	32	91	59	8	82	42	-24
Green waste: Compensation areas	212	188	148	204	172	118	227	203	163	219	187	133	172	147	107	163	131	77
Biomass: Habitat-connectivity areas	122	94	50	113	78	19	137	109	65	128	93	34	81	54	9	72	37	-22
Green waste: Extensive grassland	122	94	50	113	78	19	137	109	65	128	93	34	81	54	9	72	37	-22
Short-rotation coppice: Erosion areas	175	234	336	166	217	305	189	249	351	181	232	319	134	194	296	126	177	264

Sources:
a) (1) = Table S.67 (column 11a) + Table S.68 (column 3) + Table S.76 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 8) + Table S.76 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 13) + Table S.76 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 3) + Table S.76 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 8) + Table S.76 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 13) + Table S.76 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 3) + Table S.76 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 8) + Table S.76 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 13) + Table S.76 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 3) + Table S.76 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 8) + Table S.76 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 13) + Table S.76 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 3) + Table S.76 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 8) + Table S.76 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 13) + Table S.76 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 3) + Table S.76 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 8) + Table S.76 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 13) + Table S.76 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.93: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path A, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	228	200	156	220	184	125	245	218	173	237	201	142	192	164	119	183	148	89
Forestry residues	320	288	237	311	271	205	337	305	253	328	288	222	283	252	200	275	235	169
Open-country biomass residues	129	102	57	120	85	27	146	119	74	137	102	43	92	65	21	84	48	-10
Industrial wood waste	170	232	338	162	216	307	187	249	355	178	232	324	133	195	301	125	179	270
Wood in municipal solid waste	139	107	56	130	90	24	156	124	73	147	107	41	102	71	19	94	54	-12
Green waste: Compensation areas	220	195	156	211	179	125	237	212	172	228	196	142	183	158	119	174	142	88
Biomass: Habitat-connectivity areas	129	102	57	120	85	27	146	119	74	137	102	43	92	65	21	84	48	-10
Green waste: Extensive grassland	129	102	57	120	85	27	146	119	74	137	102	43	92	65	21	84	48	-10
Short-rotation coppice: Erosion areas	182	242	344	174	225	312	199	258	360	190	242	329	146	206	308	138	189	276

Sources:

a) (1) = Table S.67 (column 11a) + Table S.68 (column 3) + Table S.77 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 8) + Table S.77 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 13) + Table S.77 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 3) + Table S.77 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 8) + Table S.77 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 13) + Table S.77 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 3) + Table S.77 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 8) + Table S.77 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 13) + Table S.77 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 3) + Table S.77 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 8) + Table S.77 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 13) + Table S.77 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 3) + Table S.77 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 8) + Table S.77 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 13) + Table S.77 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 3) + Table S.77 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 8) + Table S.77 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 13) + Table S.77 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.94: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path B, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	233	212	174	226	199	149	251	229	192	243	216	166	196	175	138	189	162	112
Forestry residues	326	301	258	319	288	232	343	318	275	335	305	249	289	264	221	282	251	195
Open-country biomass residues	134	113	76	127	100	50	151	130	93	144	117	67	97	76	39	90	63	13
Industrial wood waste	159	208	297	152	194	271	176	224	314	168	210	288	122	170	260	114	156	233
Wood in municipal solid waste	145	121	77	138	107	51	162	137	94	155	124	68	108	84	40	101	70	14
Green waste: Compensation areas	225	206	172	217	192	147	241	222	189	234	209	164	187	168	135	180	155	110
Biomass: Habitat-connectivity areas	134	113	76	127	100	50	151	130	93	144	117	67	97	76	39	90	63	13
Green waste: Extensive grassland	134	113	76	127	100	50	151	130	93	144	117	67	97	76	39	90	63	13
Short-rotation coppice: Erosion areas	172	218	304	164	205	278	188	235	321	181	221	295	135	181	268	128	168	242
Solid cattle manure	223	234	260	217	222	236	247	258	283	240	246	260	208	219	244	201	206	220
Solid swine manure	268	305	382	261	292	358	297	334	412	291	322	388	275	312	389	268	299	365
Solid poultry manure	173	158	132	167	146	109	192	177	151	186	165	128	139	124	98	132	112	75
Commercial and industrial waste	43	45	56	35	32	30	65	67	78	58	54	52	24	27	37	17	13	11
Organic municipal solid waste	-15	13	69	-21	1	46	11	38	95	5	26	72	-22	5	62	-29	-7	39

Sources:

a) (1) = Table S.67 (column 11a) + Table S.69 (column 3) + Table S.79 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.69 (column 8) + Table S.79 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.69 (column 13) + Table S.79 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.72 (column 3) + Table S.79 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.72 (column 8) + Table S.79 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.72 (column 13) + Table S.79 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.69 (column 3) + Table S.79 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.69 (column 8) + Table S.79 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.69 (column 13) + Table S.79 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.72 (column 3) + Table S.79 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.72 (column 8) + Table S.79 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.72 (column 13) + Table S.79 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.69 (column 3) + Table S.79 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.69 (column 8) + Table S.79 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.69 (column 13) + Table S.79 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.72 (column 3) + Table S.79 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.72 (column 8) + Table S.79 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.72 (column 13) + Table S.79 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.95: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path B, Scenario *Max 2*

	Small-scale pyrolysis units						**Medium-scale pyrolysis units**						**Large-scale pyrolysis units**					
	No process heat recovery			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**		
	Lig-nite[a]	**Hard coal**[b]	**Natu-ral gas**[c]	**Lig-nite**[d]	**Hard coal**[e]	**Natu-ral gas**[f]	**Lig-nite**[g]	**Hard coal**[h]	**Natu-ral gas**[i]	**Lig-nite**[j]	**Hard coal**[k]	**Natu-ral gas**[l]	**Lig-nite**[m]	**Hard coal**[n]	**Natu-ral gas**[o]	**Lig-nite**[p]	**Hard coal**[q]	**Natu-ral gas**[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	226	204	167	219	191	141	241	220	182	234	206	157	185	164	126	178	151	101
Forestry residues	318	294	251	311	280	224	333	309	266	326	295	239	278	253	210	270	239	184
Open-country biomass residues	127	106	69	120	92	43	142	121	84	135	107	58	86	65	28	79	51	2
Industrial wood waste	152	200	290	144	186	264	167	215	304	159	201	278	111	159	249	103	145	222
Wood in municipal solid waste	137	113	70	130	99	44	152	128	85	145	114	59	97	72	29	89	59	3
Green waste: Compensation areas	217	198	165	210	185	139	232	213	180	225	200	154	176	157	124	169	144	99
Biomass: Habitat-connectivity areas	127	106	69	120	92	43	142	121	84	135	107	58	86	65	28	79	51	2
Green waste: Extensive grassland	127	106	69	120	92	43	142	121	84	135	107	58	86	65	28	79	51	2
Short-rotation coppice: Erosion areas	164	210	297	157	197	271	179	225	311	171	211	285	124	170	256	116	156	230

Sources:

a) (1) = Table S.67 (column 11a) + Table S.69 (column 3) + Table S.80 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.69 (column 8) + Table S.80 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.69 (column 13) + Table S.80 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.72 (column 3) + Table S.80 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.72 (column 8) + Table S.80 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.72 (column 13) + Table S.80 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.69 (column 3) + Table S.80 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.69 (column 8) + Table S.80 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.69 (column 13) + Table S.80 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.72 (column 3) + Table S.80 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.72 (column 8) + Table S.80 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.72 (column 13) + Table S.80 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.69 (column 3) + Table S.80 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.69 (column 8) + Table S.80 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.69 (column 13) + Table S.80 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.72 (column 3) + Table S.80 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.72 (column 8) + Table S.80 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.72 (column 13) + Table S.80 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.96: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path B, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	233	212	174	226	199	149	250	229	191	243	216	166	197	175	138	190	162	112
Forestry residues	326	301	258	318	288	232	343	318	275	335	304	249	289	265	221	282	251	195
Open-country biomass residues	134	113	76	127	100	50	151	130	93	144	116	67	97	76	39	90	63	13
Industrial wood waste	159	207	297	152	194	271	176	224	314	168	210	287	122	170	260	114	156	234
Wood in municipal solid waste	145	120	77	138	107	51	162	137	94	154	124	68	108	84	41	101	70	14
Green waste: Compensation areas	224	205	172	217	192	147	241	222	189	234	209	164	187	168	135	180	155	110
Biomass: Habitat-connectivity areas	134	113	76	127	100	50	151	130	93	144	116	67	97	76	39	90	63	13
Green waste: Extensive grassland	134	113	76	127	100	50	151	130	93	144	116	67	97	76	39	90	63	13
Short-rotation coppice: Erosion areas	172	218	304	164	204	278	188	234	321	181	221	295	135	182	268	128	168	242

Sources:

a) (1) = Table S.67 (column 11a) + Table S.69 (column 3) + Table S.81 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.69 (column 8) + Table S.81 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.69 (column 13) + Table S.81 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.72 (column 3) + Table S.81 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.72 (column 8) + Table S.81 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.72 (column 13) + Table S.81 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.69 (column 3) + Table S.81 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.69 (column 8) + Table S.81 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.69 (column 13) + Table S.81 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.72 (column 3) + Table S.81 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.72 (column 8) + Table S.81 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.72 (column 13) + Table S.81 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.69 (column 3) + Table S.81 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.69 (column 8) + Table S.81 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.69 (column 13) + Table S.81 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.72 (column 3) + Table S.81 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.72 (column 8) + Table S.81 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.72 (column 13) + Table S.81 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.97: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path C, Scenario *Max 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite[a]	Hard coal[b]	Natu-ral gas[c]	Lig-nite[d]	Hard coal[e]	Natu-ral gas[f]	Lig-nite[g]	Hard coal[h]	Natu-ral gas[i]	Lig-nite[j]	Hard coal[k]	Natu-ral gas[l]	Lig-nite[m]	Hard coal[n]	Natu-ral gas[o]	Lig-nite[p]	Hard coal[q]	Natu-ral gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	228	214	182	222	203	161	243	229	197	237	218	176	187	172	141	181	162	120
Forestry residues	322	305	268	315	294	247	336	319	283	330	308	261	280	263	227	274	252	205
Open-country biomass residues	130	115	84	123	104	62	144	130	98	138	119	77	88	73	42	82	62	21
Industrial wood waste	142	177	253	136	166	231	157	191	267	151	180	246	100	135	211	94	124	189
Wood in municipal solid waste	141	124	88	134	113	66	155	138	102	149	128	81	99	82	46	93	71	24
Green waste: Compensation areas	219	206	178	213	196	157	234	221	193	228	210	172	177	164	136	171	154	115
Biomass: Habitat-connectivity areas	130	115	84	123	104	62	144	130	98	138	119	77	88	73	42	82	62	21
Green waste: Extensive grassland	130	115	84	123	104	62	144	130	98	138	119	77	88	73	42	82	62	21
Short-rotation coppice: Erosion areas	155	188	261	149	177	240	169	202	275	163	191	254	114	146	220	107	136	198
Solid cattle manure	207	216	238	201	206	218	227	235	257	221	225	238	179	187	210	173	177	190
Solid swine manure	241	268	335	235	259	316	264	292	359	259	282	339	227	254	321	221	244	301
Solid poultry manure	167	156	135	161	147	115	183	173	151	178	163	132	127	117	95	121	107	76
Commercial and industrial waste	29	31	41	23	21	20	47	50	59	41	39	38	-2	1	10	-8	-10	-11
Organic municipal solid waste	-36	-15	34	-41	-25	15	-15	5	54	-20	-4	35	-59	-39	10	-65	-48	-9

Sources:
a) (1) = Table S.67 (column 11a) + Table S.70 (column 3) + Table S.82 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 8) + Table S.82 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 13) + Table S.82 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 3) + Table S.82 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 8) + Table S.82 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 13) + Table S.82 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 3) + Table S.82 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 8) + Table S.82 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 13) + Table S.82 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 3) + Table S.82 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 8) + Table S.82 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 13) + Table S.82 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 3) + Table S.82 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 8) + Table S.82 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 13) + Table S.82 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 3) + Table S.82 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 8) + Table S.82 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 13) + Table S.82 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.98: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path C, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite[a]	Hard coal[b]	Natu-ral gas[c]	Lig-nite[d]	Hard coal[e]	Natu-ral gas[f]	Lig-nite[g]	Hard coal[h]	Natu-ral gas[i]	Lig-nite[j]	Hard coal[k]	Natu-ral gas[l]	Lig-nite[m]	Hard coal[n]	Natu-ral gas[o]	Lig-nite[p]	Hard coal[q]	Natu-ral gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	237	222	191	231	212	170	254	239	208	248	229	187	200	185	154	194	175	133
Forestry residues	330	313	277	324	302	255	347	330	294	341	319	272	293	276	240	287	265	218
Open-country biomass residues	138	124	92	132	113	71	155	140	109	149	130	88	101	86	55	95	75	34
Industrial wood waste	151	185	261	145	174	240	168	202	278	161	191	256	113	147	224	107	137	202
Wood in municipal solid waste	149	133	96	143	122	75	166	149	113	160	138	91	112	95	59	106	84	37
Green waste: Compensation areas	228	215	187	222	204	166	245	232	204	239	221	183	190	177	149	184	167	128
Biomass: Habitat-connectivity areas	138	124	92	132	113	71	155	140	109	149	130	88	101	86	55	95	75	34
Green waste: Extensive grassland	138	124	92	132	113	71	155	140	109	149	130	88	101	86	55	95	75	34
Short-rotation coppice: Erosion areas	164	197	270	158	186	248	180	213	286	174	202	265	127	160	233	121	149	212
Solid cattle manure	222	230	253	216	220	233	246	254	276	240	244	257	206	215	237	200	205	217
Solid swine manure	262	290	357	257	280	337	292	319	386	286	309	367	269	296	363	263	286	344
Solid poultry manure	176	166	144	170	156	125	195	184	162	189	175	143	141	131	109	136	121	90
Commercial and industrial waste	43	45	55	36	35	34	65	67	77	58	57	56	23	26	36	17	16	15
Organic municipal solid waste	-19	2	51	-24	-8	32	7	27	76	1	18	57	-27	-6	43	-32	-16	24

Sources:
a) (1) = Table S.67 (column 11a) + Table S.70 (column 3) + Table S.83 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 8) + Table S.83 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 13) + Table S.83 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 3) + Table S.83 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 8) + Table S.83 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 13) + Table S.83 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 3) + Table S.83 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 8) + Table S.83 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 13) + Table S.83 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 3) + Table S.83 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 8) + Table S.83 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 13) + Table S.83 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 3) + Table S.83 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 8) + Table S.83 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 13) + Table S.83 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 3) + Table S.83 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 8) + Table S.83 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 13) + Table S.83 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.99: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path C, Scenario *Max 2*

	Small-scale pyrolysis units						**Medium-scale pyrolysis units**						**Large-scale pyrolysis units**					
	No process heat recovery			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**		
	Lig-nite[a]	**Hard coal**[b]	**Natu-ral gas**[c]	**Lig-nite**[d]	**Hard coal**[e]	**Natu-ral gas**[f]	**Lig-nite**[g]	**Hard coal**[h]	**Natu-ral gas**[i]	**Lig-nite**[j]	**Hard coal**[k]	**Natu-ral gas**[l]	**Lig-nite**[m]	**Hard coal**[n]	**Natu-ral gas**[o]	**Lig-nite**[p]	**Hard coal**[q]	**Natu-ral gas**[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	229	215	183	223	204	162	245	230	198	239	219	177	189	174	142	183	164	122
Forestry residues	323	306	269	316	295	248	338	321	284	331	310	263	282	265	228	276	254	207
Open-country biomass residues	131	116	85	124	105	64	146	131	100	139	120	78	90	75	44	83	64	23
Industrial wood waste	144	178	254	137	167	232	158	192	268	152	182	247	102	137	213	96	126	191
Wood in municipal solid waste	142	125	89	136	114	67	157	140	103	150	129	82	101	84	48	95	73	26
Green waste: Compensation areas	220	207	179	214	197	158	235	222	194	229	212	173	179	166	138	173	156	117
Biomass: Habitat-connectivity areas	131	116	85	124	105	64	146	131	100	139	120	78	90	75	44	83	64	23
Green waste: Extensive grassland	131	116	85	124	105	64	146	131	100	139	120	78	90	75	44	83	64	23
Short-rotation coppice: Erosion areas	156	189	262	150	178	241	171	204	277	164	193	255	116	148	222	109	138	200

Sources:
a) (1) = Table S.67 (column 11a) + Table S.70 (column 3) + Table S.84 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 8) + Table S.84 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 13) + Table S.84 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 3) + Table S.84 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 8) + Table S.84 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 13) + Table S.84 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 3) + Table S.84 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 8) + Table S.84 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 13) + Table S.84 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 3) + Table S.84 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 8) + Table S.84 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 13) + Table S.84 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 3) + Table S.84 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 8) + Table S.84 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 13) + Table S.84 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 3) + Table S.84 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 8) + Table S.84 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 13) + Table S.84 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.100: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2030 – Price Path C, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite[a]	Hard coal[b]	Natu-ral gas[c]	Lig-nite[d]	Hard coal[e]	Natu-ral gas[f]	Lig-nite[g]	Hard coal[h]	Natu-ral gas[i]	Lig-nite[j]	Hard coal[k]	Natu-ral gas[l]	Lig-nite[m]	Hard coal[n]	Natu-ral gas[o]	Lig-nite[p]	Hard coal[q]	Natu-ral gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	237	222	191	231	212	170	254	239	208	248	229	187	200	185	154	194	175	133
Forestry residues	330	313	277	324	302	255	347	330	293	341	319	272	293	276	240	287	265	218
Open-country biomass residues	138	123	92	132	113	71	155	140	109	149	129	88	101	86	55	95	76	34
Industrial wood waste	151	185	261	145	174	239	167	202	278	161	191	256	113	148	224	107	137	202
Wood in municipal solid waste	149	132	96	143	121	74	166	149	113	160	138	91	112	95	59	106	85	38
Green waste: Compensation areas	228	215	187	222	204	166	245	231	203	238	221	182	191	177	149	184	167	128
Biomass: Habitat-connectivity areas	138	123	92	132	113	71	155	140	109	149	129	88	101	86	55	95	76	34
Green waste: Extensive grassland	138	123	92	132	113	71	155	140	109	149	129	88	101	86	55	95	76	34
Short-rotation coppice: Erosion areas	164	197	270	157	186	248	180	213	286	174	202	265	127	160	233	121	149	212

Sources:
a) (1) = Table S.67 (column 11a) + Table S.70 (column 3) + Table S.85 (column 3).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 8) + Table S.85 (column 3).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 13) + Table S.85 (column 3).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 3) + Table S.85 (column 3).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 8) + Table S.85 (column 3).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 13) + Table S.85 (column 3).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 3) + Table S.85 (column 8).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 8) + Table S.85 (column 8).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 13) + Table S.85 (column 8).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 3) + Table S.85 (column 8).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 8) + Table S.85 (column 8).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 13) + Table S.85 (column 8).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 3) + Table S.85 (column 13).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 8) + Table S.85 (column 13).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 13) + Table S.85 (column 13).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 3) + Table S.85 (column 13).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 8) + Table S.85 (column 13).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 13) + Table S.85 (column 13).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.101: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path A, Scenario *Max 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite[a]	Hard coal[b]	Natu-ral gas[c]	Lig-nite[d]	Hard coal[e]	Natu-ral gas[f]	Lig-nite[g]	Hard coal[h]	Natu-ral gas[i]	Lig-nite[j]	Hard coal[k]	Natu-ral gas[l]	Lig-nite[m]	Hard coal[n]	Natu-ral gas[o]	Lig-nite[p]	Hard coal[q]	Natu-ral gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	200	153	86	188	127	41	215	167	101	202	142	55	161	113	47	148	88	1
Forestry residues	290	235	159	277	209	112	304	249	173	291	223	126	250	195	119	237	169	72
Open-country biomass residues	101	54	-11	89	28	-58	116	69	3	103	43	-43	61	14	-51	49	-12	-98
Industrial wood waste	193	298	452	180	272	405	207	312	467	194	286	419	153	258	412	140	232	365
Wood in municipal solid waste	109	54	-22	96	28	-69	123	69	-7	110	42	-55	69	15	-61	56	-12	-109
Green waste: Compensation areas	194	152	93	181	126	47	208	166	107	196	140	61	154	112	53	141	86	7
Biomass: Habitat-connectivity areas	101	54	-11	89	28	-58	116	69	3	103	43	-43	61	14	-51	49	-12	-98
Green waste: Extensive grassland	101	54	-11	89	28	-58	116	69	3	103	43	-43	61	14	-51	49	-12	-98
Short-rotation coppice: Erosion areas	203	304	452	190	277	405	217	318	466	204	291	419	163	264	412	150	238	365
Solid cattle manure	213	234	274	201	210	230	232	253	293	220	229	250	187	208	248	175	184	204
Solid swine manure	273	348	475	262	325	432	296	371	497	284	347	455	261	336	462	249	312	420
Solid poultry manure	146	112	66	134	88	24	161	128	81	150	104	39	108	74	28	96	50	-14
Commercial and industrial waste	25	29	42	13	3	-4	43	46	60	30	21	14	-3	0	14	-16	-26	-32
Organic municipal solid waste	-13	43	136	-24	20	94	8	63	156	-4	40	115	-34	22	115	-45	-2	73

Sources:

a) (1) = Table S.67 (column 11a) + Table S.68 (column 5) + Table S.74 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 10) + Table S.74 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 15) + Table S.74 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 5) + Table S.74 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 10) + Table S.74 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 15) + Table S.74 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 5) + Table S.74 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 10) + Table S.74 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 15) + Table S.74 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 5) + Table S.74 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 10) + Table S.74 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 15) + Table S.74 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 5) + Table S.74 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 10) + Table S.74 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 15) + Table S.74 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 5) + Table S.74 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 10) + Table S.74 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 15) + Table S.74 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.102: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path A, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	209	162	96	197	136	50	226	179	113	214	153	67	174	127	60	162	101	15
Forestry residues	299	244	168	286	218	121	315	261	185	302	235	137	263	209	133	250	183	85
Open-country biomass residues	110	63	-2	98	38	-49	127	80	14	114	54	-32	75	28	-38	62	2	-84
Industrial wood waste	202	307	462	189	281	414	218	323	478	205	297	430	166	271	426	153	245	378
Wood in municipal solid waste	118	64	-12	105	37	-60	134	80	4	121	54	-43	82	28	-48	69	2	-95
Green waste: Compensation areas	203	161	102	190	135	56	219	177	119	207	152	73	167	125	66	154	99	20
Biomass: Habitat-connectivity areas	110	63	-2	98	38	-49	127	80	14	114	54	-32	75	28	-38	62	2	-84
Green waste: Extensive grassland	110	63	-2	98	38	-49	127	80	14	114	54	-32	75	28	-38	62	2	-84
Short-rotation coppice: Erosion areas	212	313	461	199	287	414	228	329	477	216	303	430	177	278	426	164	252	379
Solid cattle manure	228	249	289	216	225	246	252	273	312	240	248	269	214	235	275	203	211	232
Solid swine manure	295	370	496	283	346	454	324	399	526	313	376	483	304	379	505	292	355	463
Solid poultry manure	155	122	75	144	98	33	174	140	94	162	117	52	122	89	42	111	65	0
Commercial and industrial waste	40	43	57	27	17	11	61	65	78	49	39	32	22	26	40	10	0	-6
Organic municipal solid waste	5	60	154	-7	37	112	30	86	179	19	63	137	-1	55	148	-12	31	106

Sources:

a) (1) = Table S.67 (column 11a) + Table S.68 (column 5) + Table S.75 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 10) + Table S.75 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 15) + Table S.75 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 5) + Table S.75 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 10) + Table S.75 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 15) + Table S.75 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 5) + Table S.75 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 10) + Table S.75 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 15) + Table S.75 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 5) + Table S.75 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 10) + Table S.75 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 15) + Table S.75 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 5) + Table S.75 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 10) + Table S.75 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 15) + Table S.75 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 5) + Table S.75 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 10) + Table S.75 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 15) + Table S.75 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.103: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path A, Scenario *Max 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	201	154	88	189	128	42	216	169	103	204	143	57	163	115	49	150	90	3
Forestry residues	291	236	160	278	210	113	305	251	175	292	224	127	252	197	121	239	171	74
Open-country biomass residues	102	55	-10	90	29	-57	117	70	4	104	44	-42	63	16	-49	51	-10	-96
Industrial wood waste	194	299	454	181	273	406	208	314	468	195	287	421	155	260	414	142	233	367
Wood in municipal solid waste	110	55	-21	97	29	-68	124	70	-6	111	44	-53	71	16	-60	58	-10	-107
Green waste: Compensation areas	195	153	94	182	127	48	210	167	109	197	142	63	156	114	55	143	88	9
Biomass: Habitat-connectivity areas	102	55	-10	90	29	-57	117	70	4	104	44	-42	63	16	-49	51	-10	-96
Green waste: Extensive grassland	102	55	-10	90	29	-57	117	70	4	104	44	-42	63	16	-49	51	-10	-96
Short-rotation coppice: Erosion areas	204	305	453	191	278	406	218	319	467	205	293	420	165	266	414	152	240	367

Sources:
a) (1) = Table S.67 (column 11a) + Table S.68 (column 5) + Table S.76 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 10) + Table S.76 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 15) + Table S.76 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 5) + Table S.76 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 10) + Table S.76 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 15) + Table S.76 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 5) + Table S.76 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 10) + Table S.76 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 15) + Table S.76 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 5) + Table S.76 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 10) + Table S.76 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 15) + Table S.76 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 5) + Table S.76 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 10) + Table S.76 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 15) + Table S.76 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 5) + Table S.76 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 10) + Table S.76 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 15) + Table S.76 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.104: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path A, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite[a]	Hard coal[b]	Natu-ral gas[c]	Lig-nite[d]	Hard coal[e]	Natu-ral gas[f]	Lig-nite[g]	Hard coal[h]	Natu-ral gas[i]	Lig-nite[j]	Hard coal[k]	Natu-ral gas[l]	Lig-nite[m]	Hard coal[n]	Natu-ral gas[o]	Lig-nite[p]	Hard coal[q]	Natu-ral gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	209	162	95	197	136	50	226	178	112	213	153	66	174	127	61	162	101	15
Forestry residues	299	244	168	286	218	121	315	261	185	302	234	137	264	209	133	251	183	86
Open-country biomass residues	110	63	-2	97	37	-49	127	80	14	114	54	-32	75	28	-38	62	2	-84
Industrial wood waste	202	307	461	189	280	414	218	323	477	205	297	430	166	271	426	153	245	378
Wood in municipal solid waste	118	63	-13	105	37	-60	134	80	4	121	53	-44	83	28	-48	70	2	-95
Green waste: Compensation areas	203	160	102	190	135	56	219	177	118	207	151	72	167	125	66	155	99	20
Biomass: Habitat-connectivity areas	110	63	-2	97	37	-49	127	80	14	114	54	-32	75	28	-38	62	2	-84
Green waste: Extensive grassland	110	63	-2	97	37	-49	127	80	14	114	54	-32	75	28	-38	62	2	-84
Short-rotation coppice: Erosion areas	212	313	461	199	286	414	228	329	477	215	302	430	177	278	426	164	252	379

Sources:
a) (1) = Table S.67 (column 11a) + Table S.68 (column 5) + Table S.77 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.68 (column 10) + Table S.77 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.68 (column 15) + Table S.77 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.71 (column 5) + Table S.77 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.71 (column 10) + Table S.77 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.71 (column 15) + Table S.77 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.68 (column 5) + Table S.77 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.68 (column 10) + Table S.77 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.68 (column 15) + Table S.77 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.71 (column 5) + Table S.77 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.71 (column 10) + Table S.77 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.71 (column 15) + Table S.77 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.68 (column 5) + Table S.77 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.68 (column 10) + Table S.77 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.68 (column 15) + Table S.77 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.71 (column 5) + Table S.77 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.71 (column 10) + Table S.77 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.71 (column 15) + Table S.77 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.105: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path B, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	218	188	142	208	169	109	235	205	159	224	186	126	182	153	107	172	134	73
Forestry residues	309	274	222	298	255	187	325	291	238	314	271	204	273	239	186	262	219	152
Open-country biomass residues	119	89	44	108	70	10	135	106	61	125	87	27	83	53	8	72	34	-26
Industrial wood waste	183	250	359	173	231	324	200	266	375	189	247	341	147	214	322	136	195	288
Wood in municipal solid waste	128	94	41	117	74	7	144	110	57	133	91	23	92	58	5	81	38	-29
Green waste: Compensation areas	210	184	143	200	165	110	227	200	160	217	182	127	174	148	107	164	129	74
Biomass: Habitat-connectivity areas	119	89	44	108	70	10	135	106	61	125	87	27	83	53	8	72	34	-26
Green waste: Extensive grassland	119	89	44	108	70	10	135	106	61	125	87	27	83	53	8	72	34	-26
Short-rotation coppice: Erosion areas	195	259	363	184	239	329	211	275	379	200	255	345	159	223	328	149	204	293
Solid cattle manure	225	239	269	215	221	237	248	262	292	238	245	261	211	225	255	201	207	223
Solid swine manure	282	332	424	273	314	393	312	361	453	302	344	422	291	340	432	281	322	401
Solid poultry manure	161	140	108	152	123	78	180	159	127	170	141	96	128	107	75	119	90	45
Commercial and industrial waste	39	42	54	29	24	21	61	64	76	51	45	42	22	25	36	12	6	3
Organic municipal solid waste	-4	32	100	-14	15	70	21	57	125	11	40	95	-11	26	93	-20	9	63

Sources:
a) (1) = Table S.67 (column 11a) + Table S.69 (column 5) + Table S.79 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.69 (column 10) + Table S.79 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.69 (column 15) + Table S.79 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.72 (column 5) + Table S.79 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.72 (column 10) + Table S.79 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.72 (column 15) + Table S.79 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.69 (column 5) + Table S.79 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.69 (column 10) + Table S.79 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.69 (column 15) + Table S.79 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.72 (column 5) + Table S.79 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.72 (column 10) + Table S.79 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.72 (column 15) + Table S.79 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.69 (column 5) + Table S.79 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.69 (column 10) + Table S.79 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.69 (column 15) + Table S.79 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.72 (column 5) + Table S.79 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.72 (column 10) + Table S.79 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.72 (column 15) + Table S.79 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.106: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path B, Scenario *Max 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	210	180	134	199	161	101	225	195	149	214	176	116	171	141	95	161	122	62
Forestry residues	301	266	214	290	247	179	315	281	228	304	261	194	261	227	175	251	208	140
Open-country biomass residues	111	81	36	100	62	2	125	96	51	115	77	17	72	42	-3	61	23	-37
Industrial wood waste	175	242	351	165	223	316	190	257	365	179	237	331	136	203	311	125	183	277
Wood in municipal solid waste	120	85	33	109	66	-2	134	100	47	123	81	13	81	46	-6	70	27	-41
Green waste: Compensation areas	202	176	135	192	157	102	217	191	150	207	172	117	163	137	96	153	118	63
Biomass: Habitat-connectivity areas	111	81	36	100	62	2	125	96	51	115	77	17	72	42	-3	61	23	-37
Green waste: Extensive grassland	111	81	36	100	62	2	125	96	51	115	77	17	72	42	-3	61	23	-37
Short-rotation coppice: Erosion areas	186	250	355	176	231	320	201	265	369	190	245	335	148	212	316	137	192	282

Sources:
a) (1) = Table S.67 (column 11a) + Table S.69 (column 5) + Table S.80 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.69 (column 10) + Table S.80 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.69 (column 15) + Table S.80 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.72 (column 5) + Table S.80 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.72 (column 10) + Table S.80 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.72 (column 15) + Table S.80 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.69 (column 5) + Table S.80 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.69 (column 10) + Table S.80 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.69 (column 15) + Table S.80 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.72 (column 5) + Table S.80 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.72 (column 10) + Table S.80 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.72 (column 15) + Table S.80 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.69 (column 5) + Table S.80 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.69 (column 10) + Table S.80 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.69 (column 15) + Table S.80 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.72 (column 5) + Table S.80 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.72 (column 10) + Table S.80 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.72 (column 15) + Table S.80 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.107: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path B, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite[a]	Hard coal[b]	Natural gas[c]	Lignite[d]	Hard coal[e]	Natural gas[f]	Lignite[g]	Hard coal[h]	Natural gas[i]	Lignite[j]	Hard coal[k]	Natural gas[l]	Lignite[m]	Hard coal[n]	Natural gas[o]	Lignite[p]	Hard coal[q]	Natural gas[r]
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	218	188	142	207	169	109	234	205	159	224	186	126	182	153	107	172	134	74
Forestry residues	308	274	221	298	255	187	325	291	238	314	271	203	273	239	186	262	219	152
Open-country biomass residues	119	89	44	108	70	10	135	106	60	125	87	27	83	54	8	73	35	-25
Industrial wood waste	183	250	358	172	231	324	199	266	375	189	247	340	147	214	323	136	195	288
Wood in municipal solid waste	127	93	41	117	74	6	144	110	57	133	90	23	92	58	5	81	39	-29
Green waste: Compensation areas	210	184	143	200	165	110	227	200	160	216	181	126	174	148	107	164	129	74
Biomass: Habitat-connectivity areas	119	89	44	108	70	10	135	106	60	125	87	27	83	54	8	73	35	-25
Green waste: Extensive grassland	119	89	44	108	70	10	135	106	60	125	87	27	83	54	8	73	35	-25
Short-rotation coppice: Erosion areas	194	258	363	184	239	328	210	275	379	200	255	345	159	223	328	149	204	294

Sources:

a) (1) = Table S.67 (column 11a) + Table S.69 (column 5) + Table S.81 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.69 (column 10) + Table S.81 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.69 (column 15) + Table S.81 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.72 (column 5) + Table S.81 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.72 (column 10) + Table S.81 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.72 (column 15) + Table S.81 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.69 (column 5) + Table S.81 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.69 (column 10) + Table S.81 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.69 (column 15) + Table S.81 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.72 (column 5) + Table S.81 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.72 (column 10) + Table S.81 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.72 (column 15) + Table S.81 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.69 (column 5) + Table S.81 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.69 (column 10) + Table S.81 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.69 (column 15) + Table S.81 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.72 (column 5) + Table S.81 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.72 (column 10) + Table S.81 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.72 (column 15) + Table S.81 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.108: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path C, Scenario *Max 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite[a]	Hard coal[b]	Natu-ral gas[c]	Lig-nite[d]	Hard coal[e]	Natu-ral gas[f]	Lig-nite[g]	Hard coal[h]	Natu-ral gas[i]	Lig-nite[j]	Hard coal[k]	Natu-ral gas[l]	Lig-nite[m]	Hard coal[n]	Natu-ral gas[o]	Lig-nite[p]	Hard coal[q]	Natu-ral gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	214	195	160	205	181	135	229	210	175	220	196	149	174	156	120	166	141	95
Forestry residues	306	284	244	297	269	217	320	298	258	311	284	231	266	244	204	257	229	177
Open-country biomass residues	116	97	62	107	82	36	130	111	76	121	97	50	75	57	22	66	42	-4
Industrial wood waste	162	205	289	153	190	262	176	219	303	167	204	276	122	165	249	112	150	222
Wood in municipal solid waste	125	103	63	116	89	36	139	118	77	130	103	51	85	63	23	76	49	-4
Green waste: Compensation areas	206	190	159	197	175	133	221	204	173	212	190	147	166	149	118	157	135	92
Biomass: Habitat-connectivity areas	116	97	62	107	82	36	130	111	76	121	97	50	75	57	22	66	42	-4
Green waste: Extensive grassland	116	97	62	107	82	36	130	111	76	121	97	50	75	57	22	66	42	-4
Short-rotation coppice: Erosion areas	174	215	296	164	200	269	187	229	310	178	214	283	134	175	256	124	160	229
Solid cattle manure	207	217	242	199	204	218	227	237	261	218	223	237	181	191	215	172	177	191
Solid swine manure	253	286	360	244	273	336	275	309	382	267	295	358	239	273	346	231	259	322
Solid poultry manure	156	142	118	148	129	94	172	158	134	163	145	110	117	104	80	109	91	56
Commercial and industrial waste	25	28	38	16	13	12	43	46	56	34	31	30	-4	-1	9	-13	-15	-17
Organic municipal solid waste	-28	-3	51	-36	-16	27	-8	17	71	-16	4	48	-50	-25	29	-58	-38	5

Sources:
a) (1) = Table S.67 (column 11a) + Table S.70 (column 5) + Table S.82 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 10) + Table S.82 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 15) + Table S.82 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 5) + Table S.82 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 10) + Table S.82 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 15) + Table S.82 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 5) + Table S.82 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 10) + Table S.82 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 15) + Table S.82 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 5) + Table S.82 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 10) + Table S.82 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 15) + Table S.82 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 5) + Table S.82 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 10) + Table S.82 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 15) + Table S.82 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 5) + Table S.82 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 10) + Table S.82 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 15) + Table S.82 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.109: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path C, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite[a]	Hard coal[b]	Natu-ral gas[c]	Lig-nite[d]	Hard coal[e]	Natu-ral gas[f]	Lig-nite[g]	Hard coal[h]	Natu-ral gas[i]	Lig-nite[j]	Hard coal[k]	Natu-ral gas[l]	Lig-nite[m]	Hard coal[n]	Natu-ral gas[o]	Lig-nite[p]	Hard coal[q]	Natu-ral gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	224	205	170	215	190	144	240	221	186	231	207	161	188	169	134	179	154	108
Forestry residues	315	293	253	306	279	226	331	310	269	322	295	243	279	257	217	270	243	190
Open-country biomass residues	125	106	71	116	91	45	141	122	88	132	108	61	88	70	35	79	55	9
Industrial wood waste	171	214	298	162	199	272	187	230	314	178	215	288	135	178	262	125	163	235
Wood in municipal solid waste	134	113	72	125	98	46	151	129	89	142	114	62	98	77	36	89	62	10
Green waste: Compensation areas	215	199	168	207	184	142	232	215	184	223	201	158	179	162	131	170	148	105
Biomass: Habitat-connectivity areas	125	106	71	116	91	45	141	122	88	132	108	61	88	70	35	79	55	9
Green waste: Extensive grassland	125	106	71	116	91	45	141	122	88	132	108	61	88	70	35	79	55	9
Short-rotation coppice: Erosion areas	183	224	305	174	209	279	199	240	321	190	225	295	147	189	270	138	174	243
Solid cattle manure	223	233	257	214	219	233	246	256	280	238	242	256	208	218	242	200	204	218
Solid swine manure	274	307	381	266	294	357	303	336	410	295	323	386	281	315	388	273	301	364
Solid poultry manure	165	152	128	157	139	104	184	170	146	176	157	123	132	119	94	124	106	71
Commercial and industrial waste	39	42	52	31	28	27	61	64	74	52	49	48	21	24	34	12	10	8
Organic municipal solid waste	-10	14	68	-19	1	45	15	39	93	7	26	70	-18	7	61	-26	-6	38

Sources:

a) (1) = Table S.67 (column 11a) + Table S.70 (column 5) + Table S.83 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 10) + Table S.83 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 15) + Table S.83 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 5) + Table S.83 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 10) + Table S.83 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 15) + Table S.83 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 5) + Table S.83 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 10) + Table S.83 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 15) + Table S.83 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 5) + Table S.83 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 10) + Table S.83 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 15) + Table S.83 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 5) + Table S.83 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 10) + Table S.83 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 15) + Table S.83 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 5) + Table S.83 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 10) + Table S.83 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 15) + Table S.83 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.110: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path C, Scenario *Max 2*

	Small-scale pyrolysis units						**Medium-scale pyrolysis units**						**Large-scale pyrolysis units**					
	No process heat recovery			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**		
	Lig-nite[a]	**Hard coal[b]**	**Natu-ral gas[c]**	**Lig-nite[d]**	**Hard coal[e]**	**Natu-ral gas[f]**	**Lig-nite[g]**	**Hard coal[h]**	**Natu-ral gas[i]**	**Lig-nite[j]**	**Hard coal[k]**	**Natu-ral gas[l]**	**Lig-nite[m]**	**Hard coal[n]**	**Natu-ral gas[o]**	**Lig-nite[p]**	**Hard coal[q]**	**Natu-ral gas[r]**
	$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock						$€_{2012}/t_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	215	197	161	207	182	136	230	211	176	221	197	151	176	157	122	167	143	97
Forestry residues	307	285	245	298	270	218	322	300	260	312	285	233	268	246	206	259	231	179
Open-country biomass residues	117	98	63	108	83	37	131	112	78	122	98	52	77	59	24	68	44	-2
Industrial wood waste	163	206	290	154	191	264	177	220	305	168	206	278	123	167	251	114	152	224
Wood in municipal solid waste	126	105	64	117	90	38	141	119	79	132	104	52	87	65	25	78	50	-2
Green waste: Compensation areas	207	191	160	199	176	134	222	205	174	213	191	148	168	151	120	159	137	94
Biomass: Habitat-connectivity areas	117	98	63	108	83	37	131	112	78	122	98	52	77	59	24	68	44	-2
Green waste: Extensive grassland	117	98	63	108	83	37	131	112	78	122	98	52	77	59	24	68	44	-2
Short-rotation coppice: Erosion areas	175	216	297	165	201	270	189	230	311	180	215	284	136	177	258	126	162	231

Sources:
a) (1) = Table S.67 (column 11a) + Table S.70 (column 5) + Table S.84 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 10) + Table S.84 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 15) + Table S.84 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 5) + Table S.84 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 10) + Table S.84 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 15) + Table S.84 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 5) + Table S.84 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 10) + Table S.84 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 15) + Table S.84 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 5) + Table S.84 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 10) + Table S.84 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 15) + Table S.84 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 5) + Table S.84 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 10) + Table S.84 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 15) + Table S.84 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 5) + Table S.84 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 10) + Table S.84 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 15) + Table S.84 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

Table S.111: Net GHG Mitigation Costs of Biochar per Dry Tonne of Feedstock, 2050 – Price Path C, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite[a]	Hard coal[b]	Natu-ral gas[c]	Lig-nite[d]	Hard coal[e]	Natu-ral gas[f]	Lig-nite[g]	Hard coal[h]	Natu-ral gas[i]	Lig-nite[j]	Hard coal[k]	Natu-ral gas[l]	Lig-nite[m]	Hard coal[n]	Natu-ral gas[o]	Lig-nite[p]	Hard coal[q]	Natu-ral gas[r]
	€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock						€$_{2012}$/t$_{DM}$ feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	223	204	169	214	190	143	240	221	186	231	207	160	188	169	134	179	155	108
Forestry residues	315	293	253	306	278	226	331	310	269	322	295	242	279	258	217	270	243	191
Open-country biomass residues	124	106	71	115	91	45	141	122	87	132	107	61	89	70	35	80	55	9
Industrial wood waste	171	214	298	162	199	271	187	230	314	178	215	287	135	178	262	125	163	235
Wood in municipal solid waste	134	112	72	125	97	45	150	129	88	141	114	62	98	77	37	89	62	10
Green waste: Compensation areas	215	198	167	206	184	141	232	215	184	223	200	158	179	163	131	170	148	106
Biomass: Habitat-connectivity areas	124	106	71	115	91	45	141	122	87	132	107	61	89	70	35	80	55	9
Green waste: Extensive grassland	124	106	71	115	91	45	141	122	87	132	107	61	89	70	35	80	55	9
Short-rotation coppice: Erosion areas	183	224	305	173	209	278	199	240	321	189	225	294	147	189	270	138	174	243

Sources:
a) (1) = Table S.67 (column 11a) + Table S.70 (column 5) + Table S.85 (column 5).
b) (2) = Table S.67 (column 11a) + Table S.70 (column 10) + Table S.85 (column 5).
c) (3) = Table S.67 (column 11a) + Table S.70 (column 15) + Table S.85 (column 5).
d) (4) = Table S.67 (column 11a) + Table S.73 (column 5) + Table S.85 (column 5).
e) (5) = Table S.67 (column 11a) + Table S.73 (column 10) + Table S.85 (column 5).
f) (6) = Table S.67 (column 11a) + Table S.73 (column 15) + Table S.85 (column 5).
g) (7) = Table S.67 (column 11b) + Table S.70 (column 5) + Table S.85 (column 10).
h) (8) = Table S.67 (column 11b) + Table S.70 (column 10) + Table S.85 (column 10).
i) (9) = Table S.67 (column 11b) + Table S.70 (column 15) + Table S.85 (column 10).
j) (10) = Table S.67 (column 11b) + Table S.73 (column 5) + Table S.85 (column 10).
k) (11) = Table S.67 (column 11b) + Table S.73 (column 10) + Table S.85 (column 10).
l) (12) = Table S.67 (column 11b) + Table S.73 (column 15) + Table S.85 (column 10).
m) (13) = Table S.67 (column 11c) + Table S.70 (column 5) + Table S.85 (column 15).
n) (14) = Table S.67 (column 11c) + Table S.70 (column 10) + Table S.85 (column 15).
o) (15) = Table S.67 (column 11c) + Table S.70 (column 15) + Table S.85 (column 15).
p) (16) = Table S.67 (column 11c) + Table S.73 (column 5) + Table S.85 (column 15).
q) (17) = Table S.67 (column 11c) + Table S.73 (column 10) + Table S.85 (column 15).
r) (18) = Table S.67 (column 11c) + Table S.73 (column 15) + Table S.85 (column 15).

Notes: Values rounded. DM = dry mass. t = tonne.

S.3) Total Net Avoided GHG Emissions per Dry Tonne of Feedstock

This section presents the total net avoided GHG emissions per dry tonne of feedstock turned into biochar referred to but not displayed in Teichmann (2015).

Table S.112: Total Net Avoided GHG Emissions, 2030, Scenario *Min 1*

	Small-scale pyrolysis units						**Medium-scale pyrolysis units**						**Large-scale pyrolysis units**					
	No process heat recovery			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**		
	Lignite	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**
	t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	0.879	0.801	0.649	1.002	0.904	0.714	0.878	0.801	0.648	1.002	0.904	0.714	0.876	0.799	0.646	1.000	0.902	0.712
Forestry residues	0.952	0.863	0.688	1.080	0.970	0.756	0.951	0.862	0.688	1.079	0.969	0.756	0.949	0.860	0.686	1.077	0.967	0.754
Open-country biomass residues	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.093
Industrial wood waste	-0.418	-0.249	0.075	-0.290	-0.142	0.143	-0.418	-0.249	0.074	-0.290	-0.142	0.143	-0.420	-0.251	0.073	-0.292	-0.144	0.141
Wood in municipal solid waste	1.367	1.278	1.103	1.495	1.385	1.172	1.366	1.278	1.103	1.494	1.384	1.171	1.365	1.276	1.101	1.492	1.383	1.169
Green waste: Compensation areas	0.774	0.705	0.569	0.898	0.808	0.635	0.773	0.704	0.568	0.897	0.808	0.634	0.772	0.702	0.566	0.896	0.806	0.633
Biomass: Habitat-connectivity areas	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.093
Green waste: Extensive grassland	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.093
Short-rotation coppice: Erosion areas	-0.527	-0.366	-0.058	-0.400	-0.260	0.010	-0.528	-0.367	-0.058	-0.400	-0.260	0.009	-0.530	-0.369	-0.060	-0.402	-0.262	0.008
Solid cattle manure	0.312	0.342	0.389	0.429	0.440	0.451	0.311	0.341	0.388	0.428	0.438	0.450	0.307	0.337	0.384	0.424	0.434	0.446
Solid swine manure	0.385	0.499	0.698	0.500	0.594	0.759	0.384	0.497	0.696	0.498	0.593	0.757	0.377	0.490	0.689	0.492	0.586	0.751
Solid poultry manure	0.714	0.658	0.548	0.827	0.753	0.608	0.713	0.657	0.547	0.826	0.752	0.608	0.711	0.655	0.545	0.824	0.750	0.606
Commercial and industrial waste	0.701	0.703	0.696	0.825	0.806	0.762	0.700	0.702	0.695	0.824	0.805	0.761	0.697	0.698	0.691	0.821	0.802	0.757
Organic municipal solid waste	0.068	0.152	0.302	0.180	0.246	0.362	0.066	0.151	0.300	0.179	0.245	0.360	0.062	0.146	0.295	0.174	0.240	0.355

Sources: Teichmann (2014b: Table A.83).

Notes: Values rounded. DM = dry mass. t = tonne. GHG emissions are indicated by a negative sign, C removals or avoided emissions are displayed as positive values. Negative total net avoided GHG emissions are highlighted by grey color.

Table S.113: Total Net Avoided GHG Emissions, 2030, Scenario *Max 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas
	t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	0.879	0.801	0.649	1.002	0.905	0.715	0.878	0.801	0.648	1.002	0.904	0.714	0.877	0.800	0.647	1.001	0.903	0.713
Forestry residues	0.952	0.863	0.688	1.080	0.970	0.756	0.951	0.862	0.688	1.079	0.969	0.756	0.950	0.861	0.687	1.078	0.968	0.755
Open-country biomass residues	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.285	1.095	1.256	1.179	1.028	1.381	1.283	1.094
Industrial wood waste	-0.418	-0.249	0.075	-0.290	-0.142	0.143	-0.418	-0.249	0.075	-0.290	-0.142	0.143	-0.419	-0.250	0.073	-0.291	-0.143	0.142
Wood in municipal solid waste	1.367	1.278	1.104	1.495	1.385	1.172	1.367	1.278	1.103	1.495	1.385	1.171	1.365	1.277	1.102	1.493	1.383	1.170
Green waste: Compensation areas	0.774	0.705	0.569	0.898	0.808	0.635	0.774	0.704	0.568	0.897	0.808	0.635	0.772	0.703	0.567	0.896	0.807	0.633
Biomass: Habitat-connectivity areas	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.285	1.095	1.256	1.179	1.028	1.381	1.283	1.094
Green waste: Extensive grassland	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.285	1.095	1.256	1.179	1.028	1.381	1.283	1.094
Short-rotation coppice: Erosion areas	-0.527	-0.366	-0.058	-0.400	-0.259	0.010	-0.528	-0.366	-0.058	-0.400	-0.260	0.010	-0.529	-0.368	-0.059	-0.401	-0.261	0.008

Sources: Teichmann (2014a: Table 45).

Notes: Values rounded. DM = dry mass. t = tonne. GHG emissions are indicated by a negative sign, C removals or avoided emissions are displayed as positive values. Negative total net avoided GHG emissions are highlighted by grey color.

Table S.114: Total Net Avoided GHG Emissions, 2030, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas
	t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	0.879	0.801	0.649	1.002	0.904	0.714	0.878	0.801	0.648	1.002	0.904	0.714	0.876	0.799	0.646	1.000	0.902	0.712
Forestry residues	0.952	0.863	0.688	1.080	0.970	0.756	0.951	0.862	0.688	1.079	0.969	0.756	0.949	0.860	0.686	1.077	0.967	0.754
Open-country biomass residues	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.093
Industrial wood waste	-0.418	-0.249	0.075	-0.290	-0.142	0.143	-0.418	-0.249	0.074	-0.290	-0.142	0.143	-0.420	-0.251	0.073	-0.292	-0.144	0.141
Wood in municipal solid waste	1.367	1.278	1.103	1.495	1.385	1.172	1.366	1.278	1.103	1.494	1.384	1.171	1.365	1.276	1.101	1.492	1.383	1.169
Green waste: Compensation areas	0.774	0.705	0.569	0.898	0.808	0.635	0.773	0.704	0.568	0.897	0.808	0.634	0.772	0.702	0.566	0.895	0.806	0.632
Biomass: Habitat-connectivity areas	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.093
Green waste: Extensive grassland	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.093
Short-rotation coppice: Erosion areas	-0.527	-0.366	-0.058	-0.400	-0.260	0.010	-0.528	-0.367	-0.058	-0.400	-0.260	0.009	-0.530	-0.369	-0.060	-0.402	-0.262	0.008

Sources: Teichmann (2014b: Table A.85).

Notes: Values rounded. DM = dry mass. t = tonne. GHG emissions are indicated by a negative sign, C removals or avoided emissions are displayed as positive values. Negative total net avoided GHG emissions are highlighted by grey color.

Table S.115: Total Net Avoided GHG Emissions, 2050, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas
	t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	0.879	0.801	0.649	1.002	0.904	0.715	0.878	0.801	0.648	1.002	0.904	0.714	0.877	0.799	0.647	1.000	0.903	0.713
Forestry residues	0.952	0.863	0.688	1.080	0.970	0.756	0.951	0.862	0.688	1.079	0.969	0.756	0.950	0.861	0.686	1.078	0.968	0.754
Open-country biomass residues	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.094
Industrial wood waste	-0.418	-0.249	0.075	-0.290	-0.142	0.143	-0.418	-0.249	0.074	-0.290	-0.142	0.143	-0.420	-0.251	0.073	-0.292	-0.144	0.141
Wood in municipal solid waste	1.367	1.278	1.103	1.495	1.385	1.171	1.366	1.278	1.103	1.494	1.384	1.171	1.365	1.276	1.101	1.493	1.383	1.169
Green waste: Compensation areas	0.774	0.705	0.569	0.898	0.808	0.635	0.773	0.704	0.568	0.897	0.808	0.634	0.772	0.703	0.567	0.896	0.806	0.633
Biomass: Habitat-connectivity areas	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.094
Green waste: Extensive grassland	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.094
Short-rotation coppice: Erosion areas	-0.527	-0.366	-0.058	-0.400	-0.260	0.010	-0.528	-0.367	-0.058	-0.400	-0.260	0.010	-0.529	-0.368	-0.060	-0.402	-0.262	0.008
Solid cattle manure	0.312	0.342	0.389	0.429	0.440	0.451	0.311	0.341	0.388	0.428	0.439	0.450	0.308	0.338	0.384	0.425	0.435	0.447
Solid swine manure	0.385	0.499	0.698	0.500	0.594	0.759	0.384	0.497	0.696	0.499	0.593	0.757	0.378	0.491	0.690	0.493	0.587	0.752
Solid poultry manure	0.714	0.658	0.548	0.827	0.753	0.608	0.713	0.658	0.548	0.826	0.752	0.608	0.711	0.656	0.546	0.824	0.750	0.606
Commercial and industrial waste	0.701	0.703	0.696	0.825	0.806	0.762	0.700	0.702	0.695	0.824	0.805	0.761	0.697	0.699	0.692	0.821	0.802	0.758
Organic municipal solid waste	0.068	0.152	0.302	0.180	0.246	0.361	0.067	0.151	0.300	0.179	0.245	0.360	0.062	0.147	0.296	0.175	0.241	0.356

Sources: Teichmann (2014b: Table A.90).

Notes: Values rounded. DM = dry mass. t = tonne. GHG emissions are indicated by a negative sign, C removals or avoided emissions are displayed as positive values. Negative total net avoided GHG emissions are highlighted by grey color.

Table S.116: Total Net Avoided GHG Emissions, 2050, Scenario *Max 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas	Lignite	Hard coal	Natu-ral gas
	t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	0.879	0.801	0.649	1.002	0.905	0.715	0.879	0.801	0.648	1.002	0.904	0.714	0.877	0.800	0.647	1.001	0.903	0.713
Forestry residues	0.952	0.863	0.688	1.080	0.970	0.756	0.952	0.863	0.688	1.079	0.969	0.756	0.950	0.861	0.687	1.078	0.968	0.755
Open-country biomass residues	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.285	1.095	1.256	1.179	1.028	1.381	1.284	1.094
Industrial wood waste	-0.418	-0.249	0.075	-0.290	-0.142	0.143	-0.418	-0.249	0.075	-0.290	-0.142	0.143	-0.419	-0.250	0.074	-0.291	-0.143	0.142
Wood in municipal solid waste	1.367	1.278	1.103	1.495	1.385	1.172	1.367	1.278	1.103	1.494	1.385	1.171	1.366	1.277	1.102	1.493	1.384	1.170
Green waste: Compensation areas	0.774	0.705	0.569	0.898	0.808	0.635	0.774	0.705	0.569	0.898	0.808	0.635	0.773	0.704	0.568	0.897	0.807	0.634
Biomass: Habitat-connectivity areas	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.285	1.095	1.256	1.179	1.028	1.381	1.284	1.094
Green waste: Extensive grassland	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.285	1.095	1.256	1.179	1.028	1.381	1.284	1.094
Short-rotation coppice: Erosion areas	-0.527	-0.366	-0.058	-0.400	-0.259	0.010	-0.528	-0.366	-0.058	-0.400	-0.260	0.010	-0.529	-0.367	-0.059	-0.401	-0.261	0.009

Sources: Teichmann (2014b: Table A.91).

Notes: Values rounded. DM = dry mass. t = tonne. GHG emissions are indicated by a negative sign, C removals or avoided emissions are displayed as positive values. Negative total net avoided GHG emissions are highlighted by grey color.

Table S.117: Total Net Avoided GHG Emissions, 2050, Scenario *Min 2*

	Small-scale pyrolysis units						**Medium-scale pyrolysis units**						**Large-scale pyrolysis units**					
	No process heat recovery			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**		
	Lignite	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**	**Lignite**	**Hard coal**	**Natu-ral gas**
	t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock						t CO_2e/t_{DM} feedstock					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	0.879	0.801	0.649	1.002	0.904	0.715	0.878	0.801	0.648	1.002	0.904	0.714	0.877	0.799	0.647	1.000	0.902	0.713
Forestry residues	0.952	0.863	0.688	1.080	0.970	0.756	0.951	0.862	0.688	1.079	0.969	0.756	0.950	0.861	0.686	1.078	0.968	0.754
Open-country biomass residues	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.094
Industrial wood waste	-0.418	-0.249	0.075	-0.290	-0.142	0.143	-0.418	-0.249	0.074	-0.290	-0.142	0.143	-0.420	-0.251	0.073	-0.292	-0.144	0.141
Wood in municipal solid waste	1.367	1.278	1.103	1.495	1.385	1.171	1.366	1.278	1.103	1.494	1.384	1.171	1.365	1.276	1.101	1.493	1.383	1.169
Green waste: Compensation areas	0.774	0.705	0.569	0.898	0.808	0.635	0.773	0.704	0.568	0.897	0.808	0.634	0.772	0.703	0.567	0.896	0.806	0.633
Biomass: Habitat-connectivity areas	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.094
Green waste: Extensive grassland	1.257	1.180	1.029	1.382	1.285	1.096	1.257	1.180	1.029	1.382	1.284	1.095	1.255	1.178	1.027	1.380	1.283	1.094
Short-rotation coppice: Erosion areas	-0.527	-0.366	-0.058	-0.400	-0.260	0.010	-0.528	-0.367	-0.058	-0.400	-0.260	0.010	-0.529	-0.368	-0.060	-0.402	-0.262	0.008

Sources: Teichmann (2014b: Table A.93).

Notes: Values rounded. DM = dry mass. t = tonne. GHG emissions are indicated by a negative sign, C removals or avoided emissions are displayed as positive values. Negative total net avoided GHG emissions are highlighted by grey color.

S.4) Net GHG Mitigation Costs per Tonne of CO_2e Abated

In this section, we display the supplementary results tables for the net GHG mitigation costs of biochar per tonne of CO_2e abated referred to in Section 4 of Teichmann (2015).

Table S.118: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2030 – Price Path A, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	260	250	240	219	204	175	279	272	267	236	223	200	218	205	184	183	164	125
Forestry residues	336	334	344	288	280	272	354	354	369	304	298	294	298	292	292	255	243	224
Open-country biomass residues	103	86	56	87	66	24	116	101	72	99	80	40	73	55	20	60	38	-10
Industrial wood waste	-	-	4,522	-	-	2,147	-	-	4,773	-	-	2,271	-	-	4,144	-	-	1,915
Wood in municipal solid waste	102	84	51	87	65	21	114	97	66	98	78	35	75	55	17	63	39	-11
Green waste: Compensation areas	284	277	274	236	222	197	306	301	304	254	243	224	237	225	209	195	176	139
Biomass: Habitat-connectivity areas	103	86	56	87	66	24	116	101	72	99	80	40	73	55	20	60	38	-10
Green waste: Extensive grassland	103	86	56	87	66	24	116	101	72	99	80	40	73	55	20	60	38	-10
Short-rotation coppice: Erosion areas	-	-	-	-	-	31,362	-	-	-	-	-	34,754	-	-	-	-	-	36,244
Solid cattle manure	721	698	688	506	508	530	801	770	752	564	564	584	685	664	659	477	480	502
Solid swine manure	715	645	589	535	515	505	796	707	633	597	567	545	751	671	607	560	536	520
Solid poultry manure	238	228	217	196	180	150	264	257	251	219	205	181	190	177	155	155	135	94
Commercial and industrial waste	61	65	81	41	36	34	92	96	113	68	64	63	35	39	55	19	13	10
Organic municipal solid waste	-132	165	302	-92	42	175	254	337	389	51	148	248	-259	124	284	-136	14	159

Sources: Own calculation, Table S.118 = Table S.91/Table S.112.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.112).

Table S.119: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2030 – Price Path A, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	259	250	240	219	204	175	279	272	267	236	223	199	219	205	185	183	164	125
Forestry residues	336	334	344	288	280	271	354	354	369	304	297	294	298	292	292	255	243	224
Open-country biomass residues	103	86	56	87	66	24	116	100	72	99	79	40	73	55	20	61	38	-9
Industrial wood waste	-	-	4,520	-	-	2,146	-	-	4,771	-	-	2,270	-	-	4,148	-	-	1,917
Wood in municipal solid waste	102	84	51	87	65	21	114	97	66	98	78	35	75	55	18	63	39	-10
Green waste: Compensation areas	284	277	273	235	221	197	306	301	303	254	242	224	237	225	209	195	176	139
Biomass: Habitat-connectivity areas	103	86	56	87	66	24	116	100	72	99	79	40	73	55	20	61	38	-9
Green waste: Extensive grassland	103	86	56	87	66	24	116	100	72	99	79	40	73	55	20	61	38	-9
Short-rotation coppice: Erosion areas	-	-	-	-	-	31,355	-	-	-	-	-	34,768	-	-	-	-	-	36,402

Sources: Own calculation, Table S.119 = Table S.93/Table S.114.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.114).

Table S.120: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2030 – Price Path B, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	266	265	269	226	220	209	285	286	296	243	239	233	224	219	213	189	179	158
Forestry residues	342	349	375	295	297	307	360	369	400	311	314	329	304	307	323	261	259	259
Open-country biomass residues	107	96	74	92	78	46	120	110	90	104	91	61	77	64	38	65	49	12
Industrial wood waste	-	-	3,970	-	-	1,895	-	-	4,217	-	-	2,017	-	-	3,573	-	-	1,658
Wood in municipal solid waste	106	94	70	92	77	44	118	108	85	103	89	58	79	66	37	67	51	12
Green waste: Compensation areas	290	292	303	242	238	231	312	316	333	261	259	258	243	239	238	201	192	173
Biomass: Habitat-connectivity areas	107	96	74	92	78	46	120	110	90	104	91	61	77	64	38	65	49	12
Green waste: Extensive grassland	107	96	74	92	78	46	120	110	90	104	91	61	77	64	38	65	49	12
Short-rotation coppice: Erosion areas	-	-	-	-	-	27,925	-	-	-	-	-	31,131	-	-	-	-	-	31,722
Solid cattle manure	715	685	668	505	504	523	794	757	731	562	560	577	677	650	637	475	475	494
Solid swine manure	695	611	547	522	492	472	775	673	591	584	543	513	729	636	564	545	511	487
Solid poultry manure	243	241	241	202	194	179	269	269	276	225	219	210	195	189	179	161	149	123
Commercial and industrial waste	61	65	80	43	40	40	92	96	112	70	67	69	34	38	53	20	17	15
Organic municipal solid waste	-214	84	230	-116	3	129	168	254	317	26	108	200	-358	36	210	-164	-28	110

Sources: Own calculation, Table S.120 = Table S.94/Table S.112.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.112).

Table S.121: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2030 – Price Path B, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	265	264	269	226	220	208	285	286	295	243	239	233	224	220	213	190	180	158
Forestry residues	342	349	375	295	297	307	360	369	400	311	314	329	304	307	323	262	259	259
Open-country biomass residues	107	96	74	92	78	46	120	110	90	104	91	61	77	65	38	65	49	12
Industrial wood waste	-	-	3,968	-	-	1,894	-	-	4,216	-	-	2,016	-	-	3,577	-	-	1,659
Wood in municipal solid waste	106	94	70	92	77	44	118	107	85	103	89	58	79	66	37	68	51	12
Green waste: Compensation areas	290	292	303	242	238	231	312	316	333	261	259	258	243	240	238	201	192	173
Biomass: Habitat-connectivity areas	107	96	74	92	78	46	120	110	90	104	91	61	77	65	38	65	49	12
Green waste: Extensive grassland	107	96	74	92	78	46	120	110	90	104	91	61	77	65	38	65	49	12
Short-rotation coppice: Erosion areas	-	-	-	-	-	27,916	-	-	-	-	-	31,142	-	-	-	-	-	31,862

Sources: Own calculation, Table S.121 = Table S.96/Table S.114.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.114).

Table S.122: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2030 – Price Path C, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	270	277	294	230	234	238	289	299	321	248	253	262	228	232	238	194	194	186
Forestry residues	347	363	402	300	312	338	365	383	427	316	329	360	309	321	350	266	274	289
Open-country biomass residues	110	105	90	95	88	65	123	119	106	108	101	80	80	73	53	68	59	31
Industrial wood waste	-	-	3,490	-	-	1,676	-	-	3,733	-	-	1,797	-	-	3,076	-	-	1,434
Wood in municipal solid waste	109	104	87	96	88	64	122	117	102	107	100	78	82	75	54	71	61	32
Green waste: Compensation areas	294	305	328	247	253	261	316	329	358	266	274	288	247	252	263	206	207	203
Biomass: Habitat-connectivity areas	110	105	90	95	88	65	123	119	106	108	101	80	80	73	53	68	59	31
Green waste: Extensive grassland	110	105	90	95	88	65	123	119	106	108	101	80	80	73	53	68	59	31
Short-rotation coppice: Erosion areas	-	-	-	-	-	24,931	-	-	-	-	-	27,976	-	-	-	-	-	27,784
Solid cattle manure	710	673	650	504	501	516	789	745	713	560	557	570	671	637	617	473	471	487
Solid swine manure	681	581	511	513	471	444	761	642	555	574	522	484	713	604	527	535	488	458
Solid poultry manure	247	252	263	206	207	205	273	280	297	229	232	236	199	200	200	165	162	149
Commercial and industrial waste	61	64	79	44	43	44	92	96	110	71	70	73	34	37	51	21	19	19
Organic municipal solid waste	-274	10	168	-134	-33	88	106	180	254	8	72	159	-431	-44	145	-184	-66	67

Sources: Own calculation, Table S.122 = Table S.98/Table S.112.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.112).

Table S.123: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2030 – Price Path C, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	270	277	294	230	234	237	289	299	320	248	253	262	229	232	238	194	194	187
Forestry residues	347	363	402	300	312	337	365	383	427	316	329	360	309	321	350	266	274	289
Open-country biomass residues	110	105	89	95	88	65	123	119	106	108	101	80	80	73	53	69	59	31
Industrial wood waste	-	-	3,487	-	-	1,674	-	-	3,732	-	-	1,796	-	-	3,079	-	-	1,435
Wood in municipal solid waste	109	104	87	96	88	64	122	117	102	107	100	78	82	75	54	71	61	32
Green waste: Compensation areas	294	304	328	247	252	261	316	329	358	266	273	288	247	253	264	206	207	203
Biomass: Habitat-connectivity areas	110	105	89	95	88	65	123	119	106	108	101	80	80	73	53	69	59	31
Green waste: Extensive grassland	110	105	89	95	88	65	123	119	106	108	101	80	80	73	53	69	59	31
Short-rotation coppice: Erosion areas	-	-	-	-	-	24,922	-	-	-	-	-	27,984	-	-	-	-	-	27,910

Sources: Own calculation, Table S.123 = Table S.100/Table S.114.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.114).

Table S.124: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2050 – Price Path A, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	238	202	148	196	151	70	258	223	174	213	170	93	199	158	93	161	112	20
Forestry residues	314	283	245	265	225	160	332	303	269	280	242	182	277	243	194	232	189	113
Open-country biomass residues	88	54	-2	71	29	-44	101	68	14	83	42	-29	59	23	-37	45	1	-77
Industrial wood waste	-	-	6,165	-	-	2,896	-	-	6,417	-	-	3,018	-	-	5,833	-	-	2,680
Wood in municipal solid waste	86	50	-11	70	27	-51	98	63	4	81	39	-37	60	22	-44	46	1	-82
Green waste: Compensation areas	262	228	179	212	167	88	284	252	209	230	188	114	216	178	117	172	123	32
Biomass: Habitat-connectivity areas	88	54	-2	71	29	-44	101	68	14	83	42	-29	59	23	-37	45	1	-77
Green waste: Extensive grassland	88	54	-2	71	29	-44	101	68	14	83	42	-29	59	23	-37	45	1	-77
Short-rotation coppice: Erosion areas	-	-	-	-	-	41,562	-	-	-	-	-	45,151	-	-	-	-	-	47,878
Solid cattle manure	730	728	743	504	512	545	808	799	805	560	566	598	696	697	716	477	485	519
Solid swine manure	765	742	711	566	582	598	845	803	755	627	633	638	803	771	732	593	604	615
Solid poultry manure	218	185	138	174	131	55	244	213	171	196	155	85	172	135	78	134	87	1
Commercial and industrial waste	56	61	81	33	21	14	88	92	113	59	48	43	32	37	57	12	0	-9
Organic municipal solid waste	70	397	509	-37	151	310	453	569	596	105	256	381	-17	373	499	-71	131	298

Sources: Own calculation, Table S.124 = Table S.102/Table S.115.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.115).

Table S.125: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2050 – Price Path A, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas	Lignite	Hard coal	Natural gas
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	238	202	147	196	150	69	257	223	173	213	169	93	199	159	94	162	112	21
Forestry residues	314	283	244	265	225	160	331	302	268	280	242	181	277	243	194	232	189	113
Open-country biomass residues	88	53	-2	70	29	-45	101	67	14	82	42	-30	60	24	-37	45	1	-77
Industrial wood waste	-	-	6,161	-	-	2,894	-	-	6,413	-	-	3,016	-	-	5,837	-	-	2,681
Wood in municipal solid waste	86	49	-12	70	27	-51	98	62	3	81	38	-37	60	22	-43	47	1	-81
Green waste: Compensation areas	262	228	179	212	167	88	283	251	208	230	187	114	217	178	117	173	123	32
Biomass: Habitat-connectivity areas	88	53	-2	70	29	-45	101	67	14	82	42	-30	60	24	-37	45	1	-77
Green waste: Extensive grassland	88	53	-2	70	29	-45	101	67	14	82	42	-30	60	24	-37	45	1	-77
Short-rotation coppice: Erosion areas	-	-	-	-	-	41,541	-	-	-	-	-	45,155	-	-	-	-	-	48,055

Sources: Own calculation, Table S.125 = Table S.104/Table S.117.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.117).

Table S.126: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2050 – Price Path B, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas
	$€_{2012}$/t CO_2e						$€_{2012}$/t CO_2e						$€_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	248	235	219	207	187	153	267	256	245	224	206	176	208	191	165	172	148	103
Forestry residues	324	318	322	276	263	248	342	337	346	291	280	270	287	277	271	243	227	201
Open-country biomass residues	95	76	43	78	55	10	108	90	59	90	68	25	66	45	8	53	27	-23
Industrial wood waste	-	-	4,792	-	-	2,268	-	-	5,035	-	-	2,388	-	-	4,421	-	-	2,042
Wood in municipal solid waste	93	73	37	78	54	6	106	86	52	89	65	20	67	45	5	54	28	-25
Green waste: Compensation areas	272	261	252	223	204	173	293	285	281	241	225	199	226	210	189	183	160	117
Biomass: Habitat-connectivity areas	95	76	43	78	55	10	108	90	59	90	68	25	66	45	8	53	27	-23
Green waste: Extensive grassland	95	76	43	78	55	10	108	90	59	90	68	25	66	45	8	53	27	-23
Short-rotation coppice: Erosion areas	-	-	-	-	-	33,001	-	-	-	-	-	36,195	-	-	-	-	-	37,073
Solid cattle manure	719	699	691	501	503	527	797	769	753	557	558	580	684	666	663	473	476	500
Solid swine manure	733	665	607	546	529	518	812	726	651	606	579	557	768	691	625	570	549	534
Solid poultry manure	226	213	198	184	164	128	252	241	231	206	188	158	180	163	138	144	120	74
Commercial and industrial waste	56	60	78	35	29	27	87	91	109	62	56	56	31	36	53	14	8	4
Organic municipal solid waste	-65	211	331	-77	61	193	314	380	416	64	165	263	-173	175	315	-116	36	178

Sources: Own calculation, Table S.126 = Table S.105/Table S.115.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.115).

Table S.127: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2050 – Price Path B, Scenario *Min 2*

	Small-scale pyrolysis units						**Medium-scale pyrolysis units**						**Large-scale pyrolysis units**					
	No process heat recovery			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**			**No process heat recovery**			**Process heat recovery**		
	Lig-nite	**Hard coal**	**Natu-ral gas**	**Lig-nite**	**Hard coal**	**Natu-ral gas**	**Lig-nite**	**Hard coal**	**Natu-ral gas**	**Lig-nite**	**Hard coal**	**Natu-ral gas**	**Lig-nite**	**Hard coal**	**Natu-ral gas**	**Lig-nite**	**Hard coal**	**Natu-ral gas**
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	248	234	219	207	187	152	267	255	245	224	206	176	208	191	165	172	148	103
Forestry residues	324	318	322	276	263	247	341	337	346	291	280	269	287	277	271	243	227	201
Open-country biomass residues	94	76	43	78	55	9	107	89	59	90	67	24	66	45	8	53	27	-23
Industrial wood waste	-	-	4,788	-	-	2,266	-	-	5,032	-	-	2,386	-	-	4,424	-	-	2,043
Wood in municipal solid waste	93	73	37	78	53	5	105	86	52	89	65	19	68	45	5	55	28	-25
Green waste: Compensation areas	272	261	251	222	204	173	293	284	281	241	224	199	226	211	189	183	160	117
Biomass: Habitat-connectivity areas	94	76	43	78	55	9	107	89	59	90	67	24	66	45	8	53	27	-23
Green waste: Extensive grassland	94	76	43	78	55	9	107	89	59	90	67	24	66	45	8	53	27	-23
Short-rotation coppice: Erosion areas	-	-	-	-	-	32,978	-	-	-	-	-	36,191	-	-	-	-	-	37,213

Sources: Own calculation, Table S.127 = Table S.107/Table S.117.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.117).

Table S.128: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2050 – Price Path C, Scenario *Min 1*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas
	€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e						€$_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	254	255	261	214	210	201	274	277	287	231	229	225	214	211	207	179	171	152
Forestry residues	331	340	368	283	287	299	348	359	392	299	304	321	294	299	317	251	251	253
Open-country biomass residues	99	90	69	84	71	41	112	104	85	96	84	56	70	59	34	58	43	8
Industrial wood waste	-	-	3,984	-	-	1,899	-	-	4,223	-	-	2,017	-	-	3,588	-	-	1,666
Wood in municipal solid waste	98	88	66	84	71	39	110	101	80	95	82	53	72	60	33	60	45	8
Green waste: Compensation areas	278	282	295	230	228	223	300	305	324	249	248	249	232	231	232	190	184	167
Biomass: Habitat-connectivity areas	99	90	69	84	71	41	112	104	85	96	84	56	70	59	34	58	43	8
Green waste: Extensive grassland	99	90	69	84	71	41	112	104	85	96	84	56	70	59	34	58	43	8
Short-rotation coppice: Erosion areas	-	-	-	-	-	27,966	-	-	-	-	-	30,925	-	-	-	-	-	30,704
Solid cattle manure	712	680	661	499	498	516	790	750	723	555	553	569	675	646	631	470	470	488
Solid swine manure	711	617	546	532	495	471	790	677	589	592	545	510	744	640	563	554	513	485
Solid poultry manure	232	231	233	190	185	171	258	259	267	213	209	202	186	181	173	150	141	117
Commercial and industrial waste	56	60	75	37	34	35	87	91	107	63	61	63	31	35	50	15	12	11
Organic municipal solid waste	-155	93	226	-103	4	124	220	260	311	37	107	194	-281	48	207	-147	-25	106

Sources: Own calculation, Table S.128 = Table S.109/Table S.115.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.115).

Table S.129: Net GHG Mitigation Costs of Biochar per Tonne of CO_2e Abated, 2050 – Price Path C, Scenario *Min 2*

	Small-scale pyrolysis units						Medium-scale pyrolysis units						Large-scale pyrolysis units					
	No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery			No process heat recovery			Process heat recovery		
	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas	Lig-nite	Hard coal	Natu-ral gas
	$€_{2012}$/t CO_2e						$€_{2012}$/t CO_2e						$€_{2012}$/t CO_2e					
Feedstocks	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Cereal straw	254	255	261	214	210	201	273	276	287	231	229	224	214	211	207	179	171	152
Forestry residues	331	340	367	283	287	299	348	359	391	298	304	321	294	299	317	251	251	253
Open-country biomass residues	99	90	69	83	71	41	112	103	85	95	84	56	71	59	34	58	43	8
Industrial wood waste	-	-	3,980	-	-	1,897	-	-	4,219	-	-	2,015	-	-	3,591	-	-	1,667
Wood in municipal solid waste	98	88	65	84	70	39	110	101	80	94	82	53	72	60	33	60	45	8
Green waste: Compensation areas	278	282	294	230	228	223	299	305	323	248	248	249	232	231	232	190	184	167
Biomass: Habitat-connectivity areas	99	90	69	83	71	41	112	103	85	95	84	56	71	59	34	58	43	8
Green waste: Extensive grassland	99	90	69	83	71	41	112	103	85	95	84	56	71	59	34	58	43	8
Short-rotation coppice: Erosion areas	-	-	-	-	-	27,942	-	-	-	-	-	30,917	-	-	-	-	-	30,822

Sources: Own calculation, Table S.129 = Table S.111/Table S.117.

Notes: Values rounded. t = tonne. - = not applicable. The net GHG mitigation costs are not shown for cases of negative total net avoided GHG emissions per tonne of dry-matter feedstock (cp. Table S.117).

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