Tracking the fate of aluminium in the EU using the MaTrace model

Gabriela Jarrín Jacóme[a*], Jo Dewulf[a], María Fernanda Godoy León[a], Rodrigo Alvarenga[a]

[a] Research Group Sustainable Systems Engineering (STEN), Ghent University, Coupure Links 653, 9000 Ghent, Belgium

SUPPLEMENTARY MATERIAL

1. Nomenclature

The model considers *n* applications and n_R recycling process. Each recycling processes produces a different secondary material. Subscript *i* indicates the application, *R* the recycling process, *t* refers to the year of evaluation and *j* to the process (*j*: P, production, M, manufacturing, R, recycling, PT, pre-treatment).

β	: Shape or slope parameter [-]
κ	: Scale parameter [year]
λ	: Total production yield [-]
λ_j	: Production yield (j: P, processing; M, manufacturing, PT: pre-treatment, R: recycling) [-]
ξ_j	: Recovery of scrap during production yield (*j*: P, processing; M, manufacturing) [-]
ς	: Percentage of End-of-Life product categories collected for recycling (collection-to-recycling rate) [-]
ϑ	: Percentage of End-of-Service product categories hoarded by users during *p* years [-]
ψ_{EoL}	: Percentage of collected End-of-Life applications that are exported [-]
ψ_P	: Percentage of applications that are exported [-]
B	: Allocation of material recovered from pre-treatment to the recycling processes [-]
D	: Allocation of secondary material for production of new applications [dimensionless]
E	: Weibull probability density function [years^{-1}]
L_a	: Aggregated losses [tonne]
L_T	: Total loss for the system [tonne]
$\bar{L}_T$	: Stock of losses [tonne]
R_p	: Amount of hoarded End-of-Service applications that are released after *p* years [tonne]
$\overline{R_p}$	: Stock of released hoarded applications [tonne]
t	: Time [years]
t_H	: Hoarding time [years]
t_L	: Lifetime [years]
V	: Amount of EoL applications non-selectively disposed [tonne]
x	: Total amount of applications produced from secondary materials [tonne]
x_{EU}	: Mass of the material under consideration in final applications that stay in the region [tonne]
$\bar{x}_{EU}$	: Stock of applications [tonne]
z	: Mass of material that occurs in End-of-Service applications [tonne]

2. Initial distribution of Aluminium (Passarini et al., 2018)

Since the data was reported per sector and not per individual product category, the reported value per sector was divided by the number of product types analyzed in the sector. For instance, Passarini et al. (2018) indicated that 25% of the in-use sector in the EU correspond to building and construction. This sector consists of two product categories i.e., residential and non-residential buildings. Hence, each product type represents 12.5% of the in-use share (see Table 1). The same reasoning was applied to the rest of product types.

Table S1. Initial distribution of aluminium among 12 product types in use in the EU in 2018 (Adapted from Passarini et al. (2018))

Sector	Initial distribution in 2018 (per sector) (wt%)	Product	Initial distribution in 2018 ($x_{EU,i}(0)$) (wt%)
Transportation	31.0	Automobiles	10.3
		Aerospace	10.3
		Other transport	10.3
Building and construction	25.0	Residential buildings	12.5
		Non-residential buildings	12.5
Packaging and cans	20.0	Used beverage cans	10.0
		Mixed packaging	10.0
Industrial machinery and equipment	3.0	Industrial machinery and equipment	3.0
Electrical engineering	10.0	Cables	5.0
		Other engineering	5.0
Consumer durables	6.0	Consumer durables	6.0
Others*	5.0	Others*	5.0

3. Full data set and assumptions

Table S2. Full data set of the application automobiles. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	92	%	Passarini et al. (2018)	YES	
		Germany	2001	85	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	84	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	94	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	37	%	Boin & Bertram (2005)	YES	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	12	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	26.5	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (3)
	Matrix D (wrought alloys)	Germany	2001	4.6	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (3)
Use	Initial material	EU	2018	10.33	%	Passarini et al. (2018)	YES	Reported value per sector (31%), divided among the 3 applications
	Weibull scale parameter	Japan	2008	10.2	-	Nomura & Momose (2008)	NO	Value for light duty vehicles for own use
		Japan	2008	9.7	-		NO	Value for compact vehicles for own se
		Japan	2008	10.2	-		NO	Value for ordinary passenger cars
		Japan	2008	19.4	-		NO	Value for other vehicles for own use
		Japan	2008	8.2	-		NO	Value for taxies
		Japan	2008	10.8	-		NO	Value for light vehicles for freight
		Japan	2008	10.2	-		NO	Value for compact vehicles for freight

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
End-of-life		Japan	2008	10.6	-		NO	Value for ordinary passenger cars for freight
	Weibull shape parameter	Japan	2008	1.6	-	Nomura & Momose (2008)	NO	
		Japan	2008	1.75	-		NO	Value for light duty vehicles for own use
		Japan	2008	1.63	-		NO	Value for compact vehicles for own se
		Japan	2008	2.31	-		NO	Value for ordinary passenger cars
		Japan	2008	1.84	-		NO	Value for other vehicles for own use
		Japan	2008	2.35	-		NO	Value for taxies
		Japan	2008	2.86	-		NO	Value for light vehicles for freight
		Japan	2008	2.35	-		NO	Value for compact vehicles for freight
	Lifetime	EU	2017	15	years	Bertram et al. (2017)	NO	
		Japan	2012	13	years	Hatamaya et al. (2012)	YES	
	Hoarding rate	Global	2000	25	%	Martchek (2006)	YES	Calculated as the difference of products collected at its end-of-life
		EU	2018	10	%	EAA (2018)	NO	Calculated as the difference of products collected at its end-of-life
	Hoarding time	US	2015	5	years	Maxfield (2008)	NO	Assumed value
	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
		EU	2017	4.33	%	Eurostat (2017)	NO	Calculated as ratio of ELV exported to total ELV in the EU
		EU	2015	9.92	%	Huisman et al. (2017)	NO	
	Collection-to-recycling rate	EU	2017	88	%	Eurostat (2017)	NO	
	Pre-treatment efficiency	Global	2012	97	%	Liu et al. (2012)	NO	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	95.5	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	4.5	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S3. Full data set of the application aerospace. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	92	%	Passarini et al. (2018)	YES	
		Germany	2001	85	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	60	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	94	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	37	%	Boin & Bertram (2005)	YES	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	2	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	26.5	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (3)
	Matrix D (wrought alloys)	Germany	2001	4.6	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (3)
Use	Initial material	EU	2018	10.33	%	Passarini et al. (2018)	YES	Reported value per sector (31%), divided among the 3 applications
	Weibull scale parameter	Japan	2008	6.8	-	Nomura & Momose (2008	NO	Value reported for aircraft and helicopters
	Weibull shape parameter	Japan	2008	2.00	-	Nomura & Momose (2008	NO	Value reported for aircraft and helicopters
	Lifetime	EU	2017	40	years	Bertram et al. (2017)	NO	
		Japan	2012	13	years	Hatamaya et al. (2012)	YES	

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Hoarding rate	Global	2000	25	%	Martchek (2006	YES	Calculated as the difference of products collected at its end-of-life
	Hoarding time	US	2015	5	years	Maxfield (2008)	NO	Assumed value, considered the same as automobiles
End-of-life	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
	Collection-to-recycling rate	EU	2011	80	%	EC (2011)	NO	
	Pre-treatment efficiency	Global	2012	100	%	Liu et al. (2012)	NO	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	50.8	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	49.2	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S4. Full data set of the application other transport. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	92	%	Passarini et al. (2018)	YES	
		Germany	2001	85	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	80	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	94	%	Rombach & Friedrich (2001)	YES	

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Manufacturing scrap recovery	EU	2005	37	%	Boin & Bertram (2005)	YES	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	12	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	26.5	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (3)
	Matrix D (wrought alloys)	Germany	2001	4.6	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (3)
Use	Initial material	EU	2018	10.33	%	Passarini et al. (2018)	YES	Reported value per sector (31%), divided among the 3 applications
	Weibull scale parameter	Japan	2008	14.9	-	Nomura & Momose (2008	NO	Value for small-size bus for own use
		Japan	2008	18.1	-		NO	Value for motor coaches for own use
		Japan	2008	12.3	-		NO	Value for trucks (light-duty cars) for own use
		Japan	2008	11.9	-		NO	Value for trucks (small cars) for own use
		Japan	2008	11.6	-		NO	Value for trucks (ordinary vehicles) for own use
		Japan	2008	18.4	-		NO	Value for small-size busses for passengers
		Japan	2008	18.1	-		NO	Value for motor coaches for passengers
		Japan	2008	13.5	-		NO	Value for trucks (light-duty cars) for freight
		Japan	2008	13.2	-		NO	Value for trucks (small gas-powered cars) for freight
		Japan	2008	12.8	-		NO	Value for trucks (small diesel cars) for freight
		Japan	2008	12.3	-		NO	Value for trucks (ordinary gas-powered cars) for freight

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
		Japan	2008	12.4	-		NO	Value for trucks (ordinary diesel cars) for freight
		Japan	2008	13.3	-		NO	Value for trucks (tractors) for freight
		Japan	2008	19.9	-		NO	Value for platform trucks, including trailers
		Japan	2008	19.2	-		NO	Value for other industrial trucks
	Weibull shape parameter	Japan	2008	3.07	-	Nomura & Momose (2008	NO	Value for small-size bus for own use
		Japan	2008	2.37	-		NO	Value for motor coaches for own use
		Japan	2008	3.07	-		NO	Value for trucks (light-duty cars) for own use
		Japan	2008	1.77	-		NO	Value for trucks (small cars) for own use
		Japan	2008	1.95	-		NO	Value for trucks (ordinary vehicles) for own use
		Japan	2008	3.14	-		NO	Value for small-size busses for passengers
		Japan	2008	3.51	-		NO	Value for motor coaches for passengers
		Japan	2008	2.4	-		NO	Value for trucks (light-duty cars) for freight
		Japan	2008	2	-		NO	Value for trucks (small gas-powered cars) for freight
		Japan	2008	1.93	-		NO	Value for trucks (small diesel cars) for freight
		Japan	2008	2.15	-		NO	Value for trucks (ordinary gas-powered cars) for freight
		Japan	2008	3.03	-		NO	Value for trucks (ordinary diesel cars) for freight
		Japan	2008	2.23	-		NO	Value for trucks (tractors) for freight
		Japan	2008	2.01	-		NO	Value for platform trucks, including trailers
		Japan	2008	2.31	-		NO	Value for other industrial trucks
		Japan	2008	2.3	-		NO	Value for small-size bus for own use
	Lifetime	EU	2017	30	years	Bertram et al. (2017)	NO	
		Japan	2012	13	years	Hatamaya et al. (2012)	YES	
	Hoarding rate	Global	2000	17	%	-		Proxy value taken from the application automobiles
	Hoarding time	US	2015	5	years	(Maxfield, 2008)	NO	Assumed value, considered the same as automobiles

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
End-of-life	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
	Collection-to-recycling rate	EU	2011	88	%	-	NO	Proxy value taken from the application automobiles
	Pre-treatment efficiency	Global	2012	100	%	Liu et al. (2012)	NO	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	50.8	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	49.2	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S5. Full data set of the application residential buildings. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	95	%	Passarini et al. (2018)	YES	
		Germany	2001	95	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	90	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	97	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	17	%	Boin & Bertram (2005)	YES	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Export of products	EU	2019	0	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	10	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (2)
	Matrix D (wrought alloys)	Germany	2001	18.2	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (2)
Use	Initial material	EU	2018	12.5	%	Passarini et al. (2018)	YES	Reported value per sector (25%), divided among the 2 applications
	Weibull scale parameter	Japan	2008	38.7	-	Nomura & Momose (2008)	NO	Value from housing
		Japan	2008	36.4	-		NO	Value from complex housing
		Japan	2008	30.9	-		NO	Value from warehouses
		Japan	2008	6.2	-		NO	Value from model houses/rooms
	Weibull shape parameter	Japan	2008	2..25	-	Nomura & Momose (2008)	NO	Value from housing
		Japan	2008	2.73	-		NO	Value from complex housing
		Japan	2008	1.94	-		NO	Value from warehouses
		Japan	2008	1.66	-		NO	Value from model houses/rooms
	Lifetime	EU	2017	60	years	Bertram et al. (2017)	NO	
		Japan	2012	31.5	years	Hatamaya et al. (2012)	YES	
	Hoarding rate	EU	2004	5	%	Delft University of Technology (2004)	YES	Calculated as the difference of products collected at its end-of-life
	Hoarding time	UK	2014	30	years	The Guardian (2014)	NO	Assumed value Report abandoned buildings up to 30 years
End-of-life	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
	Collection-to-recycling rate	EU	2006	89	%	EAA (2006)	YES	
	Pre-treatment efficiency	Global	2012	100	%	Liu et al. (2012)	YES	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	50.8	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	49.2	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S6. Full data set of the application non-residential buildings. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	95	%	Passarini et al. (2018)	YES	
		Germany	2001	95	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	90	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	97	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	17	%	Boin & Bertram (2005)	YES	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	0	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	10	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (2)
	Matrix D (wrought alloys)	Germany	2001	18.2	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (2)
Use	Initial material	EU	2018	12.5	%	Passarini et al. (2018)	YES	Reported value per sector (25%), divided among the 2 applications
	Weibull scale parameter	Japan	2008	35.4	-	Nomura & Momose (2008	NO	Value taken from office buildings
		Japan	2008	23.3	-		NO	Value taken from other buildings
	Weibull shape parameter	Japan	2008	1.6	-	Nomura & Momose (2008	NO	Value taken from office buildings
		Japan	2008	1.8	-		NO	Value taken from other buildings
	Lifetime	EU	2017	60	years	Bertram et al. (2017)	NO	
		Japan	2012	31.5	years	Hatamaya et al. (2012)	YES	

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Hoarding rate	EU	2004	5	%	Delft University of Technology (2004)	YES	Calculated as the difference of products collected at its end-of-life
	Hoarding time	UK	2014	30	years	The Guardian (2014)		Assumed value – same value as residential buildings
End-of-life	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
	Collection-to-recycling rate	EU	2006	89	%	EAA (2006)	YES	
	Pre-treatment efficiency	Global	2012	100	%	Liu et al. (2012)	NO	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	50.8	%	Boin & Bertram (2005)	YES	
	Matrix B (remelting)	EU	2005	49.2	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S7. Full data set of the application used beverage cans. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	59	%	Passarini et al. (2018)	YES	
		Germany	2001	75	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	75	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	85	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	12	%	Boin & Bertram (2005)	YES	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	0	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	0	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (3)
	Matrix D (wrought alloys)	Germany	2001	6.9	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (3)
Use	Initial material	EU	2018	10	%	Passarini et al. (2018)	YES	Reported value per sector (31%), divided among the 3 applications
	Weibull scale parameter	Japan	2008	15.5	-	Nomura & Momose (2008)	NO	Assumed value
	Weibull shape parameter	Japan	2008	1.42	-	Nomura & Momose (2008	NO	Assumed value
	Lifetime	EU	2017	1	years	Bertram et al. (2017)	NO	
	Hoarding rate	EU	2016	33	%	Niero & Olsen (2016)	YES	Calculated as the difference of products collected at its end-of-life

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Hoarding time	EU	2019	3	years	Packaging insights (2019)	YES	Assumed value
End-of-life	Export of EoL products	EU	2005	0	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
	Collection-to-recycling rate	EU	2016	55	%	Niero & Olsen (2016)	NO	
				65	%			
				75	%			
	Pre-treatment efficiency	Global	2012	99	%	Liu et al. (2012)	YES	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	20	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	80	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S8. Full data set of the application mixed packaging. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	59	%	Passarini et al. (2018)	YES	
		Germany	2001	75	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	75	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	85	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	12	%	Boin & Bertram (2005)	YES	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	0	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	0	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (2)
	Matrix D (wrought alloys)	Germany	2001	6.9	%	Rombach & Friedrich (2001)	YES	Value reported per sector. Divided by the number of applications (2)
Use	Initial material	EU	2018	10	%	Passarini et al. (2018)	YES	Reported value per sector (20%), divided among the 2 applications
Use	Weibull scale parameter	Japan	2008	15.5	-	Nomura & Momose (2008)	NO	Average proxy value taken from application other and metallic containers
Use	Weibull shape parameter	Japan	2008	1.42	-	Nomura & Momose (2008)	NO	Average proxy value taken from application other and metallic containers
Use	Lifetime	EU	2017	1	years	Bertram et al. (2017)	NO	
Use	Hoarding rate	EU	2016	29	%	Niero & Olsen (2016)	YES	Calculated as the difference of products collected at its end-of-life
Use	Hoarding time	EU	2019	3	years	Packaging insights (2019)	YES	Assumed value
End-of-life	Export of EoL products	EU	2005	0	%	Boin & Bertram (2005	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
End-of-life	Collection-to-recycling rate	EU	2016	55 65 75	% % %	Niero & Olsen (2016)	NO	
End-of-life	Pre-treatment efficiency	Global	2012	99	%	Liu et al. (2012)	YES	
End-of-life	Pre-treatment efficiency	EU	2017	98	%	Bertram et al. (2017)	YES	
End-of-life	Matrix B (refining)	EU	2005	20	%	Boin & Bertram (2005)	NO	
End-of-life	Matrix B (remelting)	EU	2005	80	%	Boin & Bertram (2005)	NO	
End-of-life	Recycling efficiency	EU	2018	97	%	Passarini et al. (2018)	YES	

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	(remelting and refining)							

Table S9. Full data set of the application machinery and equipment. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	80	%	Passarini et al. (2018)	YES	
		Germany	2001	95	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	75	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	97	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	6	%	Boin & Bertram (2005)	YES	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	10	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	9.4	%	Rombach & Friedrich (2001)	YES	Value reported per sector.
	Matrix D (wrought alloys)	Germany	2001	8.6	%	Rombach & Friedrich (2001)	YES	Value reported per sector.
Use	Initial material	EU	2018	3	%	Passarini et al. (2018)	YES	Reported value per sector
	Weibull scale parameter	Japan	2005	12.4	-	Nomura (2005)	NO	Value from construction machinery
		Japan	2005	14.7	-		NO	Value from food processing machinery
		Japan	2005	14.3	-		NO	Value from printing and bookbinding machinery
		Japan	2005	15.3	-		NO	Value from chemical machinery
		Japan	2005	10.4	-		NO	Value from semiconductor machinery

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
		Japan	2005	14.2	-		NO	Value from other service machinery
		Japan	2005	12.2	-		NO	Value from machinery service for industry
		Japan	2005	15.7	-		NO	Value from wrapping and packaging machinery
		Japan	2005	15.5	-		NO	Value from plastic processing machinery
	Weibull shape parameter	Japan	2005	1.39	-	Nomura (2005)	NO	Value from construction machinery
		Japan	2005	1.68	-		NO	Value from food processing machinery
		Japan	2005	1.66	-		NO	Value from printing and bookbinding machinery
		Japan	2005	1.36	-		NO	Value from chemical machinery
		Japan	2005	2.56	-		NO	Value from semiconductor machinery
		Japan	2005	1.54	-		NO	Value from other service machinery
		Japan	2005	1.86	-		NO	Value from machinery service for industry
		Japan	2005	2.16	-		NO	Value from wrapping and packaging machinery
	Lifetime	EU	2017	40	years	Bertram et al. (2017)	NO	
		Japan	2012	15	years	Hatamaya et al. (2012)	YES	
	Hoarding rate	EU	2020	36	%	Godoy León et al. (2020)	NO	Value taken as proxy from hard metals (Cobalt)
	Hoarding time	EU	2020	1	years	Godoy León et al. (2020)	NO	Value taken as proxy from hard metals (Cobalt)
End-of-life	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
	Collection-to-recycling rate	EU	2020	80	%	Godoy León et al. (2020)	NO	Value taken as proxy from hard metals (Cobalt)
	Pre-treatment efficiency	Global	2012	97	%	Liu et al. (2012)	YES	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	100	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	0	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S10. Full data set of the application cables. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	70	%	Passarini et al. (2018)	YES	
		Germany	2001	85	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	90	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	91	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	3	%	Boin & Bertram (2005)	YES	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	14	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	2	%	Rombach & Friedrich (2001)	YES	Value reported per sector.
	Matrix D (wrought alloys)	Germany	2001	3.8	%	Rombach & Friedrich (2001)	YES	Value reported per sector.
Use	Initial material	EU	2018	5	%	Passarini et al. (2018)	YES	Reported value per sector (10%), divided among the 2 applications.
	Weibull scale parameter	Japan	2005	10.7	-	Nomura (2005)	YES	Value from electric wire and cables
	Weibull shape parameter	Japan	2005	1.37	-	Nomura (2005)	YES	Value taken from electric wire and cables
	Lifetime	EU	2017	40	years	Bertram et al. (2017)	NO	
		Japan	2012	17.5	years	Hatamaya et al. (2012)	YES	
	Hoarding rate	EU	2020	51	%	Eurostat (2020)	NO	Proxy value taken from consumer durables application (assumed as WEE)

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Hoarding time	EU	2020	4	years	Godoy León et al. (2020)	NO	Value taken as proxy from portable batteries (Cobalt)
End-of-life	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
	Collection-to-recycling rate	EU	2020	39	%	Eurostat (2020)	NO	Proxy value taken from consumer durables application (assumed as WEE)
	Pre-treatment efficiency	Global	2012	97	%	Liu et al. (2012)	YES	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	91.1	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	8.9	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S11. Full data set of the application other engineering. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	70	%	Passarini et al. (2018)	YES	
		Germany	2001	85	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	80	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	91	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	17	%	Boin & Bertram (2005)	NO	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	14	%	Workman (2019)	NO	

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Matrix D (cast alloys)	Germany	2001	9.4	%	Rombach & Friedrich (2001)	YES	Value reported per sector.
	Matrix D (wrought alloys)	Germany	2001	8.6	%	Rombach & Friedrich (2001)	YES	Value reported per sector.
Use	Initial material	EU	2018	5	%	Passarini et al. (2018)	YES	Reported value per sector (10%), divided among the 2 applications.
	Weibull scale parameter	Japan	2005	10.7	-	Nomura (2005)	NO	Value taken from electric wire and cables
	Weibull shape parameter	Japan	2005	1.37	-	Nomura (2005)	NO	Value taken from electric wire and cables
	Lifetime	EU	2017	20	years	Bertram et al. (2017)	NO	
		Japan	2012	17.5	years	Hatamaya et al. (2012)	YES	
	Hoarding rate	EU	2020	51	%	Eurostat (2020)	NO	Proxy value taken from consumer durables application (assumed as WEE)
	Hoarding time	EU	2020	4	years	Godoy León et al. (2020)	NO	Value taken as proxy from portable batteries (Cobalt)
End-of-life	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
	Collection-to-recycling rate	EU	2020	39	%	Eurostat (2020)	NO	Proxy value taken from consumer durables application (assumed as WEE)
	Pre-treatment efficiency	Global	2012	97	%	Liu et al. (2012)	YES	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	91.1	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	8.9	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S12. Full data set of the application consumer durables. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	50	%	Passarini et al. (2018)	YES	
		Germany	2001	90	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	80	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	94	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	6	%	Boin & Bertram (2005)	NO	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	14	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	2	%	Rombach & Friedrich (2001)	YES	Value reported per sector.
	Matrix D (wrought alloys)	Germany	2001	5.5	%	Rombach & Friedrich (2001)	YES	Value reported per sector.
Use	Initial material	EU	2018	6	%	Passarini et al. (2018)	YES	Reported value per sector
	Weibull scale parameter	Japan	2005	11.4	-	Nomura (2005)	NO	Parameter considered as WEEE. Value from television and video equipment
		Japan	2005	15.5	-		NO	Parameter considered as WEEE. Value from air conditioners
		Japan	2005	14.5	-		NO	Parameter considered as WEEE. Value from electric appliances for kitchen
		Japan	2005	14.1	-		NO	Parameter considered as WEEE. Value from electric lighting fixtures and apparatus
		Japan	2005	8.1	-		NO	Parameter considered as WEEE. Value for personal computers

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
		Japan	2005	10.4	-		NO	Parameter considered as WEEE. Value from wired communication equipment
		Japan	2005	10.8	-		NO	Parameter considered as WEEE. Value from wireless communication equipment
		Japan	2005	12.7	-		NO	Parameter considered as WEEE. Value from applied electronic equipment
	Weibull shape parameter	Japan	2005	1.2	-	(Nomura, 2005)	NO	Parameter considered as WEEE. Value from television and video equipment
		Japan	2005	1.76	-		NO	Parameter considered as WEEE. Value from air conditioners
		Japan	2005	1.53	-		NO	Parameter considered as WEEE. Value from electric appliances for kitchen
		Japan	2005	1.45	-		NO	Parameter considered as WEEE. Value from electric lighting fixtures and apparatus
		Japan	2005	2.6	-		NO	Parameter considered as WEEE. Value for personal computers
		Japan	2005	1.63	-		NO	Parameter considered as WEEE. Value from wired communication equipment
		Japan	2005	1.95	-		NO	Parameter considered as WEEE. Value from wireless communication equipment
		Japan	2005	1.63	-		NO	Parameter considered as WEEE. Value from wireless communication equipment
		Japan	2005	1.63	-		NO	Parameter considered as WEEE. Value from applied electronic equipment
	Lifetime	EU	2017	8	years	Bertram et al. (2017)	NO	
		Japan	2012	10	years	Hatamaya et al. (2012)	YES	
	Hoarding rate	EU	2020	51	%	Eurostat (2020)	NO	Application assumed as WEEE
	Hoarding time	EU	2020	4	years	Godoy León et al. (2020)	NO	Value taken as proxy from portable batteries (Cobalt)
End-of-life	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
		EU	2015	40	%	Huisman et al. (2017)	NO	

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Collection-to-recycling rate	EU	2020	39	%	Eurostat (2020)	NO	Application assumed as WEEE
	Pre-treatment efficiency	Global	2012	97	%	Liu et al. (2012)	YES	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	100	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	0	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

Table S13. Full data set of the application others. It includes the assumptions made and a distinction when the value was reported per sector

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
Production	Processing yield	EU	2018	30	%	Passarini et al. (2018)	YES	
		Germany	2001	80	%	Rombach & Friedrich (2001)	YES	
	Manufacturing yield	Global	2012	80	%	Liu et al. (2012)	NO	
	Processing scrap recovery	Germany	2001	92	%	Rombach & Friedrich (2001)	YES	
	Manufacturing scrap recovery	EU	2005	6	%	Boin & Bertram (2005)	NO	Obtained as the ratio of the scrap recovered from manufacturing to the total scrap generated
	Processing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Manufacturing downcycled scrap	EU	2005	0	%	Boin & Bertram (2005)	YES	The scrap generated is remelted in the same plant
	Export of products	EU	2019	14	%	Workman (2019)	NO	
	Matrix D (cast alloys)	Germany	2001	3	%	Rombach & Friedrich (2001)	YES	Value reported per sector.

Phase	Parameter	Data country/region	Data year	Value	Unit	Reference	Value per sector	Assumptions
	Matrix D (wrought alloys)	Germany	2001	1.4	%	Rombach & Friedrich (2001)	YES	Value reported per sector.
Use	Initial material	EU	2018	5	%	Passarini et al. (2018)	YES	Reported value per sector. Includes the share of dissipative uses (3%)
	Weibull scale parameter	Japan	2005	13.50	-	Nomura (2005)	NO	Value taken from other metallic uses
	Weibull shape parameter	Japan	2005	1.52	-	Nomura (2005	NO	Value taken from other metallic uses
	Lifetime	EU	2017	20	years	Bertram et al. (2017)	NO	
		Japan	2012	10	years	Hatamaya et al. (2012)	YES	
	Hoarding rate	EU	2020	50	%	Godoy León et al. (2020)	NO	Proxy value from other metals (Cobalt)
	Hoarding time	EU	2020	5	years	Godoy León et al. (2020	NO	Proxy value from other metals (Cobalt)
End-of-life	Export of EoL products	EU	2005	4.71	%	Boin & Bertram (2005)	YES	Calculated as ratio of exported scrap to total scrap generated in the EU
	Collection-to-recycling rate	Japan	2007	30	%	Hatamaya et al. (2007)	YES	
		Germany	2001	24	%	Rombach & Friedrich (2001)	YES	
	Pre-treatment efficiency	Global	2012	97	%	Liu et al. (2012)	YES	
		EU	2017	98	%	Bertram et al. (2017)	YES	
	Matrix B (refining)	EU	2005	100	%	Boin & Bertram (2005)	NO	
	Matrix B (remelting)	EU	2005	0	%	Boin & Bertram (2005)	NO	
	Recycling efficiency (remelting and refining)	EU	2018	97	%	Passarini et al. (2018)	YES	

4. Data Inventory and uncertainty

During the literature research, more than 90 sources were consulted for the collection of data related to aluminium. In total, 320 values were acquired from 20 sources. These values are related mainly to aluminium flows occurring in the EU and corresponds to 45% of the total data collected. Thirteen percent of the obtained values belong to single member countries of the EU; 8% of the values belong to global aluminium studies and 34% belong to other countries (outside the EU), mostly Japan. The values from Japanese sources are mainly related to the Weibull distribution. Regarding the temporal representation, 38% of the data cover the las 10 years (2010-2020), and 62% consists of older data (2000-2010).

Regarding the communication format more than 81% of the data collected come from scientific papers, 11% was acquired from official reports. The consulted reports correspond to reports commissioned by governmental institutions such as the Join Research Centre (JRC) of the European Commission or the European Aluminium Association (EAA). The remaining data (8%) were obtained from websites and for the European Statistical System (Eurostat).

Despite the reliability of the sources consulted to obtain the data to run the model, the data is susceptible to uncertainties **Fuente especificada no válida.**.

For instance, the geographical, temporal and technological variation can result in values with lower accuracy**Fuente especificada no válida.**. In this study, more than 60% of the collected data belong to the period 2000-2010. Some of the key parameters to run the model such as matrix B and matrix D belong to this group. In addition, the averaging of reviewed values is another source of uncertainty (Williams et al., 2009).

The way in which the data is reported can also lead to uncertainties. For instance, Godoy León & Dewulf **Fuente especificada no válida.** indicate that lifetime and hoarding time values can be overlapped and no distinction between these values is specified in the sources. The authors also point out the connection between the percentages of hoarding, collection and disposal and the lack of data of processes that happen between these processes e.g., reuse, refurbish or unidentified streams.

The final outcome of the data inventory was a complete dataset of aluminium. Nevertheless, as stated in previous paragraphs, it highly depended on the availability of information. Data gaps and parameters with multiple values were found during the process, requiring assumptions, average and proxy values to be considered.

The final values to run the model are shown in **Error! Reference source not found.**. In green are shown the average values, in orange the assumed values, in yellow the proxy values and in white those that did not need any kind of treatment. The complete dataset per product category and all the values collected is shown in the Supplementary Material.

Table S14. Final values used to run the model. Average values are shown in green, assumed values are shown in orange, proxy values are shown in yellow and values with no treatment are shown in white. AUT: automobiles, AE: aerospace, OTT: other transport, R: residential buildings, NR: non-residential buildings, UBC: used beverage cans, MPA: mixed packaging, MAE: machinery and equipment, CA: cables, OTE: other engineering, CD: consumer durables, OT: others

Phase	Parameter		Sectors – Product types											
			Transportation			Building and construction		Packaging and cans		Industrial machinery and equipment	Electrical engineering		Consumer durables	Others
			AUT	AE	OTT	R	NR	UBC	MPA	MAE	CA	OTE	CD	OT
Production	Processing yield (%)	λ_P	0.88	0.89	0.89	0.95	0.95	0.67	0.67	0.88	0.78	0.78	0.70	0.55
	Manufacturing yield (%)	λ_M	0.84	0.60	0.80	0.90	0.90	0.75	0.75	0.75	0.90	0.80	0.80	0.80
	Processing scrap recovery (%)	ξ_P	0.94	0.94	0.94	0.97	0.97	0.85	0.85	0.97	0.91	0.91	0.94	0.92
	Manufacturing scrap recovery (%)	ξ_M	0.37	0.37	0.37	0.17	0.17	0.12	0.12	0.06	0.03	0.17	0.06	0.06
	Export of products (%)	ψ_P	0.12	0.02	0.12	0.00	0.00	0.00	0.00	0.10	0.14	0.14	0.14	0.14
	Secondary material (cast alloys)	D	0.27	0.27	0.27	0.01	0.01	0.00	0.00	0.09	0.02	0.02	0.02	0.03
	Secondary material (wrought alloys)		0.05	0.05	0.05	0.18	0.18	0.07	0.07	0.09	0.04	0.04	0.05	0.14
Use	Initial material (%)	$x_{EU}(0)$	10.33	10.33	10.33	12.50	12.50	10.00	10.00	3.00	5.00	5.00	6.00	5.00
	Weibull (scale parameter)	η	11.16	6.80	14.79	14.00	15.00	15.50	12.20	13.86	10.70	10.70	12.19	13.50
	Weibull (shape parameter)	β	2.09	2.00	2.45	2.15	1.70	1.42	1.42	1.78	1.37	1.37	1.72	1.52
	Lifetime (years)	t_L	14.00	26.50	21.50	45.75	45.75	1.00	1.00	27.50	28.75	18.75	9.00	15.00
	Hoarding rate (%)	ϑ	0.17	0.25	0.17	0.05	0.05	0.33	0.29	0.36	0.51	0.51	0.51	0.50
	Hoarding time (years)	t_H	5.00	5.00	5.00	30.00	30.00	3.00	3.00	1.00	4.00	4.00	4.00	4.00
EoL	Export of EoL/EoS products (%)	ψ_{EoL}	0.06	0.05	0.05	0.05	0.05	0.00	0.00	0.05	0.05	0.05	0.22	0.05
	Collection-to-recycling rate (%)	ς	0.73	0.60	0.73	0.85	0.85	0.44	0.46	0.52	0.19	0.19	0.19	0.14
	Pre-treatment efficiency (%)	λ_{PT}	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.98	0.98
	Allocation to recycling processes (refining) (%)	B	0.96	0.51	0.51	0.51	0.51	0.20	0.20	1.00	0.91	0.91	1.00	1.00
	Allocation to recycling processes (remelting) (%)		0.05	0.49	0.49	0.49	0.49	0.80	0.80	0.00	0.09	0.09	0.00	0.00
	Recycling efficiency (refining) (%)	λ_R	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97

Recycling efficiency (remelting) (%)	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97

5. Supplementary results

Case scenario S1

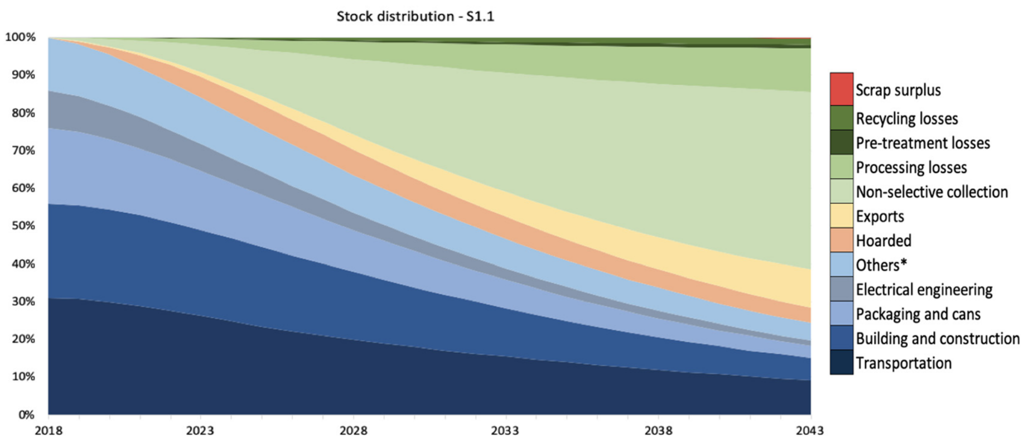

Figure S1. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S1.1

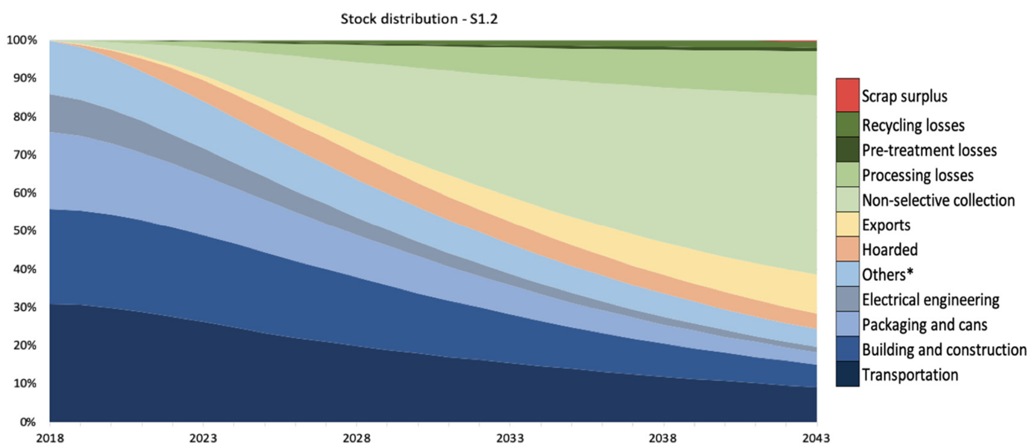

Figure S2. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S1.2

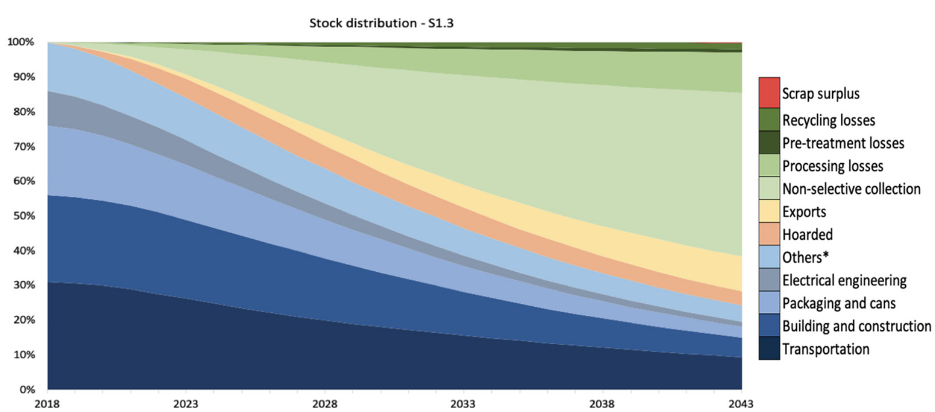

Figure S1. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S1.3

Case scenario S2

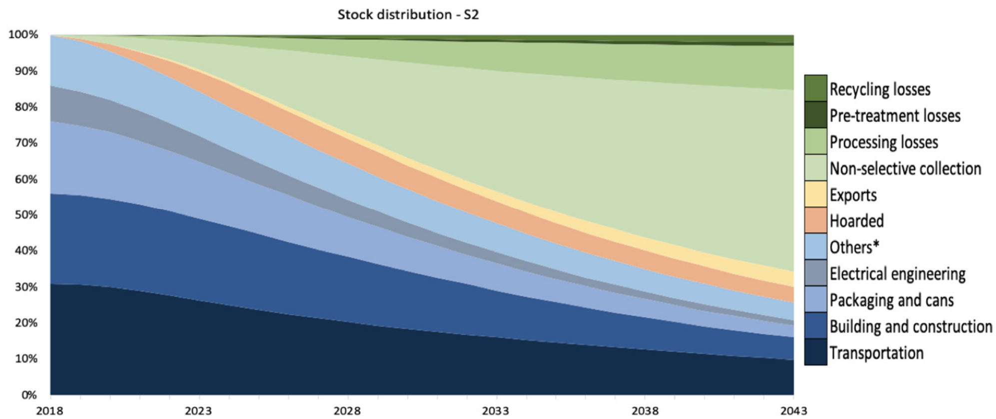

Figure S2. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S2

Case scenario S3

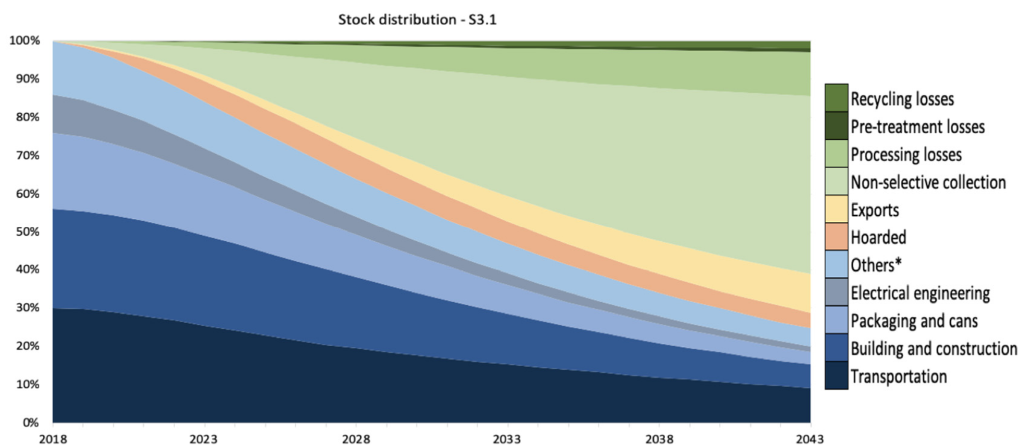

Figure S3. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S3.1

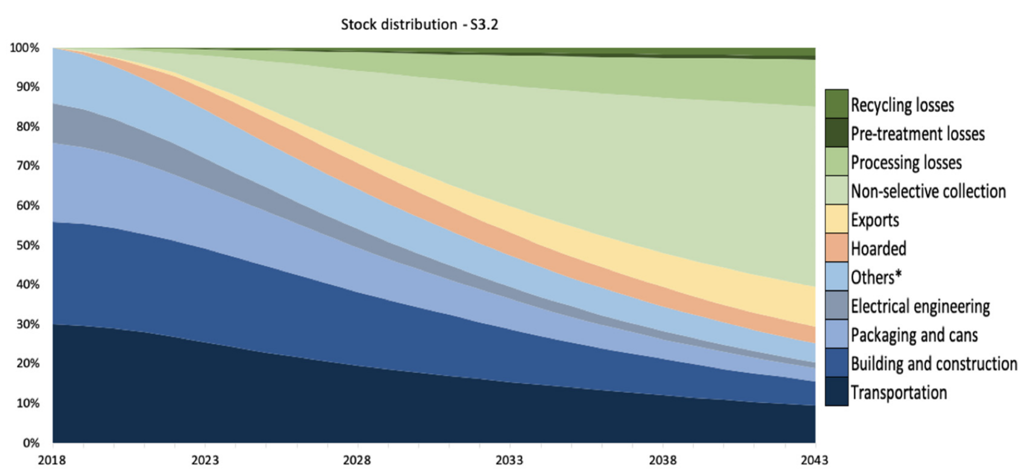

Figure S4. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S3.2

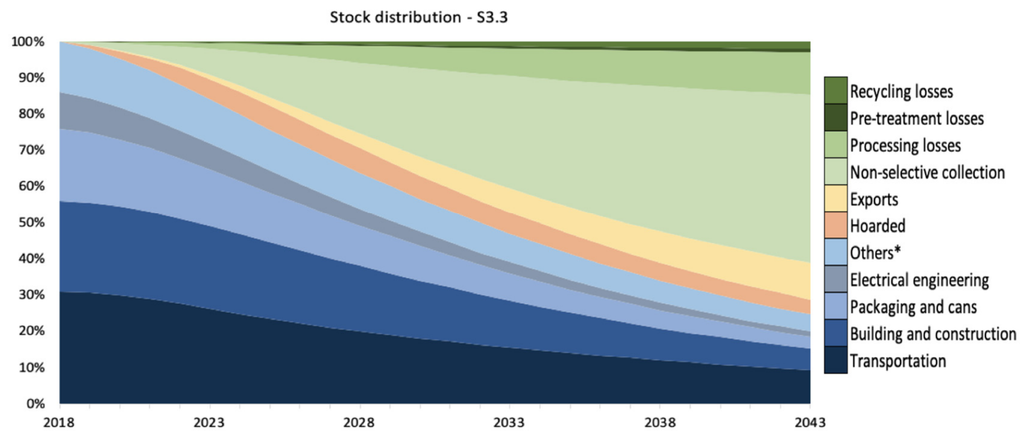

Figure S5. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S3.3

Case scenario S4

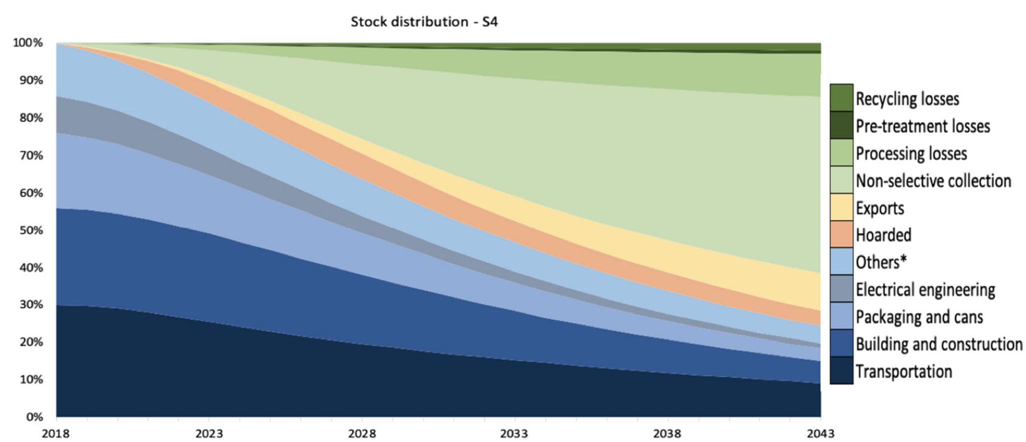

Figure S6. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S4

Case scenario S5

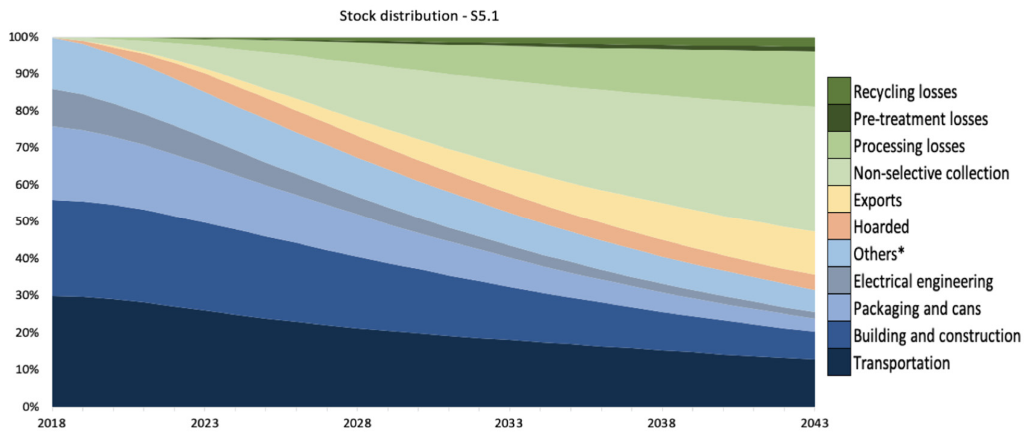

Figure S7. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S5.1

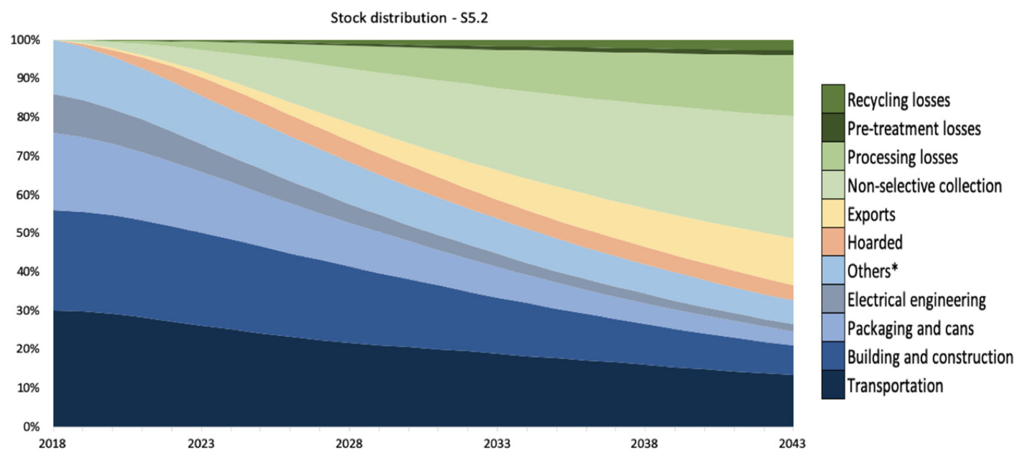

Figure S8. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S5.2

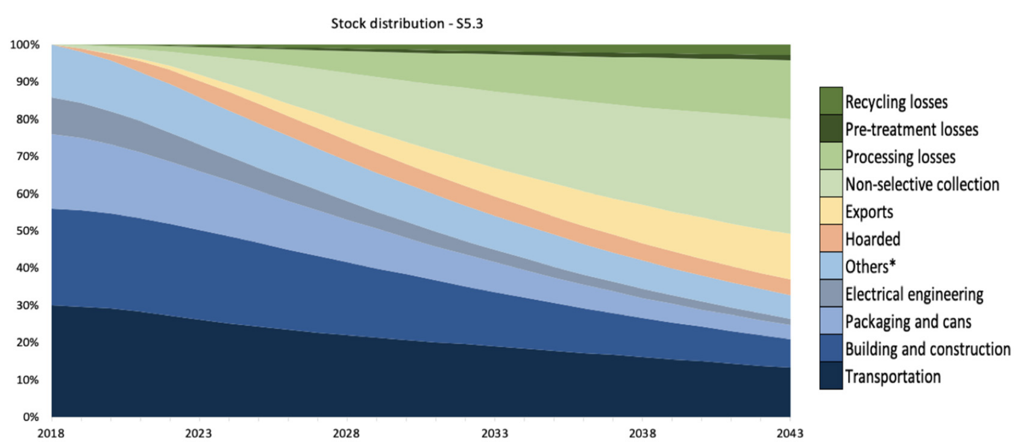

Figure S9. Evolution of the stock composition of aluminium in products and its associated losses – Scenario S5.3

6. References

Boin, U. & Bertram, M., 2005. Melting standardized aluminum scrap: A mass balance model for Europe. *JOM,* pp. 26-33.

Godoy Leon, M. & Dewulf, J., 2020. Data quality assessment framework for critical raw materials. the case of Cobalt. *Resources, Conservation and Recycling,* Volumen 157.

Lai, C., Murthy, D. & Xie, M., 2006. Weibull Distributions and their applications. In: *Springer Handbook of Engineering Statistics.* London: Springer, pp. 63-78.

Licari, J. & Swanson, D., 2005. Reliability prediction and modelling. In: Elsevier, ed. *Adhesives Technology for Electronic Applications.* s.l.:Waltham.

Maxfield, M., 2008. *Abandoned vehicles,* s.l.: COPS.

Nomura, K., 2005. Duration of Assets: Examination of Directly Observed Discard Data in Japan. *Keio Economic Observatory,* Volumen 99.

Passarini, F., Ciacci, L., Nuss, P. & Manfredi, S., 2018. *Matrial Flow Analysis of Aluminium, Copper, and Iron in the EU-28,* Brussels: Joint Research Centre - European Commission.

Wilson, G. et al., 2017. The hibernation mobiel phone: Dead storage as a barrier to efficient electronic waste recovery. *Waste Management,* Volume 60, pp. 521-533.