JATMA issued "Tyre $LCCO_2$ calculation guidelines Ver.3.0.1" due to correction of some data in Ver.3.0.

Details of the correction, please see the comparison table.

December 2021

The Japan Automobile Tyre Manufacturers Association, Inc.

Comparison table "Ver.3.0" vs "Ver.3.0.1"

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Table 5: GHG emission coefficients for tyre raw material production

(Unit: $kgCO_2e/kg$)

Raw material	GHG emission coefficient	Source and background
New rubber	—	—
Natural rubber	6.71×10^{-1}	Allen, P. W., the Malaysian Rubber Producers Research Association "Energy accounting: natural versus synthetic rubber" Rubber development vol. 32, No. 4, 1979
Synthetic rubber	3.71	Weighted average of the emission coefficients for styrene-butadiene rubber and butadiene rubber (IDEA) with the quantity of synthetic rubber shipped for tyres and tubes (statistics by the Japan Rubber Manufacturers Association, data in 2018)
Carbon black	***	JLCA database, carbon black (2017)
Process oil	***	IDEA, lubricating oil (including grease) *The unit was converted using 0.88 kg/l of the specific gravity surveyed by JATMA.
Total of organic rubber chemicals	***	IDEA, organic rubber chemical
Inorganic compounding agent	—	—
Zinc oxide	***	IDEA, zinc oxide
Sulfur	***	IDEA, recovered sulfur
Silica	***	IDEA, silica gel
Total of fibers	6.92	Weighted average of the emission coefficients for polyester tyre cords, nylon tyre cords, and rayon (IDEA) with the consumption ratios (statistics by JATMA, data in FY2018)
Steel cord	***	IDEA, steel ropes (including hard steel stranded wire)
Bead wire	***	IDEA, steel ropes (including hard steel stranded wire)

Table 5: GHG emission coefficients for tyre raw material production

(Unit: $kgCO_2e/kg$)

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New rubber	—	—
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Carbon black	***	JLCA database, carbon black (2017)
Process oil	***	IDEA, lubricating oil (including grease) *The unit was converted using 0.88 kg/l of the specific gravity surveyed by JATMA.
Total of organic rubber chemicals	***	IDEA, organic rubber chemical
Inorganic compounding agent	—	—
Zinc oxide	***	IDEA, zinc oxide
Sulfur	***	IDEA, recovered sulfur
Silica	***	IDEA, silica gel
Total of fibers	7.16	Weighted average of the emission coefficients for polyester tyre cords, nylon tyre cords, and rayon (IDEA) with the consumption ratios (statistics by JATMA, data in FY2018)
Steel cord	***	IDEA, steel ropes (including hard steel stranded wire)
Bead wire	***	IDEA, steel ropes (including hard steel stranded wire)

Comparison table "Ver.3.0" vs "Ver.3.0.1"

Page	Current (Ver.3.0)	Correction (Ver.3.0.1)
P10	Table 6: GHG emissions in raw material production (Unit: $kgCO_2e$/tyre)	Table 6: GHG emissions in raw material production (Unit: $kgCO_2e$/tyre)
P13	Table 10: GHG emissions in the entire raw material procurement stage (Unit: $kgCO_2e$/tyre)	Table 10: GHG emissions in the entire raw material procurement stage (Unit: $kgCO_2e$/tyre)

Table 6: GHG emissions in raw material production

(Unit: $kgCO_2e$/tyre)

Raw material	PC		TB	
	Conventional tyre	Fuel-efficient tyre	Conventional tyre	Fuel-efficient tyre
New rubber	—	—	—	—
Natural rubber	1.1	1.2	13.4	13.6
Synthetic rubber	9.4	7.5	22.1	20.2
Carbon black	***	***	***	***
Process oil	***	***	***	***
Total of organic rubber chemicals	***	***	***	***
Inorganic compounding agent	—	—	—	—
Zinc oxide	***	***	***	***
Sulfur	***	***	***	***
Silica	***	***	***	***
Total of fibers	2.9	2.1	0.0	0.7
Steel cord	***	***	***	***
Bead wire	***	***	***	***
Total	26.1	23.6	137.3	129.2

Table 6: GHG emissions in raw material production

(Unit: $kgCO_2e$/tyre)

Raw material	PC		TB	
	Conventional tyre	Fuel-efficient tyre	Conventional tyre	Fuel-efficient tyre
New rubber	—	—	—	—
Natural rubber	1.1	1.2	13.4	13.6
Synthetic rubber	9.4	7.5	22.1	20.2
Carbon black	***	***	***	***
Process oil	***	***	***	***
Total of organic rubber chemicals	***	***	***	***
Inorganic compounding agent	—	—	—	—
Zinc oxide	***	***	***	***
Sulfur	***	***	***	***
Silica	***	***	***	***
Total of fibers	3.0	2.2	0.0	0.7
Steel cord	***	***	***	***
Bead wire	***	***	***	***
Total	26.3	23.8	137.3	129.3

Table 10: GHG emissions in the entire raw material procurement stage

(Unit: $kgCO_2e$/tyre)

Class		PC		TB	
		Conventional tyre	Fuel-efficient tyre	Conventional tyre	Fuel-efficient tyre
Raw material procurement stage	Raw material production	26.1	23.6	137.3	129.2
	Raw material transportation	1.1	1.1	9.4	9.3
	Total	27.3	24.8	146.6	138.5

Table 10: GHG emissions in the entire raw material procurement stage

(Unit: $kgCO_2e$/tyre)

Class		PC		TB	
		Conventional tyre	Fuel-efficient tyre	Conventional tyre	Fuel-efficient tyre
Raw material procurement stage	Raw material production	26.3	23.8	137.3	129.3
	Raw material transportation	1.1	1.1	9.4	9.3
	Total	27.4	24.9	146.7	138.6

Comparison table "Ver.3.0" vs "Ver.3.0.1"

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<tr><td>P33</td><td>
Table 32: Retread compound raw material configuration ratios and GHG emissions in manufacturing
<table>
<tr><th>Class</th><th>Configuration ratio (kg)</th><th>GHG emission coefficient ($kgCO_2e/kg$)</th><th>GHG emissions ($kgCO_2e$)</th></tr>
<tr><td>Natural rubber</td><td>70</td><td>6.71×10^{-1}</td><td>46.97</td></tr>
<tr><td>Synthetic rubber</td><td>30</td><td>3.71</td><td>111.30</td></tr>
<tr><td>Carbon black</td><td>48</td><td>***</td><td>***</td></tr>
<tr><td>Process oil</td><td>7</td><td>***</td><td>***</td></tr>
<tr><td>Organic rubber chemical</td><td>7</td><td>***</td><td>***</td></tr>
<tr><td>Zinc oxide</td><td>3</td><td>***</td><td>***</td></tr>
<tr><td>Sulfur</td><td>2</td><td>***</td><td>***</td></tr>
<tr><td>Silica</td><td>0</td><td>***</td><td>0</td></tr>
<tr><td>Total</td><td>167</td><td>—</td><td>374.30</td></tr>
<tr><td>Total raw material weight/ new rubber ratio</td><td>1.67</td><td></td><td></td></tr>
</table>
*The configuration ratios were determined based on JATMA survey.
</td><td>
Table 32: Retread compound raw material configuration ratios and GHG emissions in manufacturing
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Comparison table "Ver.3.0" vs "Ver.3.0.1"

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Accordingly, the GHG emissions per kg of retread compound are as shown below.
(GHG emissions per kg of retread compound)
= GHG emissions/total material weight (kg)
= 374.30/167 = 2.24 $kgCO_2e/kg$

(ii) Retread compound weight
The ratio of the number of summer tyres to that of winter tyres was set to 1:1 based on an inquiry to Japan Retreaders' Association for calculation.
Based on a JATMA internal survey, the weights were set as follows: Summer tyres: 15 kg; winter tyres: 19 kg
15 × 0.5 + 19 × 0.5 = 17.0 kg

(iii) GHG emissions per tyre in the retread compound raw material stage
(GHG emissions in the retread compound raw material stage)
= (GHG emissions per kg of retread compound)
× retread compound weight
= 2.24 × 17.0 = 38.10 $kgCO_2e/tyre$

Table 33: GHG emissions per tyre in the retread compound raw material stage
(Unit: $kgCO_2e/tyre$)
<table>
<tr><th>Class</th><th>GHG emissions</th></tr>
<tr><td>GHG emissions per tyre</td><td>38.10</td></tr>
</table>
</td><td>
Accordingly, the GHG emissions per kg of retread compound are as shown below.
(GHG emissions per kg of retread compound)
= GHG emissions/total material weight (kg)
= 375.35/167 = 2.25 $kgCO_2e/kg$

(ii) Retread compound weight
The ratio of the number of summer tyres to that of winter tyres was set to 1:1 based on an inquiry to Japan Retreaders' Association for calculation.
Based on a JATMA internal survey, the weights were set as follows: Summer tyres: 15 kg; winter tyres: 19 kg
15 × 0.5 + 19 × 0.5 = 17.0 kg

(iii) GHG emissions per tyre in the retread compound raw material stage
(GHG emissions in the retread compound raw material stage)
= (GHG emissions per kg of retread compound)
× retread compound weight
= 2.25 × 17.0 = 38.21 $kgCO_2e/tyre$

Table 33: GHG emissions per tyre in the retread compound raw material stage
(Unit: $kgCO_2e/tyre$)
<table>
<tr><th>Class</th><th>GHG emissions</th></tr>
<tr><td>GHG emissions per tyre</td><td>38.21</td></tr>
</table>
</td></tr>
</table>

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Table 39: GHG emissions per tyre in product reuse through retreading
(Unit: $kgCO_2e$/tyre)
<table>
<tr><th>Class</th><th>GHG emissions</th></tr>
<tr><td>Retread compound raw material production stage</td><td>38.1</td></tr>
<tr><td>Retread compound raw material transportation stage</td><td>3.1</td></tr>
<tr><td>Retread compound mixing stage</td><td>2.1</td></tr>
<tr><td>Retread tyre production stage</td><td>21.3</td></tr>
<tr><td>Total GHG emissions per tyre in product reuse through retreading</td><td>64.5</td></tr>
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Table 39: GHG emissions per tyre in product reuse through retreading
(Unit: $kgCO_2e$/tyre)
<table>
<tr><th>Class</th><th>GHG emissions</th></tr>
<tr><td>Retread compound raw material production stage</td><td>38.2</td></tr>
<tr><td>Retread compound raw material transportation stage</td><td>3.1</td></tr>
<tr><td>Retread compound mixing stage</td><td>2.1</td></tr>
<tr><td>Retread tyre production stage</td><td>21.3</td></tr>
<tr><td>Total GHG emissions per tyre in product reuse through retreading</td><td>64.6</td></tr>
</table>
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<tr><td>P38</td><td>
Table 40: GHG emission reduction effects per tyre in product reuse through retreading
(Unit: $kgCO_2e$/tyre)
<table>
<tr><th rowspan="2">Class</th><th colspan="2">TB</th></tr>
<tr><th>Conventional tyre</th><th>Fuel-efficient tyre</th></tr>
<tr><td>GHG emission reduction in raw material production</td><td>−137.3</td><td>−129.2</td></tr>
<tr><td>GHG emission reduction in raw material transportation</td><td>−9.4</td><td>−9.3</td></tr>
<tr><td>GHG emission reduction in new tyre production</td><td>−39.5</td><td>−39.8</td></tr>
<tr><td>Total GHG emission reduction per tyre in product reuse through retreading</td><td>−186.2</td><td>−178.3</td></tr>
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Table 40: GHG emission reduction effects per tyre in product reuse through retreading
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</table>
</td></tr>
<tr><td>P42</td><td>
Table 45: GHG emission reduction effects in material recycling through manufacturing rubber granulate and powder and reclaimed rubber
<table>
<tr><th rowspan="2">Class</th><th colspan="2">TB</th><th rowspan="2">Unit</th></tr>
<tr><th>Conventional tyre</th><th>Fuel-efficient tyre</th></tr>
<tr><td>Weight of the recyclable part in an ELT (a)</td><td>34.69</td><td>33.10</td><td>kg/tyre</td></tr>
<tr><td>Yield to rubber granulate and powder and reclaimed rubber from an ELT (b)</td><td>90</td><td>90</td><td>%</td></tr>
<tr><td>Reclaimed rubber yield (a × b)</td><td>31.22</td><td>29.79</td><td>kg/tyre</td></tr>
<tr><td>GHG emission coefficient for the compound*</td><td>2.26</td><td>2.15</td><td>$kgCO_2e$/kg</td></tr>
<tr><td>GHG emission reduction effects in material recycling</td><td>−70.70</td><td>−64.15</td><td>$kgCO_2e$/tyre</td></tr>
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<tr><td>GHG emission reduction effects in material recycling</td><td>−70.76</td><td>−64.20</td><td>$kgCO_2e$/tyre</td></tr>
</table>
</td></tr>
</table>

Comparison table "Ver.3.0" vs "Ver.3.0.1"

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Table 46: GHG emissions and emission reduction effects in the end of life and recycling stage

(Unit: $kgCO_2e$/tyre)

Class		PC		TB		Remarks
		Conventional tyre	Fuel-efficient tyre	Conventional tyre	Fuel-efficient tyre	
Recycling ratio	Thermal recovery	78%		42%		Fig. 4
	Product reuse	—		15%		
	Material recycling	—		21%		
	Other than recycling	22%		22%		
GHG emissions	Transportation	0.4	0.4	2.5	2.4	Table 26
	Thermal recovery	12.1	9.8	24.6	22.1	GHG emissions in Table 30 × thermal recovery ratio
	Product reuse	—	—	9.7	9.7	GHG emissions in Table 39 × product reuse ratio
	Material recycling	—	—	9.6	9.2	GHG emissions in Table 44 × material recycling ratio
	Incineration	3.4	2.8	12.9	11.6	GHG emissions in Table 30 × ratio of other than recycling
Emission reduction effects	Thermal recovery	−15.9	−15.2	−54.0	−52.3	GHG emission reduction in Table 31 × thermal recovery ratio
	Product reuse	—	—	−27.9	−26.7	GHG emission reduction in Table 40 × product reuse ratio
	Material recycling	—	—	−14.8	−13.5	GHG emission reduction in Table 45 × material recycling ratio

Table 46: GHG emissions and emission reduction effects in the end of life and recycling stage

(Unit: $kgCO_2e$/tyre)

Class		PC		TB		Remarks
		Conventional tyre	Fuel-efficient tyre	Conventional tyre	Fuel-efficient tyre	
Recycling ratio	Thermal recovery	78%		42%		Fig. 4
	Product reuse	—		15%		
	Material recycling	—		21%		
	Other than recycling	22%		22%		
GHG emissions	Transportation	0.4	0.4	2.5	2.4	Table 26
	Thermal recovery	12.1	9.8	24.6	22.1	GHG emissions in Table 30 × thermal recovery ratio
	Product reuse	—	—	9.7	9.7	GHG emissions in Table 39 × product reuse ratio
	Material recycling	—	—	9.6	9.2	GHG emissions in Table 44 × material recycling ratio
	Incineration	3.4	2.8	12.9	11.6	GHG emissions in Table 30 × ratio of other than recycling
Emission reduction effects	Thermal recovery	−15.9	−15.2	−54.0	−52.3	GHG emission reduction in Table 31 × thermal recovery ratio
	Product reuse	—	—	−27.9	−26.8	GHG emission reduction in Table 40 × product reuse ratio
	Material recycling	—	—	−14.9	−13.5	GHG emission reduction in Table 45 × material recycling ratio

Comparison table "Ver.3.0" vs "Ver.3.0.1"

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Table 47: Lifecycle GHG emissions (details)

(Unit: $kgCO_2e$/tyre)

Class			PC			TB	
			Conventional tyre	Fuel-efficient tyre A	Fuel-efficient tyre B	Conventional tyre	Fuel-efficient tyre
Raw material procurement stage		Raw material production	26.1	23.6		137.3	129.2
		Raw material transportation	1.1	1.1		9.4	9.3
Production stage		Production	6.9	6.6		39.5	39.8
Distribution stage		Transportation	0.9	0.9		5.8	5.7
Use stage		Use	250.5	212.3	155.1	2,326.9	1,447.9
End of life and recycling stage	Emissions	Transportation	0.4	0.4		2.5	2.4
		Thermal recovery	12.1	9.8		24.6	22.1
		Product reuse	—	—		9.7	9.7
		Material recycling	—	—		9.6	9.2
		Simple incineration	3.4	2.8		12.9	11.6
Total GHG emissions			301.4	257.5	200.3	2,578.3	1,686.9
End of life and recycling stage	Reduction effects	Thermal recovery	−15.9	−15.2		−54.0	−52.3
		Product reuse	—	—		−27.9	−26.7
		Material recycling	—	—		−14.8	−13.5
Lifecycle GHG emissions (considering reduction effects)			285.5	242.3	185.1	2,481.5	1,594.3

Table 47: Lifecycle GHG emissions (details)

(Unit: $kgCO_2e$/tyre)

Class			PC			TB	
			Conventional tyre	Fuel-efficient tyre A	Fuel-efficient tyre B	Conventional tyre	Fuel-efficient tyre
Raw material procurement stage		Raw material production	26.3	23.8		137.3	129.3
		Raw material transportation	1.1	1.1		9.4	9.3
Production stage		Production	6.9	6.6		39.5	39.8
Distribution stage		Transportation	0.9	0.9		5.8	5.7
Use stage		Use	250.5	212.3	155.1	2,326.9	1,447.9
End of life and recycling stage	Emissions	Transportation	0.4	0.4		2.5	2.4
		Thermal recovery	12.1	9.8		24.6	22.1
		Product reuse	—	—		9.7	9.7
		Material recycling	—	—		9.6	9.2
		Simple incineration	3.4	2.8		12.9	11.6
Total GHG emissions			301.5	257.6	200.4	2,578.4	1,687.0
End of life and recycling stage	Reduction effects	Thermal recovery	−15.9	−15.2		−54.0	−52.3
		Product reuse	—	—		−27.9	−26.8
		Material recycling	—	—		−14.9	−13.5
Lifecycle GHG emissions (considering reduction effects)			285.6	242.5	185.2	2,481.6	1,594.4

Comparison table "Ver.3.0" vs "Ver.3.0.1"

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P45	Table 48: Lifecycle GHG emissions (by stage)	Table 48: Lifecycle GHG emissions (by stage)

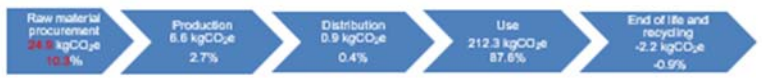
(Unit: $kgCO_2e$/tyre)

Class	PC						TB			
	Conventional tyre		Fuel-efficient tyre A		Fuel-efficient tyre B		Conventional tyre		Fuel-efficient tyre	
Raw material procurement stage	27.3	9.6%	24.8	10.2%	24.8	13.4%	146.6	5.9%	138.5	8.7%
Production stage	6.9	2.4%	6.6	2.7%	6.6	3.6%	39.5	1.6%	39.8	2.5%
Distribution stage	0.9	0.3%	0.9	0.4%	0.9	0.5%	5.8	0.2%	5.7	0.4%
Use stage	250.5	87.7%	212.3	87.6%	155.1	83.8%	2,326.9	93.8%	1,447.9	90.8%
End of life and recycling stage	0.0	0.0%	−2.2	−0.9%	−2.2	−1.2%	−37.4	−1.5%	−37.5	−2.4%
Emissions	15.9	5.6%	13.0	5.4%	13.0	7.0%	59.4	2.4%	55.0	3.5%
Emission reduction effects	−15.9	−5.6%	−15.2	−6.3%	−15.2	−8.2%	−96.8	−3.9%	−92.6	−5.8%
Total	285.5	100.0%	242.3	100.0%	185.1	100.0%	2,481.5	100.0%	1,594.3	100.0%

(Unit: $kgCO_2e$/tyre)

Class	PC						TB			
	Conventional tyre		Fuel-efficient tyre A		Fuel-efficient tyre B		Conventional tyre		Fuel-efficient tyre	
Raw material procurement stage	27.4	9.6%	24.9	10.3%	24.9	13.4%	146.7	5.9%	138.6	8.7%
Production stage	6.9	2.4%	6.6	2.7%	6.6	3.5%	39.5	1.6%	39.8	2.5%
Distribution stage	0.9	0.3%	0.9	0.4%	0.9	0.5%	5.8	0.2%	5.7	0.4%
Use stage	250.5	87.7%	212.3	87.6%	155.1	83.7%	2,326.9	93.8%	1,447.9	90.8%
End of life and recycling stage	0.0	0.0%	−2.2	−0.9%	−2.2	−1.2%	−37.4	−1.5%	−37.5	−2.4%
Emissions	15.9	5.6%	13.0	5.4%	13.0	7.0%	59.4	2.4%	55.0	3.5%
Emission reduction effects	−15.9	−5.6%	−15.2	−6.3%	−15.2	−8.2%	−96.8	−3.9%	−92.6	−5.8%
Total	285.6	100.0%	242.5	100.0%	185.2	100.0%	2,481.6	100.0%	1,594.4	100.0%

Comparison table "Ver.3.0" vs "Ver.3.0.1"

Page	Current (Ver.3.0)	Correction (Ver.3.0.1)
P45-46	[PC] Lifecycle GHG emissions per conventional tyre = 285.5 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 15.9 $kgCO_2e$, reduction effects = −15.9 $kgCO_2e$ Lifecycle GHG emissions per fuel-efficient tyre A = 242.3 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 13.0 $kgCO_2e$, reduction effects = −15.2 $kgCO_2e$ Lifecycle GHG emissions per fuel-efficient tyre B = 185.1 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 13.0 $kgCO_2e$, reduction effects = −15.2 $kgCO_2e$ [TB] Lifecycle GHG emissions per conventional tyre = 2,481.5 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 59.4 $kgCO_2e$, reduction effects = −96.8 $kgCO_2e$ Lifecycle GHG emissions per fuel-efficient tyre = 1,594.3 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 55.0 $kgCO_2e$, reduction effects = −92.6 $kgCO_2e$	[PC] Lifecycle GHG emissions per conventional tyre = 285.6 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 15.9 $kgCO_2e$, reduction effects = −15.9 $kgCO_2e$ Lifecycle GHG emissions per fuel-efficient tyre A = 242.5 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 13.0 $kgCO_2e$, reduction effects = −15.2 $kgCO_2e$ Lifecycle GHG emissions per fuel-efficient tyre B = 185.2 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 13.0 $kgCO_2e$, reduction effects = −15.2 $kgCO_2e$ [TB] Lifecycle GHG emissions per conventional tyre = 2,481.6 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 59.4 $kgCO_2e$, reduction effects = −96.8 $kgCO_2e$ Lifecycle GHG emissions per fuel-efficient tyre = 1,594.4 $kgCO_2e$  *GHG emissions in the end of life and recycling stage: emission = 55.0 $kgCO_2e$, reduction effects = −92.6 $kgCO_2e$