

---

# **LIFE CYCLE ASSESSMENT**

# **RONAL GROUP**

## **LIGHT ALLOY WHEELS**

## **FOR PASSENGER CARS**

According to the ISO 14040 and ISO 14044

### **SUMMARY**

Härkingen, October 2022

Environmental and Sustainability Department, RONAL GROUP  
RONAL AG  
Lerchenbühl 3, CH-4624 Härkingen

Audited by TÜV Rheinland Energy GmbH on January 23, 2023

## OWNER OF THE LIFE CYCLE ASSESSMENT

RONAL AG  
Lerchenbühl 3, CH-4624 Härkingen

## ISSUED BY

Environmental and Sustainability Department  
RONAL GROUP

## DESCRIPTION AND DEFINITION OF THE PRODUCT

Light alloy wheels for passenger cars

## DATE OF ISSUE

October 2022

## DATE OF TÜV INSPECTION

January 2023

---

## INTRODUCTION

In order to see where the RONAL GROUP currently stands with its CO<sub>2</sub>eq. emissions as well as other environmental impacts per wheel, the present life cycle assessment (LCA) was prepared.

The objective of this LCA is, on the one hand, to present the environmental aspects of an average RONAL GROUP light alloy wheel over its entire life cycle "cradle to grave". This approach includes raw material extraction, manufacturing, transport to the customer, and use through to disposal of the product and production waste.

On the other hand, it will also highlight the environmental impact of light alloy wheels from RONAL GROUP's worldwide production sites with the "cradle to gate" approach, in this case from raw material extraction to production and transport to the customer.

The full LCA report was reviewed critically by TÜV Rheinland Energy GmbH in January 2023 to confirm the reliability, transparency, relevance and representativeness of the methods and data used in the study.

The review report from TÜV Rheinland will be gladly provided upon request.

---

## GENERAL – NOTES AND PROCEDURES

- ✔ The LCA was calculated using Umberto LCA 11 software and ecoinvent 3.7 and 3.8 database according to ISO 14040 and ISO 14044.
- ✔ The basis of the calculations is based on the Product Carbon Footprint (PCF) of RONAL GROUP's R70-blue wheel from July 2021 and the current update in September 2022, which has been verified by TÜV-Rheinland.
- ✔ The model was adapted according to
  - Average wheel weights
  - Energy data – consumption of individual process steps
  - Energy mix – renewable and non-renewable as well as EU or MEX mixto the data from the business year 2021/22 for an average wheel of the RONAL GROUP as well as for each production plant and in addition to CO<sub>2</sub>eq. also other environmental impacts were calculated.
- ✔ This data was collected using an LCA of the RONAL GROUP and verified externally.
- ✔ A comparison of the plants is in general possible, but not recommended, as the assumptions in the report, the method, the software and the data basis may differ.

## SCOPES

In this life cycle analysis, the production of an aluminum wheel is calculated in terms of life cycle assessment. The system boundary to the natural environment is defined in such a way that all processes supplying material and energy inputs to the system, all manufacturing and transport processes and the treatment of all waste generated in the processes are part of the system.

The geographical system boundary refers to the RONAL GROUP production plants in Germany, Italy, Mexico, Poland, Spain and the Czech Republic.

The cast aluminum wheel was calculated for the following RONAL GROUP production sites:

- [1] Härkingen, CH - Ø Average wheel RONAL GROUP
- [2] Landau, DE
- [3] Teruel, ESP
- [4] Wałbrzych (1), PL
- [5] Wałbrzych (2), PL
- [6] Jelcz-Laskowice, PL
- [7] Tabina, IT
- [8] San Luis Potosí, MEX
- [9] Querétaro, MEX
- [10] Jičín, CZE
- [11] Pardubice, CZE

The two production plants in Taiwan (FULLCHAMP) and Italy (APP-TECH S.r.l.) were not considered. The two production sites were excluded because they do not produce cast wheels but forged wheels and FULLCHAMP produces forged wheels for trucks.

For an average wheel across the whole RONAL GROUP the complete life cycle "cradle to grave" with all life cycles was taken into account. However, since the use phase shows the most environmental impact and this does not differ in the production sites, since these are based on assumptions, the focus of the calculation of the individual production sites was placed on "cradle to gate".

The following life cycle phases were considered:

### [A] Raw Materials

- [A1] Primary aluminum production (incl. transport)
- [A2] Processing of secondary aluminum (pre-consumer)

### [B] Manufacture

- [B1] Melting
- [B2] Casting
- [B3] Rising drilling
- [B4] Heat treatment
- [B5] Mechanical processing
- [B6] Leak test
- [B7] Pretreatment
- [B8] Waste water treatment
- [B9] Painting
- [B10] Outgoing goods
- [B11] Packaging and transport

### [C] Distribution – Transport to the customers

### [D] Use Phase

### [E] End-of-Life

## ASSUMPTIONS

Certain assumptions have been made which are described in the full report.

---

## FUNCTIONAL UNIT

The LCA refers to the production of a specific aluminum wheel (aluminum rim) with an average finished wheel weight between 10 and 15 kg, depending on the production site.

The unit is the **average finished wheel weight [kg per wheel] of each site** from the Business Year 2021/22.

---

## IMPACT ESTIMATE

The impact assessment is based on the CML-2001 methodology. In this methodology, the assessment of environmental impact potentials is based on accepted scientific methods.

The following impacts were considered and calculated as the environmental impact category:

**ADPE** – Abiotic depletion potential elements [Sb e]

**ADPF** – Abiotic depletion potential fossil fuel [MJ]

**AP** – Acidification potential [SO<sub>2</sub> e]

**EP** – Eutrophication potential [PO<sub>4</sub> e]

**GWP** – Global warming potential [kg CO<sub>2</sub> e]

**ODP** – Stratospheric ozone depletion [CFC-11 e]

**PENR** – Primary energy non-renewable [MJ]

**PER** – Primary energy renewable [MJ]

**POCP** – Photochemical oxidation [C<sub>2</sub>H<sub>4</sub> e]

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Average Wheel of the RONAL GROUP [1]

Finished wheel weight: **12.17 kg**

Results phases average wheel RONAL GROUP – Cradle to Grave

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]	Use Phase [D]	End-of-Life [E]
<b>ADPE</b>	[Sb e]	<b>2.76E-01</b>	1.98E-04	7.83E-05	1.61E-06	2.76E-01	0.00E+00
<b>ADPF</b>	[MJ]	<b>2.64E+05</b>	7.31E+02	2.38E+02	1.05E+01	2.62E+05	0.00E+00
<b>AP</b>	[SO <sub>2</sub> e]	<b>7.31E+01</b>	7.31E-01	9.39E-02	1.74E-03	7.23E+01	0.00E+00
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.09E+01</b>	3.69E-02	1.52E-01	2.36E-04	1.07E+01	0.00E+00
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.96E+04</b>	8.80E+01	3.60E+01	6.72E-01	1.95E+04	0.00E+00
<b>ODP</b>	[CFC-11 e]	<b>2.90E-03</b>	5.83E-06	2.96E-06	1.33E-07	2.89E-03	0.00E+00
<b>PER</b>	[MJ]	<b>7.66E+03</b>	6.64E+02	3.35E+01	1.39E-01	6.96E+03	0.00E+00
<b>PENR</b>	[MJ]	<b>2.92E+05</b>	8.02E+02	3.36E+02	1.16E+01	2.91E+05	0.00E+00
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>3.33E+00</b>	5.81E-02	4.45E-03	8.09E-05	3.26E+00	0.00E+00

Results phases average wheel RONAL GROUP – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distribution
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	[C]
<b>ADPE</b>	[Sb e]	<b>2.77E-04</b>	1.97E-04	8.07E-08	1.85E-06	2.71E-05	8.32E-08	1.37E-06	9.44E-06	4.83E-08	4.14E-08	5.22E-06	4.91E-06	4.89E-06	2.34E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>9.80E+02</b>	7.31E+02	8.17E-02	8.41E+00	3.41E+01	3.94E-01	6.05E+00	2.26E+01	8.69E-01	3.09E+01	1.07E+01	1.14E+01	2.76E+01	8.52E+01	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>8.26E-01</b>	7.31E-01	5.61E-05	4.40E-03	1.48E-02	1.59E-04	2.43E-03	1.07E-02	6.72E-05	2.66E-02	2.92E-03	5.20E-03	1.11E-02	1.55E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.90E-01</b>	3.68E-02	1.30E-04	1.05E-01	1.44E-02	2.08E-05	3.19E-04	1.37E-02	5.70E-06	1.38E-02	5.10E-04	6.84E-04	1.45E-03	2.21E-03	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.25E+02</b>	8.80E+01	8.19E-03	4.76E+00	4.56E+00	3.46E-02	2.58E+00	4.74E+00	1.56E-02	3.66E+00	2.43E+00	6.15E+00	3.59E+00	3.44E+00	6.72E-01
<b>ODP</b>	[CFC-11e]	<b>8.93E-06</b>	5.83E-06	5.32E-10	3.10E-07	5.55E-07	1.49E-09	1.22E-07	9.57E-08	4.96E-09	2.79E-07	2.62E-07	7.41E-07	4.44E-07	1.45E-07	1.33E-07
<b>PER</b>	[MJ]	<b>6.97E+02</b>	6.64E+02	1.40E-02	7.18E-01	5.85E+00	1.32E-01	2.03E+00	5.86E+00	1.17E-02	2.13E+00	4.85E-01	3.12E+00	9.24E+00	3.97E+00	1.39E-01
<b>PENR</b>	[MJ]	<b>1.15E+03</b>	8.02E+02	1.19E-01	9.94E+00	5.03E+01	7.79E-01	1.20E+01	3.95E+01	9.78E-01	3.57E+01	1.22E+01	2.05E+01	5.45E+01	1.00E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>6.26E-02</b>	5.81E-02	2.47E-06	2.73E-04	5.82E-04	6.50E-06	9.97E-05	4.17E-04	4.78E-06	1.12E-03	1.12E-04	2.42E-04	4.54E-04	1.14E-03	8.09E-05

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – Landau, DE [2]

Finished wheel weight: **13.11 kg**

Results phases average wheel Landau – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
ADPE	[Sb e]	<b>2.67E-04</b>	1.99E-04	6.59E-05	1.61E-06
ADPF	[MJ]	<b>9.17E+02</b>	7.38E+02	1.69E+02	1.05E+01
AP	[SO <sub>2</sub> e]	<b>8.05E-01</b>	7.37E-01	6.59E-02	1.74E-03
EP	[PO <sub>4</sub> e]	<b>1.86E-01</b>	3.72E-02	1.49E-01	2.36E-04
GWP	[kg CO <sub>2</sub> e]	<b>1.19E+02</b>	8.88E+01	2.95E+01	6.72E-01
ODP	[CFC-11 e]	<b>7.31E-06</b>	5.89E-06	1.28E-06	1.33E-07
PER	[MJ]	<b>7.47E+02</b>	6.70E+02	7.75E+01	1.39E-01
PENR	[MJ]	<b>1.02E+03</b>	8.10E+02	1.98E+02	1.16E+01
POCP	[C <sub>2</sub> H <sub>4</sub> e]	<b>6.20E-02</b>	5.86E-02	3.31E-03	8.09E-05

Results phases average wheel Landau – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distri- bution [C]
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	
ADPE	[Sb e]	<b>2.67E-04</b>	1.99E-04	8.14E-08	1.66E-06	2.54E-05	1.77E-09	2.44E-08	7.62E-06	4.83E-08	5.36E-09	5.22E-06	2.45E-06	1.24E-07	2.34E-05	1.61E-06
ADPF	[MJ]	<b>9.17E+02</b>	7.38E+02	8.24E-02	8.41E+00	2.22E+01	2.50E-03	3.44E-02	7.15E+00	8.69E-01	3.09E+01	1.07E+01	2.87E+00	1.75E-01	8.52E+01	1.05E+01
AP	[SO <sub>2</sub> e]	<b>8.05E-01</b>	7.37E-01	5.67E-05	4.40E-03	1.01E-02	1.11E-06	1.53E-05	4.48E-03	6.72E-05	2.66E-02	2.92E-03	1.76E-03	7.74E-05	1.55E-02	1.74E-03
EP	[PO <sub>4</sub> e]	<b>1.86E-01</b>	3.71E-02	1.31E-04	1.05E-01	1.38E-02	1.90E-07	2.63E-06	1.29E-02	5.70E-06	1.38E-02	5.10E-04	2.34E-04	1.33E-05	2.21E-03	2.36E-04
GWP	[kg CO <sub>2</sub> e]	<b>1.19E+02</b>	8.88E+01	8.27E-03	4.86E+00	3.54E+00	3.22E-04	2.07E+00	3.39E+00	1.56E-02	3.66E+00	2.43E+00	5.75E+00	3.24E-01	3.44E+00	6.72E-01
ODP	[CFC-11 e]	<b>7.31E-06</b>	5.89E-06	5.37E-10	3.04E-08	5.23E-07	1.90E-11	2.63E-10	6.23E-08	4.96E-09	2.27E-07	2.62E-07	2.77E-08	1.33E-09	1.45E-07	1.33E-07
PER	[MJ]	<b>7.47E+02</b>	6.70E+02	1.42E-02	7.18E-01	1.18E+01	3.41E-01	4.71E+00	1.88E+01	1.17E-02	2.13E+00	4.85E-01	1.07E+01	2.39E+01	3.97E+00	1.39E-01
PENR	[MJ]	<b>1.02E+03</b>	8.10E+02	1.20E-01	9.94E+00	2.68E+01	3.01E-03	4.16E-02	8.95E+00	9.78E-01	3.57E+01	1.22E+01	3.47E+00	2.11E-01	1.00E+02	1.16E+01
POCP	[C <sub>2</sub> H <sub>4</sub> e]	<b>6.20E-02</b>	5.86E-02	2.49E-06	2.73E-04	3.88E-04	7.55E-08	1.04E-06	1.65E-04	4.78E-06	1.12E-03	1.12E-04	1.02E-04	5.28E-06	1.14E-03	8.09E-05

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – Teruel, ESP [3]

Finished wheel weight: **10.97 kg**

Results phases average wheel Teruel – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
<b>ADPE</b>	[Sb e]	<b>2.34E-04</b>	1.67E-04	6.58E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>7.96E+02</b>	6.17E+02	1.68E+02	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>6.85E-01</b>	6.17E-01	6.58E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.80E-01</b>	3.12E-02	1.49E-01	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.03E+02</b>	7.43E+01	2.80E+01	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>6.34E-06</b>	4.93E-06	1.28E-06	1.33E-07
<b>PER</b>	[MJ]	<b>6.15E+02</b>	5.60E+02	5.49E+01	1.39E-01
<b>PENR</b>	[MJ]	<b>8.87E+02</b>	6.77E+02	1.98E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.24E-02</b>	4.91E-02	3.30E-03	8.09E-05

Results phases average wheel Teruel – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distribution
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	[C]
<b>ADPE</b>	[Sb e]	<b>2.34E-04</b>	1.67E-04	6.81E-08	1.66E-06	2.54E-05	1.77E-09	4.37E-08	7.56E-06	4.83E-08	5.36E-09	5.22E-06	2.44E-06	7.00E-08	2.34E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>7.96E+02</b>	6.17E+02	6.90E-02	8.41E+00	2.22E+01	2.50E-03	6.17E-02	7.07E+00	8.69E-01	3.09E+01	1.07E+01	2.85E+00	9.88E-02	8.52E+01	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>6.85E-01</b>	6.17E-01	4.74E-05	4.40E-03	1.01E-02	1.11E-06	2.74E-05	4.45E-03	6.72E-05	2.66E-02	2.92E-03	1.74E-03	4.38E-05	1.55E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.80E-01</b>	3.10E-02	1.10E-04	1.05E-01	1.38E-02	1.90E-07	4.70E-06	1.29E-02	5.70E-06	1.38E-02	5.10E-04	2.32E-04	7.53E-06	2.21E-03	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.03E+02</b>	7.43E+01	6.92E-03	4.11E+00	3.54E+00	3.22E-04	1.92E+00	3.38E+00	1.56E-02	3.66E+00	2.43E+00	5.42E+00	4.95E-02	3.44E+00	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>6.34E-06</b>	4.93E-06	4.50E-10	3.04E-08	5.23E-07	1.90E-11	4.70E-10	6.18E-08	4.96E-09	2.27E-07	2.62E-07	2.75E-08	7.53E-10	1.45E-07	1.33E-07
<b>PER</b>	[MJ]	<b>6.15E+02</b>	5.60E+02	1.19E-02	7.18E-01	9.56E+00	3.41E-01	8.44E+00	8.50E+00	1.17E-02	2.13E+00	4.85E-01	7.21E+00	1.35E+01	3.97E+00	1.39E-01
<b>PENR</b>	[MJ]	<b>8.87E+02</b>	6.77E+02	1.01E-01	9.94E+00	2.68E+01	3.01E-03	7.45E-02	8.86E+00	9.78E-01	3.57E+01	1.22E+01	3.44E+00	1.19E-01	1.00E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.27E-02</b>	4.91E-02	2.09E-06	2.73E-04	3.88E-04	7.55E-08	1.87E-06	1.63E-04	4.78E-06	1.12E-03	1.12E-04	1.01E-04	2.99E-06	1.14E-03	8.09E-05

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – Wałbrzych (1), PL [4]

Finished wheel weight: **12.16 kg**

Results phases average wheel Wałbrzych (1) – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
<b>ADPE</b>	[Sb e]	<b>2.65E-04</b>	1.85E-04	7.90E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>9.26E+02</b>	6.84E+02	2.32E+02	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>7.77E-01</b>	6.84E-01	9.12E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.87E-01</b>	3.45E-02	1.52E-01	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.18E+02</b>	8.24E+01	3.48E+01	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>7.11E-06</b>	5.46E-06	1.52E-06	1.33E-07
<b>PER</b>	[MJ]	<b>6.53E+02</b>	6.21E+02	3.13E+01	1.39E-01
<b>PENR</b>	[MJ]	<b>1.09E+03</b>	7.51E+02	3.23E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.88E-02</b>	5.44E-02	4.34E-03	8.09E-05

Results phases average wheel Wałbrzych (1) – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distri- bution [C]
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	
<b>ADPE</b>	[Sb e]	<b>2.65E-04</b>	1.85E-04	7.55E-08	1.66E-06	2.80E-05	8.32E-08	1.15E-06	1.01E-05	4.83E-08	5.36E-09	5.22E-06	3.26E-06	6.07E-06	2.34E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>9.26E+02</b>	6.84E+02	7.65E-02	8.41E+00	3.47E+01	3.94E-01	5.45E+00	1.92E+01	8.69E-01	3.09E+01	1.07E+01	6.88E+00	2.88E+01	8.52E+01	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>7.77E-01</b>	6.84E-01	5.26E-05	4.40E-03	1.51E-02	1.59E-04	2.19E-03	9.33E-03	6.72E-05	2.66E-02	2.92E-03	3.36E-03	1.16E-02	1.55E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.87E-01</b>	3.44E-02	1.22E-04	1.05E-01	1.45E-02	2.08E-05	2.88E-04	1.35E-02	5.70E-06	1.38E-02	5.10E-04	4.43E-04	1.52E-03	2.21E-03	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.18E+02</b>	8.24E+01	7.67E-03	4.80E+00	4.62E+00	3.46E-02	2.52E+00	4.44E+00	1.56E-02	3.66E+00	2.43E+00	5.24E+00	3.63E+00	3.44E+00	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>7.11E-06</b>	5.46E-06	4.98E-10	3.04E-08	5.70E-07	1.49E-09	2.06E-08	1.07E-07	4.96E-09	2.27E-07	2.62E-07	4.25E-08	1.08E-07	1.45E-07	1.33E-07
<b>PER</b>	[MJ]	<b>6.53E+02</b>	6.21E+02	1.31E-02	7.18E-01	6.06E+00	1.32E-01	1.83E+00	4.74E+00	1.17E-02	2.13E+00	4.85E-01	1.59E+00	9.64E+00	3.97E+00	1.39E-01
<b>PENR</b>	[MJ]	<b>1.09E+03</b>	7.51E+02	1.12E-01	9.94E+00	5.15E+01	7.79E-01	1.08E+01	3.29E+01	9.78E-01	3.57E+01	1.22E+01	1.14E+01	5.69E+01	1.00E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.88E-02</b>	5.44E-02	2.31E-06	2.73E-04	5.93E-04	6.50E-06	8.98E-05	3.62E-04	4.78E-06	1.12E-03	1.12E-04	1.67E-04	4.74E-04	1.14E-03	8.09E-05



## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – Wałbrzych (2), PL [5]

Finished wheel weight: **10.31 kg**

Results phases average wheel Wałbrzych (2) – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
<b>ADPE</b>	[Sb e]	<b>2.36E-04</b>	1.57E-04	7.78E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>8.17E+02</b>	5.80E+02	2.26E+02	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>6.71E-01</b>	5.80E-01	8.90E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.81E-01</b>	2.93E-02	1.52E-01	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.03E+02</b>	6.98E+01	3.26E+01	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>6.26E-06</b>	4.63E-06	1.50E-06	1.33E-07
<b>PER</b>	[MJ]	<b>5.56E+02</b>	5.27E+02	2.95E+01	1.39E-01
<b>PENR</b>	[MJ]	<b>9.61E+02</b>	6.37E+02	3.12E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.04E-02</b>	4.61E-02	4.25E-03	8.09E-05

Results phases average wheel Wałbrzych (2) – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distribution
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	[C]
<b>ADPE</b>	[Sb e]	<b>2.36E-04</b>	1.57E-04	6.40E-08	1.66E-06	2.83E-05	8.32E-08	8.08E-07	1.05E-05	4.83E-08	5.36E-09	5.22E-06	3.34E-06	4.41E-06	2.34E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>8.17E+02</b>	5.80E+02	6.48E-02	8.41E+00	3.63E+01	3.94E-01	3.83E+00	2.13E+01	8.69E-01	3.09E+01	1.07E+01	7.23E+00	2.09E+01	8.52E+01	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>6.71E-01</b>	5.80E-01	4.46E-05	4.40E-03	1.57E-02	1.59E-04	1.54E-03	1.02E-02	6.72E-05	2.66E-02	2.92E-03	3.51E-03	8.40E-03	1.55E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.81E-01</b>	2.92E-02	1.03E-04	1.05E-01	1.46E-02	2.08E-05	2.02E-04	1.36E-02	5.70E-06	1.38E-02	5.10E-04	4.62E-04	1.10E-03	2.21E-03	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.03E+02</b>	6.98E+01	6.50E-03	3.91E+00	4.76E+00	3.46E-02	2.00E+00	4.63E+00	1.56E-02	3.66E+00	2.43E+00	5.72E+00	2.01E+00	3.44E+00	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>6.26E-06</b>	4.63E-06	4.23E-10	3.04E-08	5.76E-07	1.49E-09	1.45E-08	1.15E-07	4.96E-09	2.27E-07	2.62E-07	4.38E-08	7.88E-08	1.45E-07	1.33E-07
<b>PER</b>	[MJ]	<b>5.56E+02</b>	5.27E+02	1.11E-02	7.18E-01	6.60E+00	1.32E-01	1.28E+00	5.45E+00	1.17E-02	2.13E+00	4.85E-01	1.71E+00	7.00E+00	3.97E+00	1.39E-01
<b>PENR</b>	[MJ]	<b>9.61E+02</b>	6.37E+02	9.46E-02	9.94E+00	5.47E+01	7.79E-01	7.58E+00	3.70E+01	9.78E-01	3.57E+01	1.22E+01	1.21E+01	4.13E+01	1.00E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.04E-02</b>	4.61E-02	1.96E-06	2.73E-04	6.19E-04	6.50E-06	6.32E-05	3.97E-04	4.78E-06	1.12E-03	1.12E-04	1.73E-04	3.44E-04	1.14E-03	8.09E-05

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – Jelcz-Laskowice, PL [6]

Finished wheel weight: **10.63 kg**

Results phases average wheel Jelcz – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
<b>ADPE</b>	[Sb e]	<b>2.42E-04</b>	1.62E-04	7.86E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>8.41E+02</b>	6.00E+02	2.30E+02	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>6.92E-01</b>	6.00E-01	9.05E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.83E-01</b>	3.03E-02	1.52E-01	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.07E+02</b>	7.23E+01	3.38E+01	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>6.44E-06</b>	4.79E-06	1.51E-06	1.33E-07
<b>PER</b>	[MJ]	<b>5.76E+02</b>	5.45E+02	3.08E+01	1.39E-01
<b>PENR</b>	[MJ]	<b>9.91E+02</b>	6.59E+02	3.20E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.21E-02</b>	4.77E-02	4.31E-03	8.09E-05

Results phases average wheel Jelcz – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distri- bution [C]
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	
<b>ADPE</b>	[Sb e]	<b>2.42E-04</b>	1.62E-04	6.60E-08	1.66E-06	2.86E-05	8.32E-08	1.00E-06	1.07E-05	4.83E-08	5.36E-09	5.22E-06	3.67E-06	4.22E-06	2.34E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>8.41E+02</b>	6.00E+02	6.68E-02	8.41E+00	3.78E+01	3.94E-01	4.76E+00	2.20E+01	8.69E-01	3.09E+01	1.07E+01	8.82E+00	2.00E+01	8.52E+01	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>6.92E-01</b>	6.00E-01	4.59E-05	4.40E-03	1.63E-02	1.59E-04	1.92E-03	1.05E-02	6.72E-05	2.66E-02	2.92E-03	4.15E-03	8.04E-03	1.55E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.83E-01</b>	3.02E-02	1.06E-04	1.05E-01	1.46E-02	2.08E-05	2.51E-04	1.36E-02	5.70E-06	1.38E-02	5.10E-04	5.46E-04	1.06E-03	2.21E-03	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.07E+02</b>	7.23E+01	6.70E-03	4.38E+00	4.89E+00	3.46E-02	2.92E+00	4.69E+00	1.56E-02	3.66E+00	2.43E+00	5.57E+00	1.77E+00	3.44E+00	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>6.44E-06</b>	4.79E-06	4.36E-10	3.04E-08	5.82E-07	1.49E-09	1.80E-08	1.18E-07	4.96E-09	2.27E-07	2.62E-07	4.98E-08	7.54E-08	1.45E-07	1.33E-07
<b>PER</b>	[MJ]	<b>5.76E+02</b>	5.45E+02	1.15E-02	7.18E-01	7.09E+00	1.32E-01	1.60E+00	5.69E+00	1.17E-02	2.13E+00	4.85E-01	2.24E+00	6.70E+00	3.97E+00	1.39E-01
<b>PENR</b>	[MJ]	<b>9.91E+02</b>	6.59E+02	9.76E-02	9.94E+00	5.76E+01	7.79E-01	9.41E+00	3.85E+01	9.78E-01	3.57E+01	1.22E+01	1.53E+01	3.95E+01	1.00E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.21E-02</b>	4.77E-02	2.02E-06	2.73E-04	6.43E-04	6.50E-06	7.85E-05	4.09E-04	4.78E-06	1.12E-03	1.12E-04	1.99E-04	3.30E-04	1.14E-03	8.09E-05

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – Tabina, IT [7]

Finished wheel weight: **14.85 kg**

Results phases average wheel Tabina – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
<b>ADPE</b>	[Sb e]	<b>2.93E-04</b>	2.26E-04	6.60E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>1.01E+03</b>	8.36E+02	1.69E+02	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>9.03E-01</b>	8.35E-01	6.59E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.91E-01</b>	4.22E-02	1.49E-01	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.33E+02</b>	1.01E+02	3.15E+01	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>8.09E-06</b>	6.67E-06	1.29E-06	1.33E-07
<b>PER</b>	[MJ]	<b>8.44E+02</b>	7.59E+02	8.51E+01	1.39E-01
<b>PENR</b>	[MJ]	<b>1.13E+03</b>	9.17E+02	1.98E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>6.98E-02</b>	6.64E-02	3.31E-03	8.09E-05

Results phases average wheel Tabina – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distribution
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	[C]
<b>ADPE</b>	[Sb e]	<b>2.93E-04</b>	2.26E-04	9.22E-08	1.66E-06	2.54E-05	1.77E-09	3.23E-08	7.59E-06	4.83E-08	5.36E-09	5.22E-06	2.44E-06	1.99E-07	2.34E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>1.01E+03</b>	8.36E+02	9.34E-02	8.41E+00	2.22E+01	2.50E-03	4.57E-02	7.12E+00	8.69E-01	3.09E+01	1.07E+01	2.85E+00	2.81E-01	8.52E+01	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>9.03E-01</b>	8.35E-01	6.42E-05	4.40E-03	1.01E-02	1.11E-06	2.03E-05	4.47E-03	6.72E-05	2.66E-02	2.92E-03	1.75E-03	1.24E-04	1.55E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.91E-01</b>	4.20E-02	1.49E-04	1.05E-01	1.38E-02	1.90E-07	3.48E-06	1.29E-02	5.70E-06	1.38E-02	5.10E-04	2.32E-04	2.14E-05	2.21E-03	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.33E+02</b>	1.01E+02	9.37E-03	6.56E+00	3.52E+00	3.22E-04	1.71E+00	3.39E+00	1.56E-02	3.66E+00	2.43E+00	5.98E+00	7.84E-01	3.44E+00	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>8.09E-06</b>	6.67E-06	6.09E-10	3.04E-08	5.23E-07	1.90E-11	3.48E-10	6.21E-08	4.96E-09	2.27E-07	2.62E-07	2.76E-08	2.14E-09	1.45E-07	1.33E-07
<b>PER</b>	[MJ]	<b>8.44E+02</b>	7.59E+02	1.61E-02	7.18E-01	1.02E+01	3.41E-01	6.25E+00	1.43E+01	1.17E-02	2.13E+00	4.85E-01	8.36E+00	3.84E+01	3.97E+00	1.39E-01
<b>PENR</b>	[MJ]	<b>1.13E+03</b>	9.17E+02	1.36E-01	9.94E+00	2.68E+01	3.01E-03	5.51E-02	8.91E+00	9.78E-01	3.57E+01	1.22E+01	3.45E+00	3.39E-01	1.00E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>6.98E-02</b>	6.64E-02	2.83E-06	2.73E-04	3.88E-04	7.55E-08	1.38E-06	1.64E-04	4.78E-06	1.12E-03	1.12E-04	1.01E-04	8.49E-06	1.14E-03	8.09E-05

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – San Luis Potosí, MEX [8]

Finished wheel weight: **15.29 kg**

Results phases average wheel San Luis Potosí – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
<b>ADPE</b>	[Sb e]	<b>3.10E-04</b>	2.31E-04	7.76E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>1.14E+03</b>	8.50E+02	2.78E+02	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>9.56E-01</b>	8.54E-01	9.94E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.95E-01</b>	4.28E-02	1.52E-01	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.45E+02</b>	1.03E+02	4.14E+01	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>8.74E-06</b>	6.73E-06	1.87E-06	1.33E-07
<b>PER</b>	[MJ]	<b>8.02E+02</b>	7.81E+02	2.05E+01	1.39E-01
<b>PENR</b>	[MJ]	<b>1.27E+03</b>	9.33E+02	3.30E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>7.29E-02</b>	6.82E-02	4.65E-03	8.08E-05

Results phases average wheel San Luis Potosí – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distribution
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	[C]
<b>ADPE</b>	[Sb e]	<b>3.10E-04</b>	2.31E-04	9.50E-08	1.66E-06	2.55E-05	7.31E-08	1.40E-06	1.02E-05	4.83E-08	5.36E-09	5.22E-06	4.51E-06	5.58E-06	2.33E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>1.14E+03</b>	8.50E+02	9.62E-02	8.41E+00	2.38E+01	6.70E-01	1.29E+01	3.18E+01	8.69E-01	3.09E+01	1.07E+01	2.21E+01	5.11E+01	8.51E+01	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>9.56E-01</b>	8.54E-01	6.61E-05	4.40E-03	1.05E-02	2.05E-04	3.93E-03	1.20E-02	6.72E-05	2.66E-02	2.92E-03	7.63E-03	1.56E-02	1.55E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.95E-01</b>	4.26E-02	1.53E-04	1.05E-01	1.39E-02	2.01E-05	3.86E-04	1.36E-02	5.70E-06	1.38E-02	5.10E-04	8.08E-04	1.53E-03	2.20E-03	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.45E+02</b>	1.03E+02	9.65E-03	5.66E+00	3.66E+00	5.11E-02	2.65E+00	5.27E+00	1.56E-02	3.66E+00	2.43E+00	7.14E+00	7.42E+00	3.44E+00	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>8.74E-06</b>	6.73E-06	6.27E-10	3.04E-08	5.31E-07	3.60E-09	6.91E-08	1.95E-07	4.96E-09	2.28E-07	2.62E-07	1.31E-07	2.75E-07	1.45E-07	1.33E-07
<b>PER</b>	[MJ]	<b>8.02E+02</b>	7.81E+02	1.65E-02	7.18E-01	2.01E+00	6.37E-02	1.22E+00	3.02E+00	1.17E-02	2.13E+00	4.85E-01	2.06E+00	4.86E+00	3.97E+00	1.39E-01
<b>PENR</b>	[MJ]	<b>1.27E+03</b>	9.33E+02	1.40E-01	9.94E+00	2.87E+01	8.02E-01	1.54E+01	3.85E+01	9.78E-01	3.57E+01	1.22E+01	2.65E+01	6.13E+01	9.99E+01	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>7.29E-02</b>	6.82E-02	2.91E-06	2.73E-04	4.06E-04	8.27E-06	1.59E-04	4.67E-04	4.78E-06	1.12E-03	1.12E-04	3.38E-04	6.31E-04	1.14E-03	8.08E-05

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – Querétaro, MEX [9]

Finished wheel weight: **13.15 kg**

Results phases average wheel Querétaro – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
<b>ADPE</b>	[Sb e]	<b>2.85E-04</b>	2.00E-04	8.39E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>1.01E+03</b>	7.40E+02	2.55E+02	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>8.42E-01</b>	7.40E-01	1.01E-01	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.91E-01</b>	3.74E-02	1.53E-01	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.27E+02</b>	8.91E+01	3.75E+01	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>7.65E-06</b>	5.91E-06	1.61E-06	1.33E-07
<b>PER</b>	[MJ]	<b>7.11E+02</b>	6.72E+02	3.91E+01	1.39E-01
<b>PENR</b>	[MJ]	<b>1.19E+03</b>	8.12E+02	3.69E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>6.36E-02</b>	5.88E-02	4.72E-03	8.09E-05

Results phases average wheel Querétaro – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distribution
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	[C]
<b>ADPE</b>	[Sb e]	<b>2.85E-04</b>	2.00E-04	8.17E-08	1.66E-06	2.84E-05	8.32E-08	1.00E-06	9.22E-06	4.83E-08	5.36E-09	5.22E-06	5.59E-06	9.30E-06	2.34E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>1.01E+03</b>	7.40E+02	8.27E-02	8.41E+00	3.64E+01	3.94E-01	4.76E+00	1.51E+01	8.69E-01	3.09E+01	1.07E+01	1.79E+01	4.41E+01	8.52E+01	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>8.42E-01</b>	7.40E-01	5.68E-05	4.40E-03	1.58E-02	1.59E-04	1.91E-03	7.66E-03	6.72E-05	2.66E-02	2.92E-03	7.81E-03	1.77E-02	1.55E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.91E-01</b>	3.72E-02	1.32E-04	1.05E-01	1.46E-02	2.08E-05	2.51E-04	1.33E-02	5.70E-06	1.38E-02	5.10E-04	1.03E-03	2.33E-03	2.21E-03	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.27E+02</b>	8.91E+01	8.29E-03	6.09E+00	4.77E+00	3.46E-02	2.53E+00	4.08E+00	1.56E-02	3.66E+00	2.43E+00	6.54E+00	3.87E+00	3.44E+00	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>7.65E-06</b>	5.91E-06	5.39E-10	3.04E-08	5.76E-07	1.49E-09	1.79E-08	9.17E-08	4.96E-09	2.27E-07	2.62E-07	8.42E-08	1.66E-07	1.45E-07	1.33E-07
<b>PER</b>	[MJ]	<b>7.11E+02</b>	6.72E+02	1.42E-02	7.18E-01	6.64E+00	1.32E-01	1.59E+00	3.35E+00	1.17E-02	2.13E+00	4.85E-01	5.30E+00	1.48E+01	3.97E+00	1.39E-01
<b>PENR</b>	[MJ]	<b>1.19E+03</b>	8.12E+02	1.21E-01	9.94E+00	5.49E+01	7.79E-01	9.40E+00	2.47E+01	9.78E-01	3.57E+01	1.22E+01	3.33E+01	8.71E+01	1.00E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>6.36E-02</b>	5.88E-02	2.50E-06	2.73E-04	6.21E-04	6.50E-06	7.84E-05	2.94E-04	4.78E-06	1.12E-03	1.12E-04	3.49E-04	7.27E-04	1.14E-03	8.09E-05

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – Jičín, CZE [10]

Finished wheel weight: **10.68 kg**

Results phases average wheel Jičín – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
ADPE	[Sb e]	2.42E-04	1.62E-04	7.78E-05	1.61E-06
ADPF	[MJ]	8.38E+02	6.01E+02	2.26E+02	1.05E+01
AP	[SO <sub>2</sub> e]	6.91E-01	6.01E-01	8.90E-02	1.74E-03
EP	[PO <sub>4</sub> e]	1.82E-01	3.03E-02	1.52E-01	2.36E-04
GWP	[kg CO <sub>2</sub> e]	1.06E+02	7.24E+01	3.30E+01	6.72E-01
ODP	[CFC-11 e]	6.43E-06	4.80E-06	1.50E-06	1.33E-07
PER	[MJ]	5.75E+02	5.46E+02	2.95E+01	1.39E-01
PENR	[MJ]	9.84E+02	6.60E+02	3.13E+02	1.16E+01
POCP	[C <sub>2</sub> H <sub>4</sub> e]	5.21E-02	4.78E-02	4.25E-03	8.09E-05

Results phases average wheel Jičín – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distri- bution [C]
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	
ADPE	[Sb e]	2.42E-04	1.62E-04	6.63E-08	1.66E-06	2.78E-05	8.32E-08	1.06E-06	1.06E-05	4.83E-08	5.36E-09	5.22E-06	4.55E-06	3.40E-06	2.34E-05	1.61E-06
ADPF	[MJ]	8.38E+02	6.01E+02	6.72E-02	8.41E+00	3.37E+01	3.94E-01	5.04E+00	2.18E+01	8.69E-01	3.09E+01	1.07E+01	1.30E+01	1.61E+01	8.52E+01	1.05E+01
AP	[SO <sub>2</sub> e]	6.91E-01	6.01E-01	4.62E-05	4.40E-03	1.47E-02	1.59E-04	2.03E-03	1.04E-02	6.72E-05	2.66E-02	2.92E-03	5.83E-03	6.49E-03	1.55E-02	1.74E-03
EP	[PO <sub>4</sub> e]	1.82E-01	3.02E-02	1.07E-04	1.05E-01	1.44E-02	2.08E-05	2.66E-04	1.36E-02	5.70E-06	1.38E-02	5.10E-04	7.67E-04	8.51E-04	2.21E-03	2.36E-04
GWP	[kg CO <sub>2</sub> e]	1.06E+02	7.24E+01	6.74E-03	3.83E+00	4.52E+00	3.46E-02	2.62E+00	4.67E+00	1.56E-02	3.66E+00	2.43E+00	6.23E+00	1.50E+00	3.44E+00	6.72E-01
ODP	[CFC-11 e]	6.43E-06	4.80E-06	4.38E-10	3.04E-08	5.66E-07	1.49E-09	1.90E-08	1.17E-07	4.96E-09	2.27E-07	2.62E-07	6.56E-08	6.08E-08	1.45E-07	1.33E-07
PER	[MJ]	5.75E+02	5.46E+02	1.15E-02	7.18E-01	5.71E+00	1.32E-01	1.69E+00	5.60E+00	1.17E-02	2.13E+00	4.85E-01	3.64E+00	5.41E+00	3.97E+00	1.39E-01
PENR	[MJ]	9.84E+02	6.59E+02	9.80E-02	9.94E+00	4.95E+01	7.79E-01	9.96E+00	3.80E+01	9.78E-01	3.57E+01	1.22E+01	2.36E+01	3.19E+01	1.00E+02	1.16E+01
POCP	[C <sub>2</sub> H <sub>4</sub> e]	5.21E-02	4.78E-02	2.03E-06	2.73E-04	5.76E-04	6.50E-06	8.30E-05	4.04E-04	4.78E-06	1.12E-03	1.12E-04	2.68E-04	2.66E-04	1.14E-03	8.09E-05

## EFFECTS OF THE RONAL GROUP ALLOY WHEELS

### Ø- Light alloy wheel – Pardubice, CZE [11]

Finished wheel weight: **11.76 kg**

Results phases average wheel Pardubice – Cradle to Gate

	Unit	TOTAL	Raw Materials [A1-A2]	Manufacture [B1-B11]	Distribution [C]
<b>ADPE</b>	[Sb e]	<b>2.58E-04</b>	1.79E-04	7.74E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>8.96E+02</b>	6.62E+02	2.24E+02	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>7.51E-01</b>	6.61E-01	8.82E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.85E-01</b>	3.34E-02	1.52E-01	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.13E+02</b>	7.97E+01	3.26E+01	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>6.91E-06</b>	5.28E-06	1.49E-06	1.33E-07
<b>PER</b>	[MJ]	<b>6.30E+02</b>	6.01E+02	2.88E+01	1.39E-01
<b>PENR</b>	[MJ]	<b>1.05E+03</b>	7.26E+02	3.08E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.69E-02</b>	5.26E-02	4.21E-03	8.09E-05

Results phases average wheel Pardubice – Cradle to Gate

	Unit	TOTAL	Raw Materials		Manufacture											Distribution
			[A1]	[A2]	[B1]	[B2]	[B3]	[B4]	[B5]	[B6]	[B7]	[B8]	[B9]	[B10]	[B11]	[C]
<b>ADPE</b>	[Sb e]	<b>2.58E-04</b>	1.79E-04	7.31E-08	1.66E-06	2.77E-05	8.32E-08	1.36E-06	1.07E-05	4.83E-08	5.36E-09	5.22E-06	3.69E-06	3.55E-06	2.34E-05	1.61E-06
<b>ADPF</b>	[MJ]	<b>8.96E+02</b>	6.62E+02	7.40E-02	8.41E+00	3.32E+01	3.94E-01	6.47E+00	2.21E+01	8.69E-01	3.09E+01	1.07E+01	8.93E+00	1.68E+01	8.52E+01	1.05E+01
<b>AP</b>	[SO <sub>2</sub> e]	<b>7.51E-01</b>	6.61E-01	5.08E-05	4.40E-03	1.45E-02	1.59E-04	2.60E-03	1.05E-02	6.72E-05	2.66E-02	2.92E-03	4.19E-03	6.77E-03	1.55E-02	1.74E-03
<b>EP</b>	[PO <sub>4</sub> e]	<b>1.85E-01</b>	3.33E-02	1.18E-04	1.05E-01	1.44E-02	2.08E-05	3.41E-04	1.36E-02	5.70E-06	1.38E-02	5.10E-04	5.52E-04	8.87E-04	2.21E-03	2.36E-04
<b>GWP</b>	[kg CO <sub>2</sub> e]	<b>1.13E+02</b>	7.97E+01	7.42E-03	3.89E+00	4.48E+00	3.46E-02	2.55E+00	4.70E+00	1.56E-02	3.66E+00	2.43E+00	5.86E+00	1.53E+00	3.44E+00	6.72E-01
<b>ODP</b>	[CFC-11 e]	<b>6.91E-06</b>	5.28E-06	4.82E-10	3.04E-08	5.64E-07	1.49E-09	2.44E-08	1.18E-07	4.96E-09	2.27E-07	2.62E-07	5.02E-08	6.34E-08	1.45E-07	1.33E-07
<b>PER</b>	[MJ]	<b>6.30E+02</b>	6.01E+02	1.27E-02	7.18E-01	5.55E+00	1.32E-01	2.17E+00	5.71E+00	1.17E-02	2.13E+00	4.85E-01	2.28E+00	5.64E+00	3.97E+00	1.39E-01
<b>PENR</b>	[MJ]	<b>1.05E+03</b>	7.26E+02	1.08E-01	9.94E+00	4.86E+01	7.79E-01	1.28E+01	3.86E+01	9.78E-01	3.57E+01	1.22E+01	1.55E+01	3.32E+01	1.00E+02	1.16E+01
<b>POCP</b>	[C <sub>2</sub> H <sub>4</sub> e]	<b>5.69E-02</b>	5.26E-02	2.24E-06	2.73E-04	5.68E-04	6.50E-06	1.07E-04	4.10E-04	4.78E-06	1.12E-03	1.12E-04	2.01E-04	2.77E-04	1.14E-03	8.09E-05

