KARÜN

EST. IN PATAGONIA

# Report LCA 2022

Carbon footprint life cycle analysis for Karün sunglasses

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LIFE CYCLE ANALYSIS

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LIFE CYCLE ANALYSIS

Many of our environmental problems (climate change, extreme weather, loss of biodiversity, overexploited oceans and eroded soils) derive from the collision of two systems: the system nature of the Earth and the economic system of the humanity.

As a result, we find ourselves at a juncture critical for humanity. Many scientists have told us, that our current economic model has brought the load capacity of the systems of the Earth to the limit. And unless we change the current economic model, we will be thrown to unprecedented uncertainty. Take the climate change requires a total transformation of systems, from the energy sector to the food production, from how we approach cities to consumption.
We must act now, experts warn We only have ten years left to change course, that's why we have to migrate to a new one economy. The regenerative!

At Greenticket we imagine a world in which products and services don't just relieve the guilt of climate-conscious consumers, but actually put the brakes on climate change. Some distant utopia this is not: regenerative methods that conserve and rehabilitate our planet are taking root across the globe, and progressive brands are joining the movement. Welcome to the age of the regenerative economy, in where consumerism goes hand in hand with climate activism and the care of the planet. While sustainability has often been in limiting the damage to our planet, people are eager to put their purchasing power into efforts that can truly repair and restore.

In the regenerative economy, a pair of sunglasses can become a test of cleaning the oceans of plastics, and a bottle of wine can contribute directly to greening the desert. This new way of doing business will allow consumers rehabilitate the planet, one purchase at a time, and purpose-driven brands can lead the way.

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# Abstract

This report analyzes the carbon footprint life cycle analysis (LCA) for Karün sunglasses manufactured in factories in Italy, Turkey and China and sold around the world. The company is based in Chile and the analysis covers the raw materials and the manufacturing processes, based on information provided by Karün and its supply chain. Finally various sales scenarios were analyzed by transportation routes.

The impact on "climate change" was quantified by defining a functional unit (FU), which is 1 manufactured pair of sunglasses at the Turkey plant's dispatch area. The 4 products analyzed were modeled using SimaPro software and represent Karün's most popular sunglasses.

The LCA results indicate that the impact of each pair of sunglasses varies between 81.08 and 334.47 grams of carbon dioxide equivalent (gCO2e), to which are added 568.28 gCO2e for the case, 97.65 gCO2e for packaging and finally 814.87 gCO2e for transporting them from China, Italy and Turkey to the dispatch area in Turkey.

Therefore, the carbon footprint LCA results for sunglasses produced by Karün cover the procurement of raw materials through to their arrival at the dispatch area in Turkey. They vary between 1.56 kgCO2e for the Jorobada, Puma and Pingüino models, to 1.82 kgCO2e for the Cascade model including a case and packaging, with a results deviation or uncertainty of +- 126 grams, equivalent to +- 7.74%.

# Introduction

Life cycle analysis (LCA) is a method used for measuring the environmental impact of a product, process or system throughout its production, use or consumption cycle. It collects and analyzes the inputs and outputs of a system and the results indicate the potential environmental impact, with the aim of finding strategies to reduce that impact.

The LCA for a product should include all the inputs/outputs of the processes involved in its value chain. These are extracting its raw materials, processing the materials required to manufacture its components, using the product and finally recycling it or disposing of it. Significant transport, storage, distribution and other intermediate activities between each life cycle stage are also included.

The environmental impacts on "climate change" of Karün's products were analyzed, quantified and assessed with the aim of identifying the critical points in its supply chain and manufacturing processes. These span the procurement of raw materials, manufacture of products, cases and packaging, then transporting them to the dispatch area located in Istanbul, Turkey, including any intermediate transportation. The aim was to calculate the impact of one functional unit.

# Method

The results were based on life cycle analysis criteria and modeled with SimaPro* Software using the IPCC 2013 GWP 100 year impact assessment method that drew from the Agri-footprint 5 and Ecoinvent 3.7.1 databases, impact assessment methods and the EU & DK Input Outbase database.

## OBJECTIVE AND SCOPE

### Functional Unit (FU)

The functional unit was defined as 1 pair of sunglasses with case and packaging delivered to the dispatch area in Istanbul.

### System limits

The life cycle analysis of the product's carbon footprint was based on procurement of the required raw materials and energy resources, and the raw materials used to package the product.

**The system limits include the following:**

- Raw material extraction: This includes the extraction of raw materials and inputs required to manufacture the models of sunglasses covered in this analysis.
- Raw material transportation: This includes the sea and land transportation of raw materials from their place of origin to the conversion plant.
- Manufacture of sunglasses: This includes the process of converting raw materials into sunglasses at factories in Italy, Turkey and China.
- Packaging: This is the final stage that includes the case and packaging materials. After this stage, the finished product is ready for sale.

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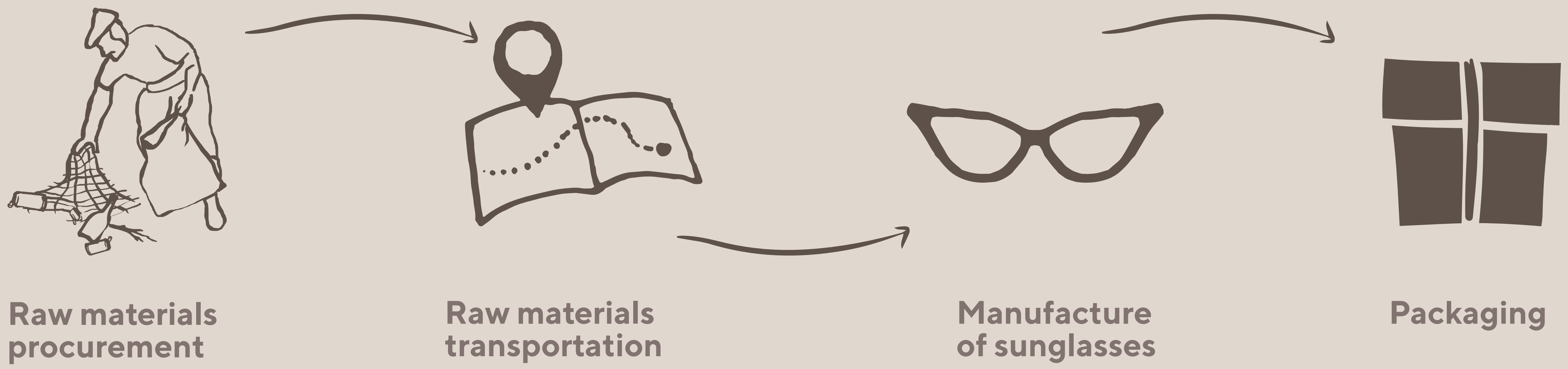
*1 Details in Appendices*

**SimaPro is a program developed by the Dutch company PRé Consultants, which allows Life Cycle Analysis (LCA), through the use of proprietary inventory databases.*

# System Inventory




## IMPACT ASSESSMENT METHODS

Life cycle phase impact assessments or product footprints were defined and quantified for the following impact categories:

**Carbon footprint**

Product carbon footprint quantification was based on the impact category related to climate change, which may involve adverse effects on ecosystem health, human health and material well-being. Climate change is related to greenhouse gas (GHG) emissions. This characterization model was developed by the IPCC, and the factors are expressed as global warming potential (GWP) over a time horizon of 100 years (GWP 100).

## DATA SOURCES

The inventory information was sourced from primary information on technical data sheets, information provided by factories that manufacture sunglasses and information provided by the company. It was used to analyze the impact of the entire value chain of Karün's sunglasses, which are sold around the world. Emissions information and characterization was extracted from Simapro databases.

The impact assessment for Karün's sunglasses, together with factory information provided by the company regarding production are as follows.

The raw material impact assessments required the materials used for each model and the technical data sheets of the products used to manufacture sunglasses.

***List of assessed models with their principal materials and weight.***

| Model | Materials | Weight (grams) |
|---|---|---|
| Pingüino | *Econyl | 29.24 |
| Jorobada | Metal | 23.6 |
| Puma | Econyl + Metal | 25.75 |
| Cascade | Polycarbonate | 43.18 |

***The ECONYL® regeneration system consists of 4 stages (Rescue-Regenerate-Remake-Reimagine):**

*• Rescue : The ECONYL® regeneration system begins by recolecting plastic waste, then organizing and cleaning it for recover as much nylon as possible. This process in Karün is led by collectors from the coast of Chile, whom we refer to in the first circle.*

*• Regenerate: Through a radical process of regeneration and purification, nylon-based waste is recycled and returned to its state of original purity. That means ECONYL® regenerated nylon is exactly the same as a virgin plastic.*

*• Remake: ECONYL® regenerated nylon is processed into pellets for the production of our eyewear.*

*• Reimagine: The beauty of ECONYL® regenerated nylon is that it can be recycled endless times, without ever losing its quality.*

The case contains the following materials

***Materials used in Karün sunglasses cases***

| Component | Materials | Weight (grams) |
| --- | --- | --- |
| Case | Carabiner Base 6/ Base 8 | 4.06 |
| | Metal Carabiner Ring - Base 6/ Base 8 | 0.42 |
| | Full Metal Button - Base 6/ Base 8 | 1.51 |
| | Leather Case - Base 6 | 37.84 |


Finally, packaging contains the following materials:

***Packaging materials for Karün sunglasses with case.***

| Component | Materials | Weight (grams) |
| --- | --- | --- |
| Packaging Base 6 | Cardboard box Base 6 | 146 |
| | Cleaning cloth - Base 6/Base 8 | 4.17 |
| | Paper - The Nest - Base 6/ Base 8 | 1.86 |
| | Paper - Manufacturer's Information - Base 6/ Base 8 | 2.6 |

The Complast factories in Italy and So-Pal in China provided manufacturing information on their sunglasses as follows:

***Resources required by Karün's supply chain to manufacture sunglasses.***

| Resource | Comments | Unit | Quantity | Karün Allocation (%) | Karün Quantity |
|---|---|---|---|---|---|
| Diesel oil | | Liters/year | 7,100 | 3% | 213 |
| Liquefied petroleum gas | | Liters/year | 12,200 | 1% | 122 |
| Fuel Oil | | Liters/year | 500 | 0.01% | 0 |
| Other fuels | | Liters/year | 200 | 1% | 2 |
| Grid electricity (Complast) | | Kwh/year | 1,292,307 | 3% | 38,769 |
| Grid electricity (So-Pal / Turkey) | | Kwh/PC | | | 0.916 |
| **Resource** | | **Unit** | **Quantity** | **Karün Allocation (%)** | **Karün Quantity** |
| Domestic | | Kg/year | 350 | 0 | 1.00 |
| Wood | | Kg/year | 8,400 | 3% | 250.00 |
| Maxisacos | Landfill | Kg/year | 4,000 | 0.03% | 1.20 |
| Paper and cardboard | | Kg/year | 7,000 | 0.03% | 1.00 |
| Plastics | | Kg/year | 31,240 | 0.06% | 20.00 |
| Chemical waste | | Kg/year | 9,200 | 3% | 276.00 |
| **Resource** | | **Unit** | **Quantity** | **Karün Allocation (%)** | **Karün Quantity** |
| Econyl | | Kg/year | 500 | 100% | 500.0 |
| **Resource** | | **Unit** | **Quantity** | **Karün Allocation (%)** | **Karün Quantity** |
| Secondary Packaging Report | | Kg/year | 700 | 1.50% | 11 |

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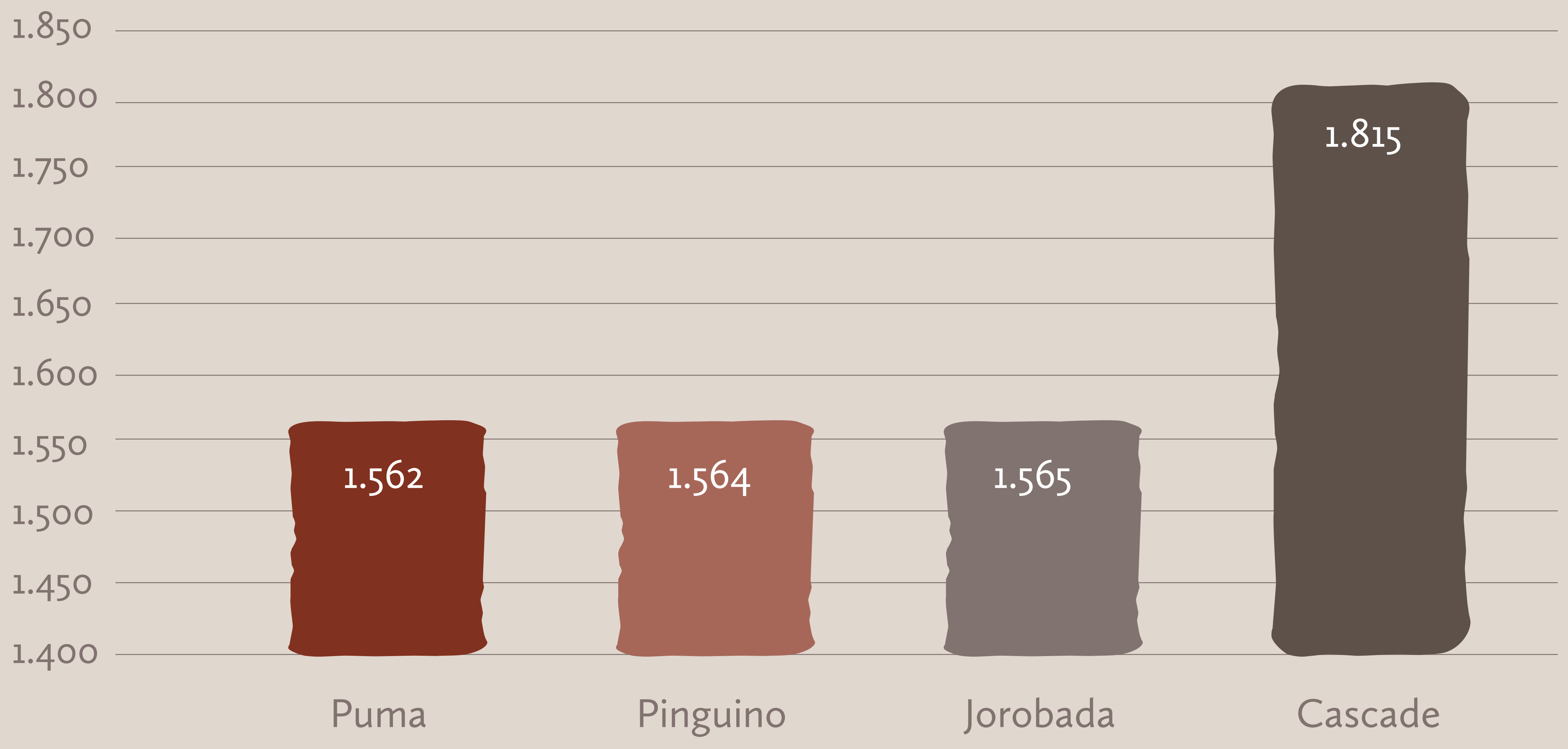
# Results

The product carbon footprint was quantified for each pair of sunglasses described in page 7, and the results were as follows:

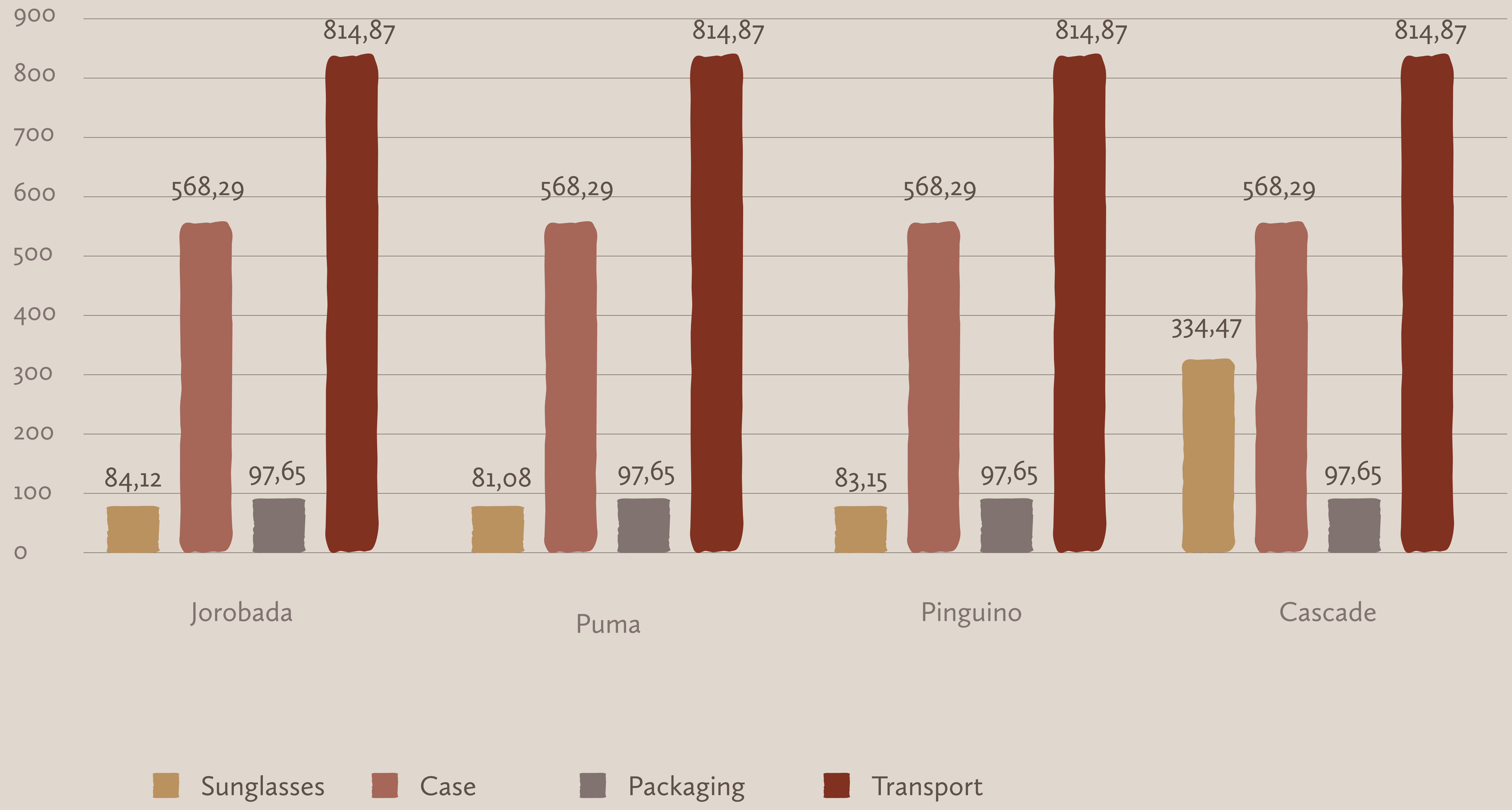
***LCA results of Karün sunglasses by phase in gCO2e.***

| Model (gCO2e) | Sunglasses | Case | Packaging | Transport | Total |
|---|---|---|---|---|---|
| Jorobada | 84.12 | 568.29 | 97,65 | 814,87 | **1.565** |
| Puma | 81.08 | 568.29 | 97,65 | 814,87 | **1.562** |
| Pingüino | 83.15 | 568.29 | 97,65 | 814,87 | **1.564** |
| Cascade | 334.47 | 568.29 | 97,65 | 814,87 | **1.815** |

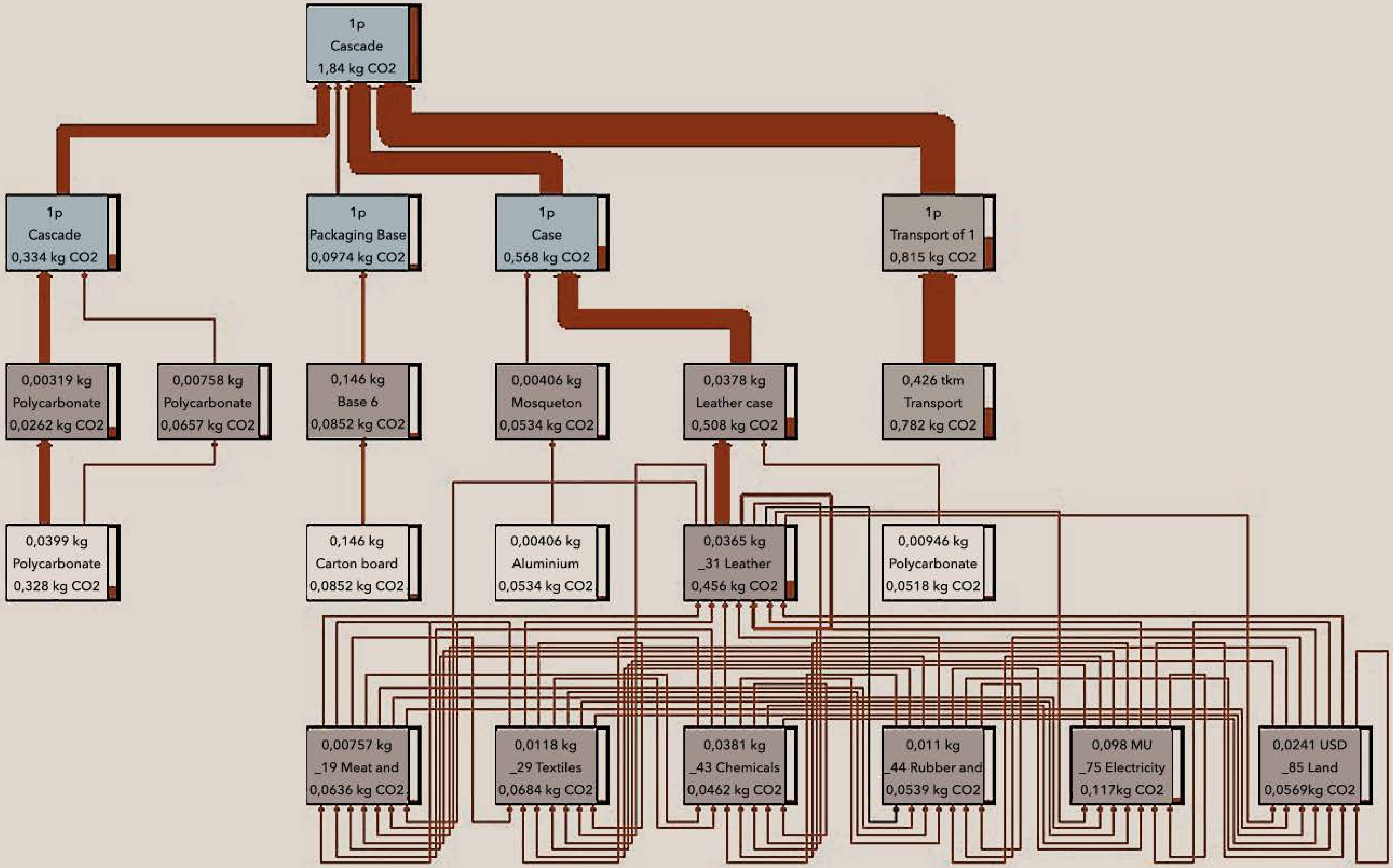
***LCA climate change result for the assessed models (gCO2e/year)***



*LCA climate change result for Karün sunglasses (gCO2e/sunglasses)*



*Cascade model LCA inventory results.*

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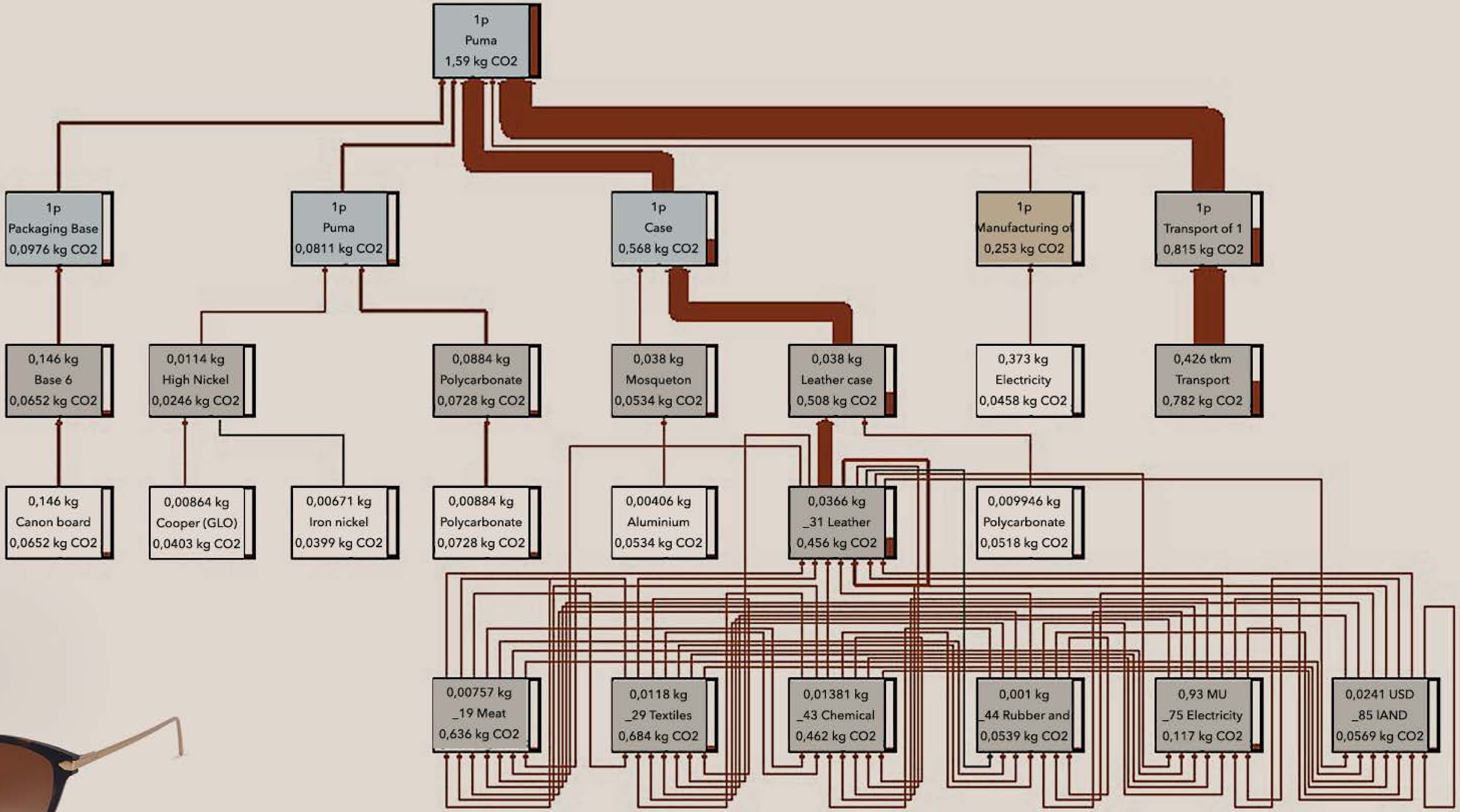
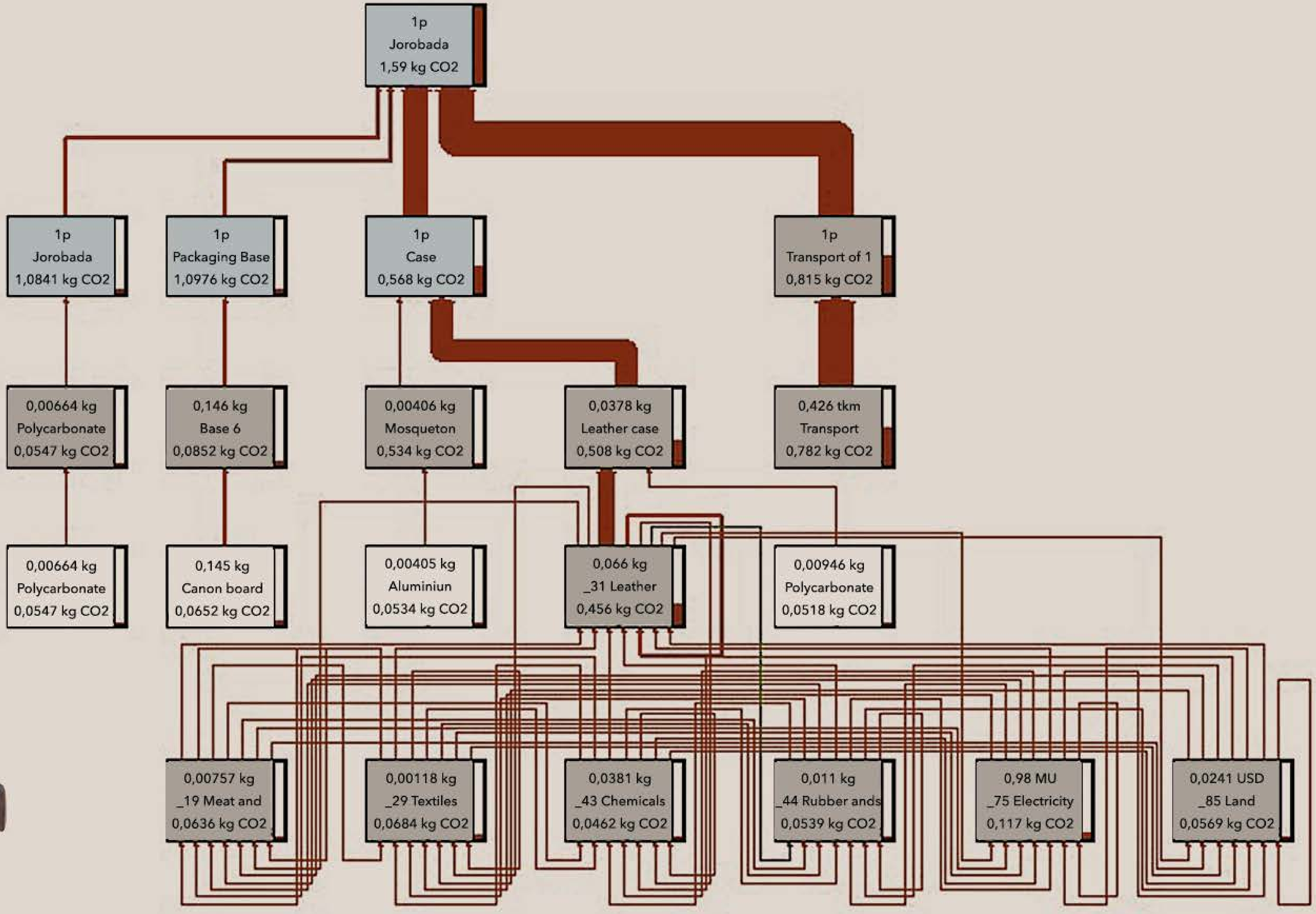
*Puma model LCA inventory results.*




*Jorobada model LCA inventory results.*

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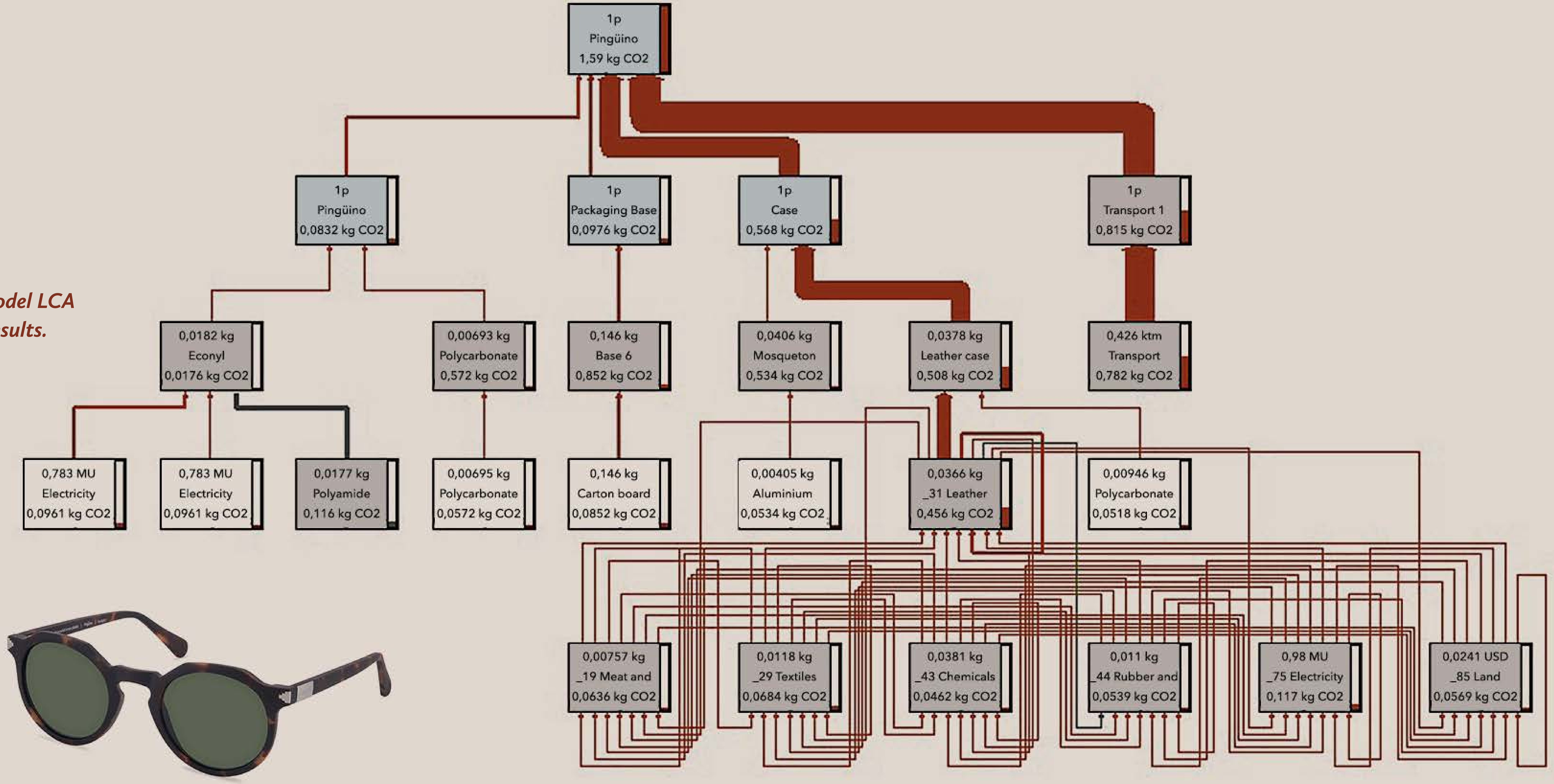
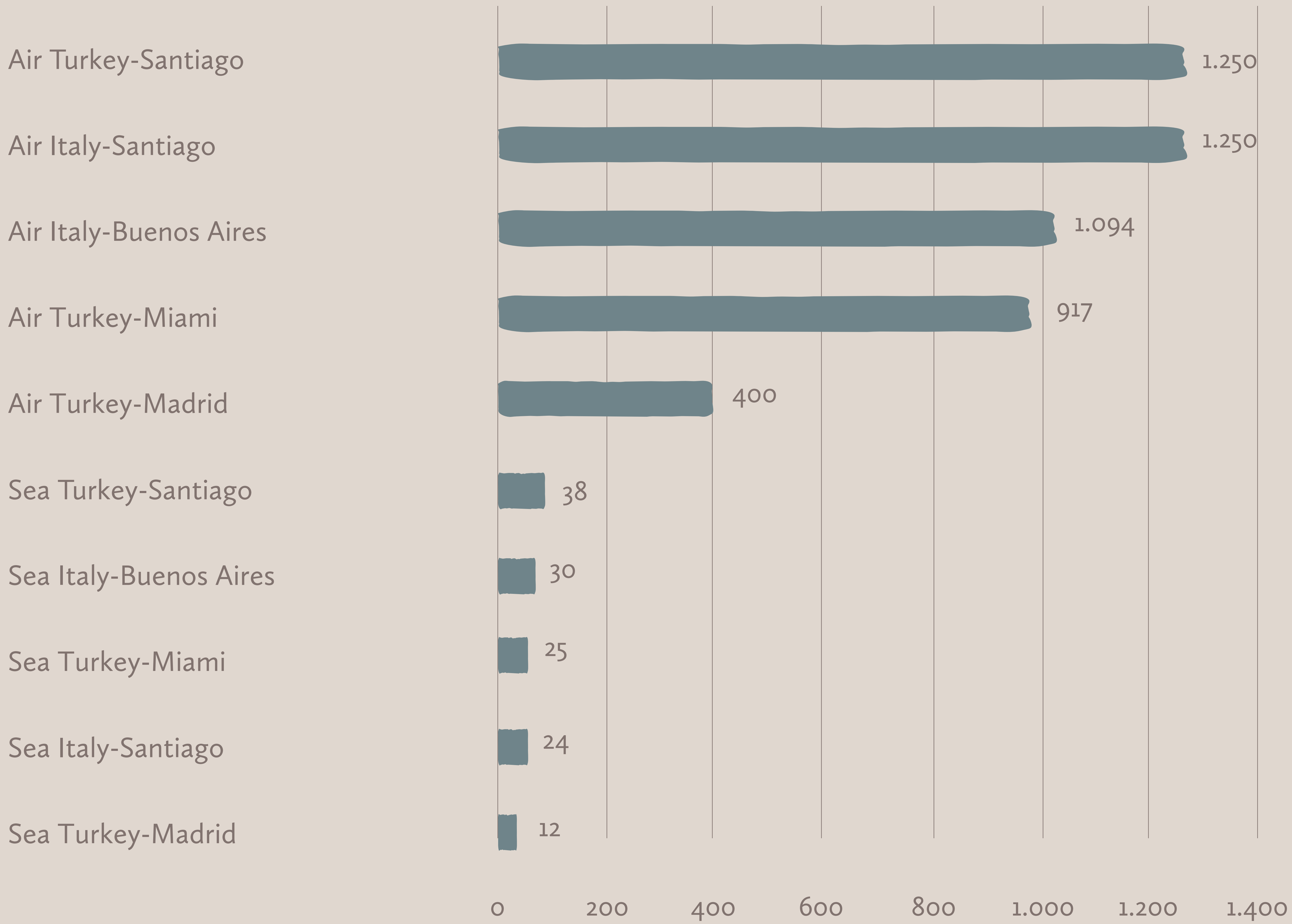
*Pingüino model LCA inventory results.*



Product sales scenarios by transportation route.

*Analysis of emissions generated by sunglasses sales by transportation route (gCO2e)*



# Conclusions

The results of the carbon footprint analysis for Karün's sunglasses cover their entire supply chain. The results of the corporate footprint analysis extend to detecting improvement opportunities in the measurement and monitoring of these impacts along their entire value chain.

The results of the carbon footprint life cycle analysis vary from 1,562 $gCO_2e$ for the Puma model made from Econyl and metal, to 1,815 $gCO_2e$ for the Cascade model made from polycarbonate.
The three main groups are:

1. **Recycled metals and regenerated nylon called Econyl:** All the products made only from metal, only from Econyl or a combination of both materials, have the lowest carbon footprint, which is 1.59 $kgCO_2e$ per functional unit or less.

2. **Combined recycled polycarbonate:** All the products made from polycarbonate combined with metal or Econyl or both have an average carbon footprint of 1.67 $kgCO_2e$ per functional unit or less.

3. **Only recycled polycarbonate:** All the products made only from recycled polycarbonate have a carbon footprint of 1.815 $kgCO_2e$ per functional unit or less.

The improvement opportunities will help Karün to reduce the impact of its products and these improvements will be seen in its next collections.

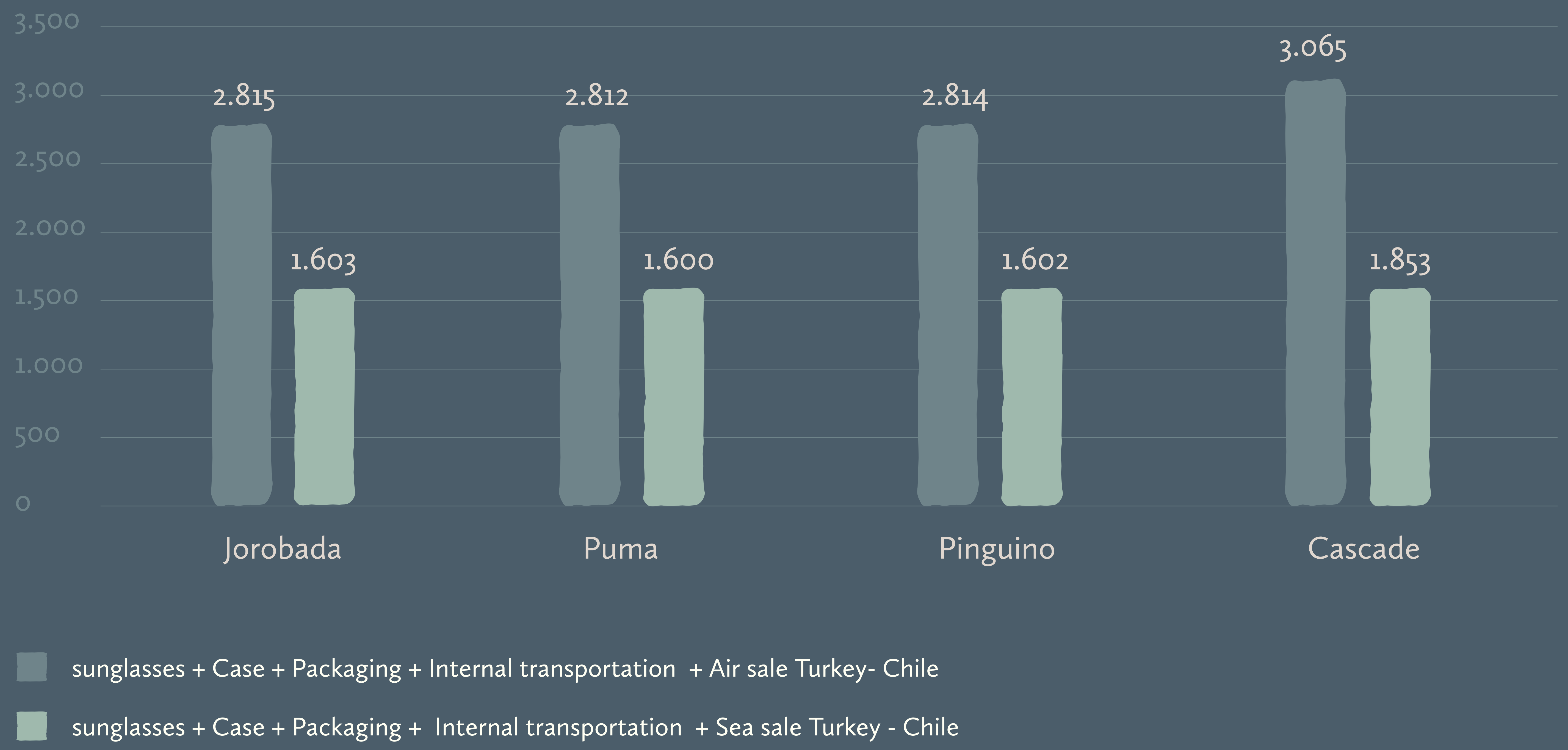
They will encourage the development of models with Econyl components. This material uses regenerative recycling technology to treat waste collected from Chilean coasts, such as fishing nets and ropes.

Simultaneously, reducing the weight of sunglasses will contribute to reducing the demand for materials, while reducing the impact of logistics, which are evaluated using an indicator that measures the number of kilometers that a kilogram of product is transported. The weight of packaging can also be reduced, in particular the cardboard box. If the weight of packaging is halved, a potential reduction of 42.6 $gCO_2e$ per product can be achieved.

Leather is used to cover the cases and this could be replaced, as it has an impact of about 35% on the footprint of this product, a vegan product could also be evaluated.

Finally, the impact on climate change of using various transportation routes to sell products was analyzed. Area sales increase emissions between 400 gCO2e to 1,250 gCO2e for the modeled routes. Emissions for these models including delivery to the final consumer would be as follows:

*Comparison of emissions from raw material procurement to the final consumer by transportation route (gCO2e)*




Note: The Ray-Ban aviator model has a product carbon footprint of 3,724 kgCO2e from raw materials to the final consumer. This information is the product's EPD for 2010.

# Exclusions and Observations

1. Note: Although the last mile was not included in finished product transportation, simulations of product sales by air and sea were performed for Karün's decision making.

2. We are continually improving the data that supports our product footprints, which means the numbers can and will change over time. The latest numbers will always be found on our website, as changing a printed document takes longer than changing a digital document.

# Appendices

IPCC 2013 is the successor of the IPCC 2007 method, which was developed by the Intergovernmental Panel on Climate Change. It contains the climate change factors of IPCC with a timeframe of 100 years, excluding the uptake of $CO_2$.
IPCC characterisation factors for the direct (except $CH_4$) global warming potential of air emissions. They are:
- not including indirect formation of dinitrogen monoxide from nitrogen emissions.
- not accounting for radiative forcing due to emissions of NOx, water, sulphate, etc. in the lower stratosphere + upper troposphere.
- not considering the range of indirect effects given by IPCC.
- not including indirect effects of CO emissions.

Normalization and weighting are not a part of this method.
Climate Change 2013. The Physical Science Basis. Working Group I contribution to the Fifth Assessment Report of the IPCC.
http://www.climatechange2013.org
Intergovernmental Panel on Climate Change (IPCC)
http://www.ipcc.ch/
Remarks about the implementation by PRé Consultants
- The factors for methane were calculated according to Munoz and Schmidt (2016)*:
Methane, biogenic: 27.75 kg $CO_2$eq/kg $CH_4$ (28 + 2.5 for correction of methane degradation to carbon dioxide - 2.75 for correction of not characterized carbon dioxide uptake)
Methane, fossil and Methane: 30.5 kg $CO_2$eq/kg $CH_4$ (28 + 2.5 for correction of methane degradation to carbon dioxide)
- For substances, which in the IPCC report have a factor "<1", characterization factors from Hodnebrog et al. (2013)** are applied.

For further information see the database manual.

Other adaptations (October 2016, version 1.03):
- 7 new substances added: HG-02; HG-03; Ether, i-nonafluorobutane ethyl-, HFE569sf2 (i-HFE-7200); Ether, n-nonafluorobutane ethyl-, HFE569sf2 (n-HFE-7200); 1-Propanol, i-3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, i-HFE-7100; 1-Propanol, n-3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, n-HFE-7100 and Carbon dioxide, to soil or biomass stock. The last one is included due to change in the way land tenure is modelled in Ecoinvent.
- The factor for Decane, 1,1,3,3,4,4,6,6,7,7,9,9,10,10,12,12-hexadecafluoro-2,5,8,11-tetraoxado- changed from 2850 to 4490 (there was a mistake in the previous version).

Other adaptations (March 2016, version 1.02):
- The characterization factors for 106 substances were aligned with the IPCC report.  Previously, they were based on Hodnebrog et al. (2013)**.
- For substances, which in the IPCC report have a factor "<1", characterization factors from Hodnebrog et al. (2013) are applied.
- 5 substances from the IPCC report are not included in this implementation.
  n-HFE-7100, i-HFE-7100, n-HFE-7200 and i-HFE-7200 - because including the mixtures of those isomers (HFE-449s1 (HFE-7100) and HFE-569sf2 (HFE-7200)) is considered sufficient.
  HG-02 - because no corresponding substance is available in SimaPro.
- Added new substance: Decane, 1,1,...,15,15-eicosafluoro-2,5,8,11,14-Pentaoxapenta-
This name is abbreviated, the full name is: Decane, 1,1,3,3,4,4,6,6,7,7,9,9,10,10,12,12,13,13,15,15-eicosafluoro-2,5,8,11,14-Pentaoxapenta-
- For "Methane", "Methane, biogenic" and "Methane, fossil" the factors from previous adaptation remain the same.
- Introduced changes have a minor impact on the results.

**Hodnebrog, Ø., M. Etminan, J. S. Fuglestvedt, G. Marston, G. Myhre, C. J. Nielsen, K. P. Shine, and T. J. Wallington (2013), Global warming potentials and radiative efficiencies of halocarbons and related compounds: A comprehensive review. Rev. Geophys., 51, 300-378, doi:10.1002/rog.20013. Spreadsheet: http://folk.uio.no/oivinho/halocarbonmetrics/

Other adaptations (June 2015, version 1.01):
- Corrected the characterization factors, according to Munoz and Schmidt (2016)*:
  Methane, biogenic to 27.75 kg $CO_2$eq/kg $CH_4$ (28 + 2.5 for correction of methane degradation to carbon dioxide - 2.75 for correction of not characterized carbon dioxide uptake)
  Methane, fossil and Methane to 30.5 kg $CO_2$eq/kg $CH_4$ (28 + 2.5 for correction of methane degradation to carbon dioxide)
- Added the characterization factor for Methane, land transformation (equal to the factor for Methane).
- Corrected the factor for Propane, 2-(difluoromethoxymethyl)-1,1,1,2,3,3,3-heptafluoro- from 116 to 407 kg $CO_2$ eq / kg

*Munoz, I. and Schmidt, J.H. (2016), Methane oxidation, biogenic carbon, and the IPCC's emission metrics. Proposal for a consistent greenhouse-gas accounting. The International Journal of Life Cycle Assessment, 21:1069-1075.

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