

SUSTAINABILITY REPORT 2024

01 Introduction

02 Photovoltaic panels put on the
italian market in 2024

03 Life Cycle Assessment

04 Overview of household WEEE
groups

05 Conclusion



6 000 000

photovoltaic panels
declared



3

GW total installed
capacity



4 124

tons of photovoltaic
panels



8 465

tons of WEEE disposed
of

2024 Achievements

The 2024 sustainability report highlights a strong commitment to the responsible management of end-of-life photovoltaic panels, supported by an increasingly efficient, transparent, and regulation-compliant system.

PV CYCLE ITALIA promotes raw material recovery and reduces environmental impact, thereby supporting the circular economy.

Throughout 2024, we responded promptly to the challenges posed by an ever-evolving regulatory framework and the growing focus on sustainability, reinforcing our role as a benchmark in Extended Producer Responsibility (EPR) for electrical and electronic equipment.

Our work is grounded in legality, traceability, and sustainability, made possible through the collaboration of members, partners, and stakeholders.

We continue to invest in enhancing environmental reporting to deliver clearer and more reliable communications. We thank everyone who contributed to making 2024 a year of growth toward a sustainable future.

Rosa Narcisi – Country Manager Italia



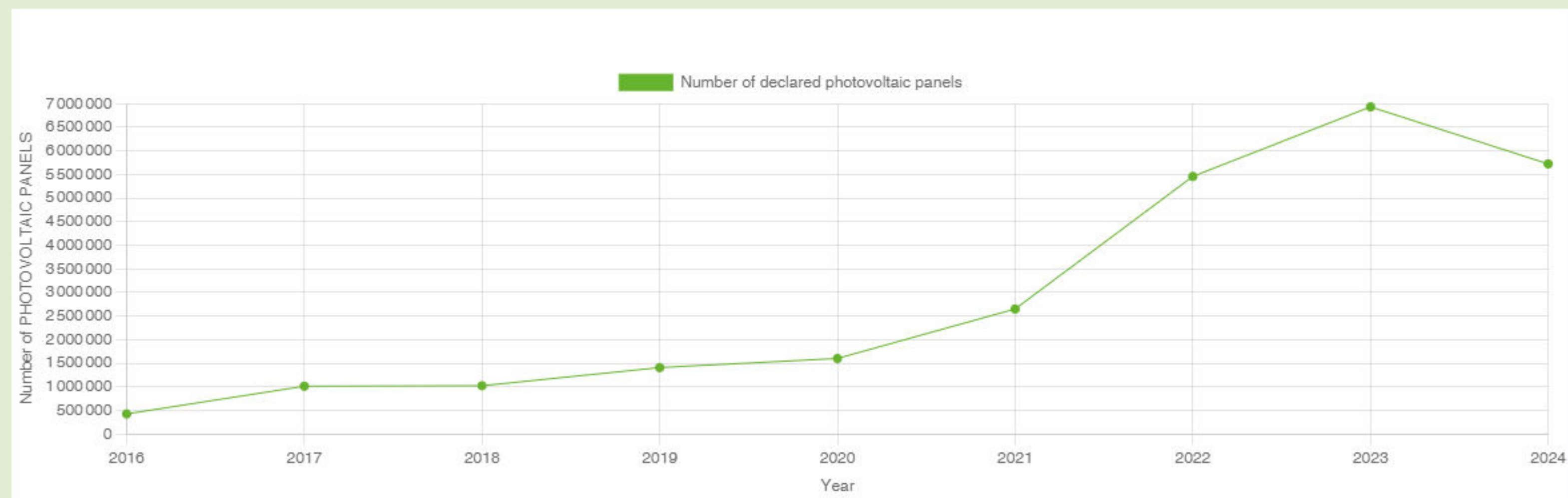


02 Photovoltaic panels put on the Italian market in 2024

Solar Panel Launches 2024: Growth and Responsibility

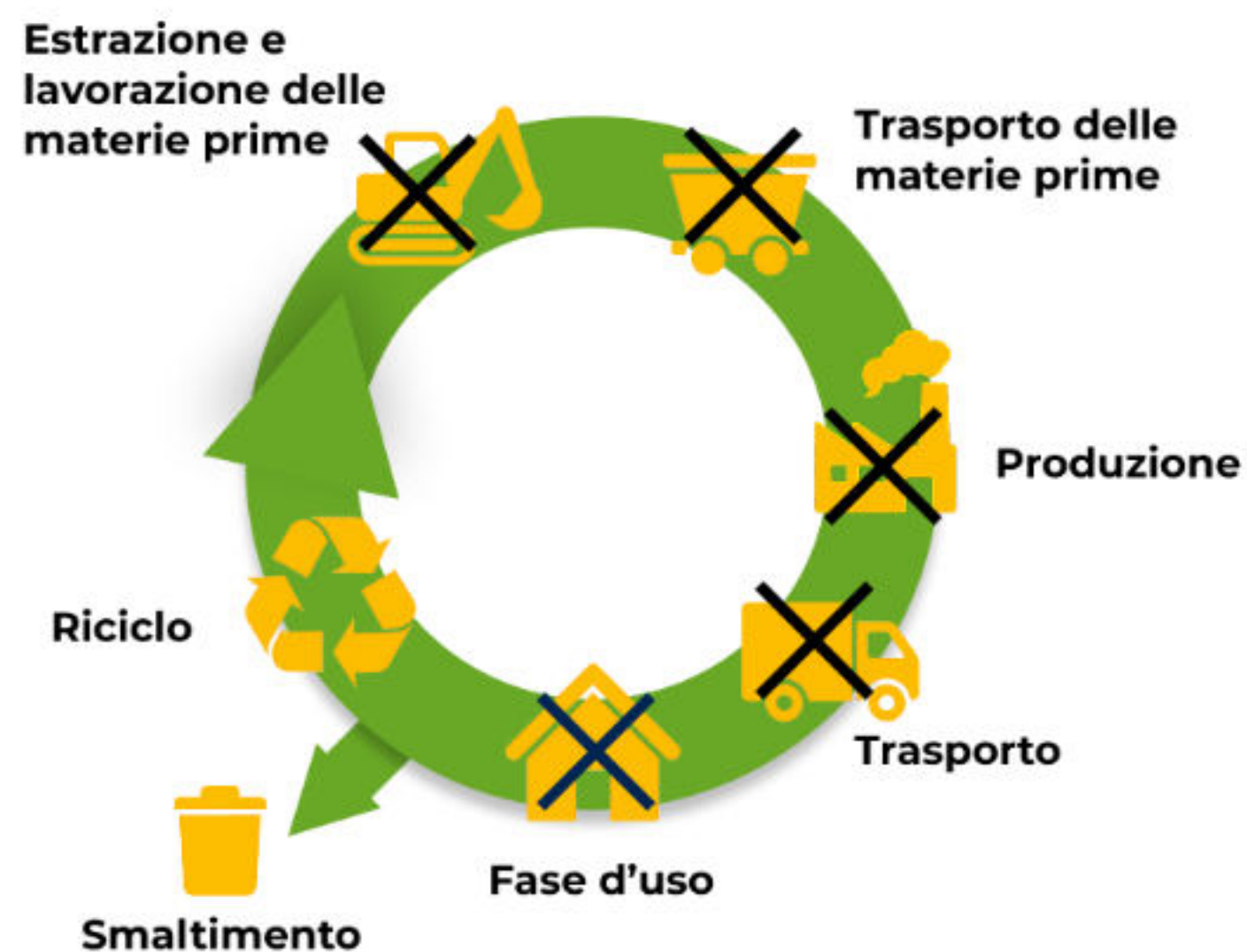
In 2024, companies affiliated with PV CYCLE ITALIA declared the placement of 6 million photovoltaic panels on the market. Although this figure is slightly lower than the record set in 2023, reflecting a modest decline in the photovoltaic market, it remains substantial and confirms the sector's solid presence in Italy. In recent years, there has been a significant increase—from less than half a million panels in 2016 to over six million in 2024—demonstrating rapid sector growth and the increasing attention companies are paying to environmental regulations.

Extended Producer Responsibility plays a fundamental role by ensuring the proper management of panels even at the end of their life. PV CYCLE ITALIA supports companies throughout this process, promoting transparency and sustainability in waste management. Thus, the 2024 figure represents not just a number but a concrete commitment to more responsible management and a sustainable future.



LCA: Environmental Impacts of End-of-Life Management

Life Cycle Assessment refers to the collection and evaluation of inputs, outputs, and potential environmental impacts associated with a product, service, or organization throughout its life cycle, from the extraction of raw materials to end-of-life management.



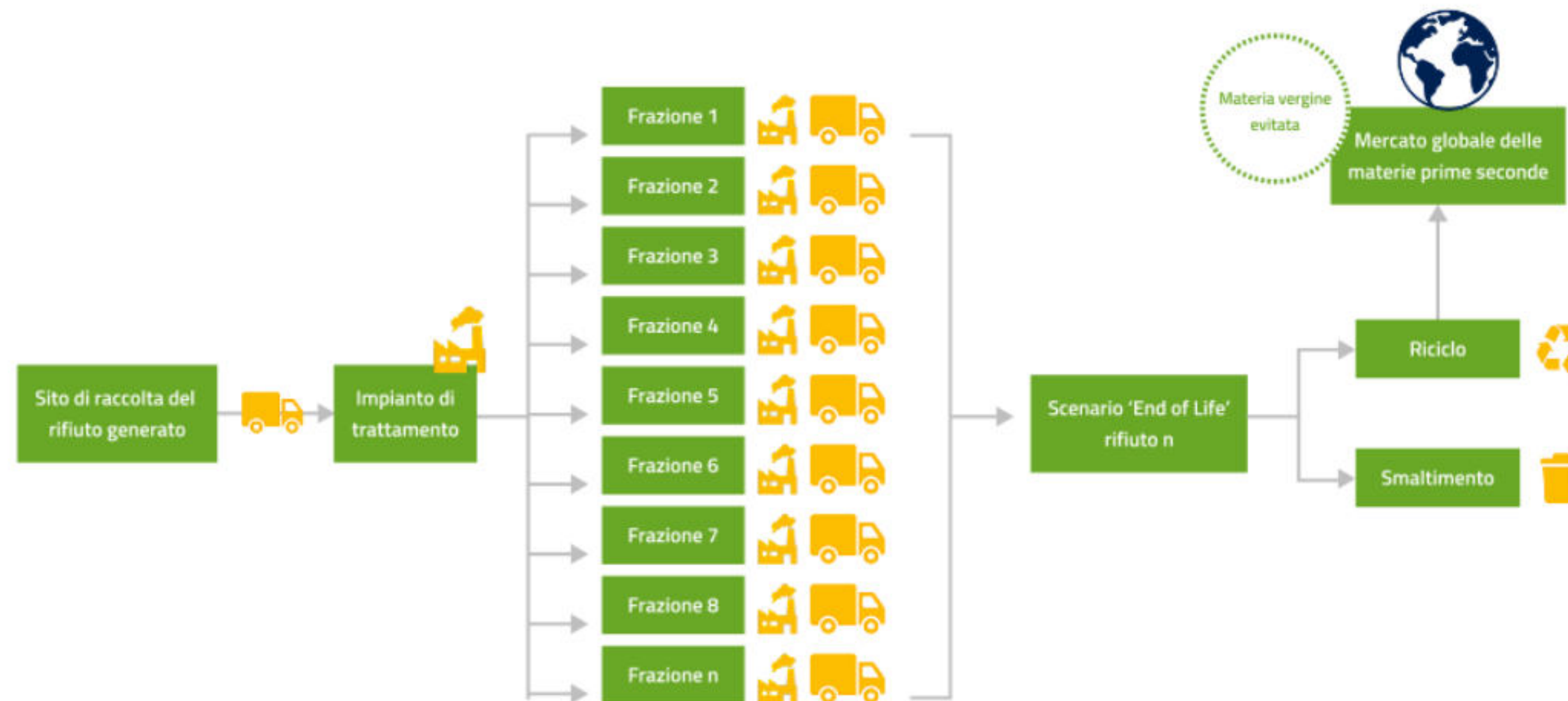
In this case, the study analyzes the life cycle of waste. Therefore, it begins not with the extraction of raw materials, but with the collection of waste, and ends with its final treatment, whether through the recovery of secondary raw materials (SRMs) or disposal.

The end-of-life LCA is carried out using the "avoided product" approach, which considers, in addition to the net impacts of waste treatment and related fractions, the quantity of material recovered based on the recycling efficiency of the treatment plants.

The aim of the study was to assess the environmental impacts resulting from the end-of-life management of professional photovoltaic panels and household WEEE (Waste Electrical and Electronic Equipment) managed by PV CYCLE ITALIA in 2024.

Overview of the flows considered

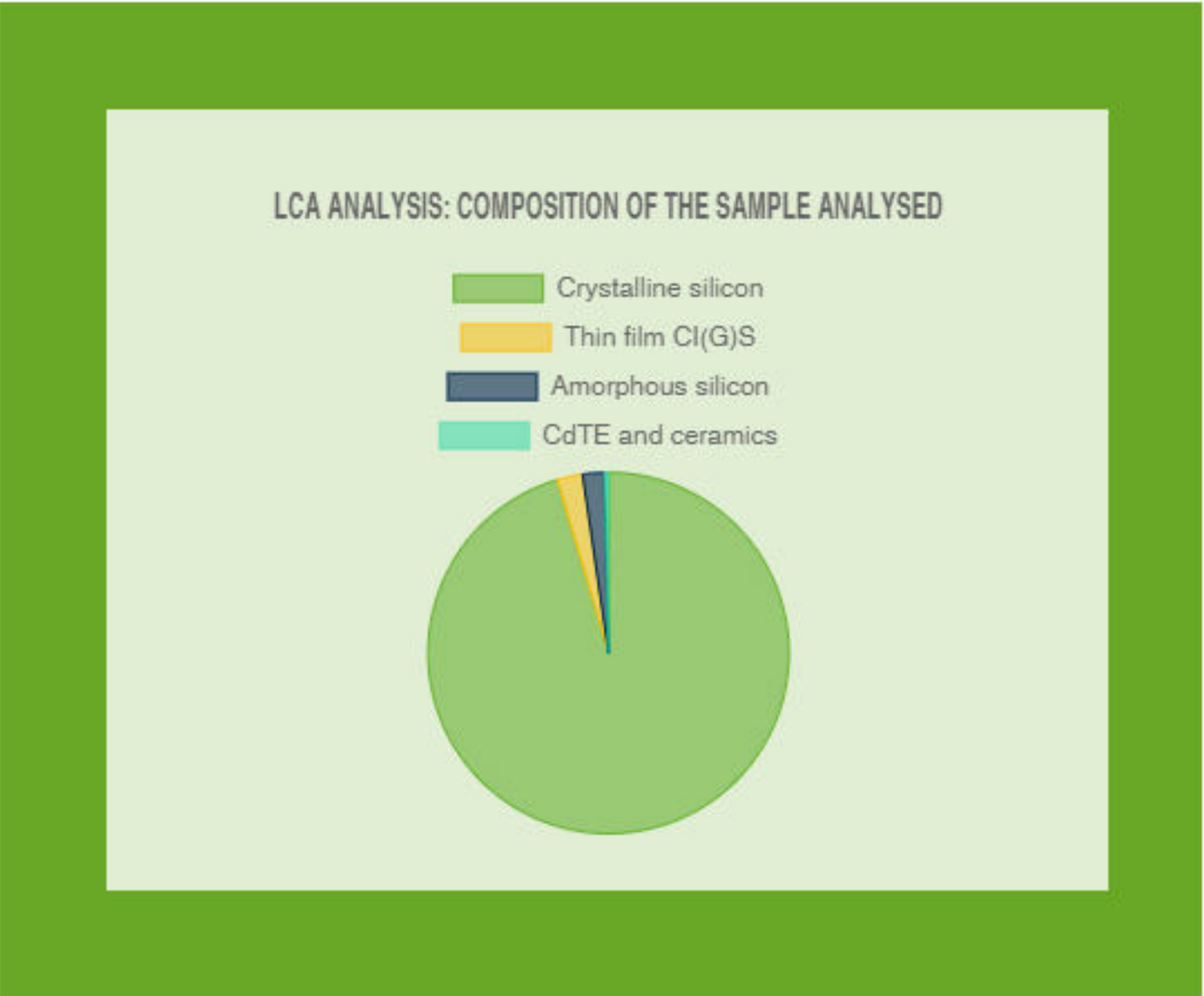
Overview of the flows considered within the scope of the PV CYCLE ITALIA 2024 study, by waste type and fraction.



LCA Analysis: composition of the sample analyzed

The total amount of photovoltaic panels managed by PV CYCLE ITALIA in 2024 is **4,124.5** tons:

- **95.4%** corresponds to **crystalline silicon** technologies (monocrystalline and polycrystalline);
- **2.3%** corresponds to **CI(G)S thin-film** technology;
- **1.9%** corresponds to **amorphous silicon** technology;
- **0.4%** corresponds to **CdTe and ceramic** technologies.



Type of photovoltaic panel	KG managed by PV CYCLE ITALIA in 2024	Number of pieces	% of total panels
Crystalline silicon	3934871	163469	95.4%
Thin film CI(G)S	94471	6186	2.3%
Amorphous silicon	77173	3676	1.9%
CdTE and ceramics	17970	1198	0.4%
Total	4124485	174529	100%

LCA Analysis: the end-of-life of professional-origin crystalline silicon photovoltaic panels

| PV CYCLE ITALIA managed **3,934** tons of crystalline silicon photovoltaic panels.

The total avoided impact, thanks to the treatment efficiencies of the plants, amounts to **-8,052,516.6** kg of **CO₂ equivalent**.

This value corresponds to the life cycle emissions of **1,000 medium-sized Euro 5 gasoline cars**, each traveling **30,000** kilometers.

Fraction	Crystalline Silicon PV (c-Si)
Copper	1.9%
Aluminium	17.5%
Plastic	14.4%
Glass	66.2%

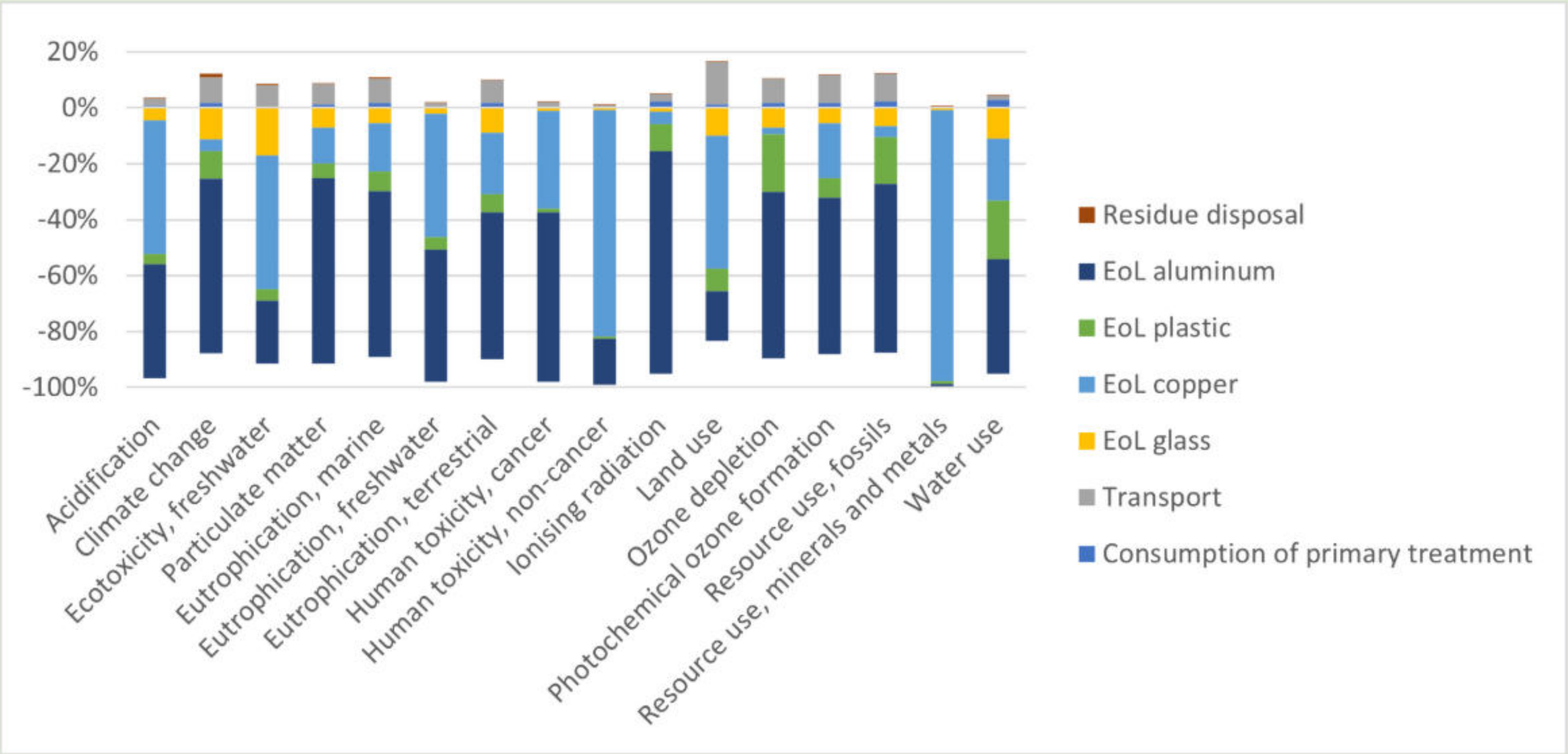
The end-of-life impact analysis of crystalline silicon photovoltaic panels highlights an energy saving of **-101,575.2** GJ, equivalent to the average annual consumption of approximately **10,450** Italian households.

Regarding material consumption, PV CYCLE ITALIA achieves an annual saving of **-825.7** kg Sb equivalent for crystalline silicon panels.

The process enables the recovery of various materials, including aluminum, copper, glass, and plastic.

Contribution Analysis for the Crystalline Silicon Photovoltaic Panel

The bar chart illustrates the contribution of each process stage to either the environmental impact or benefit within a given impact category.



LCA Analysis: the end-of-life of professional-origin thin film photovoltaic panels

PV CYCLE ITALIA managed **94** tons of thin-film photovoltaic panels.

The total avoided impact, thanks to the treatment efficiencies of the plants, amounts to **-31,202.9** kg of **CO₂ equivalent**.

This value corresponds to the emissions of **one mid-sized Euro 5 gasoline car** traveling 116,418 km.

Fraction	CI(G)S Thin-Film PV
Copper	0.1%
Aluminium	0.3%
Plastic	12.0%
Glass	87.0%
Indium-gallium-selenide	0.1%

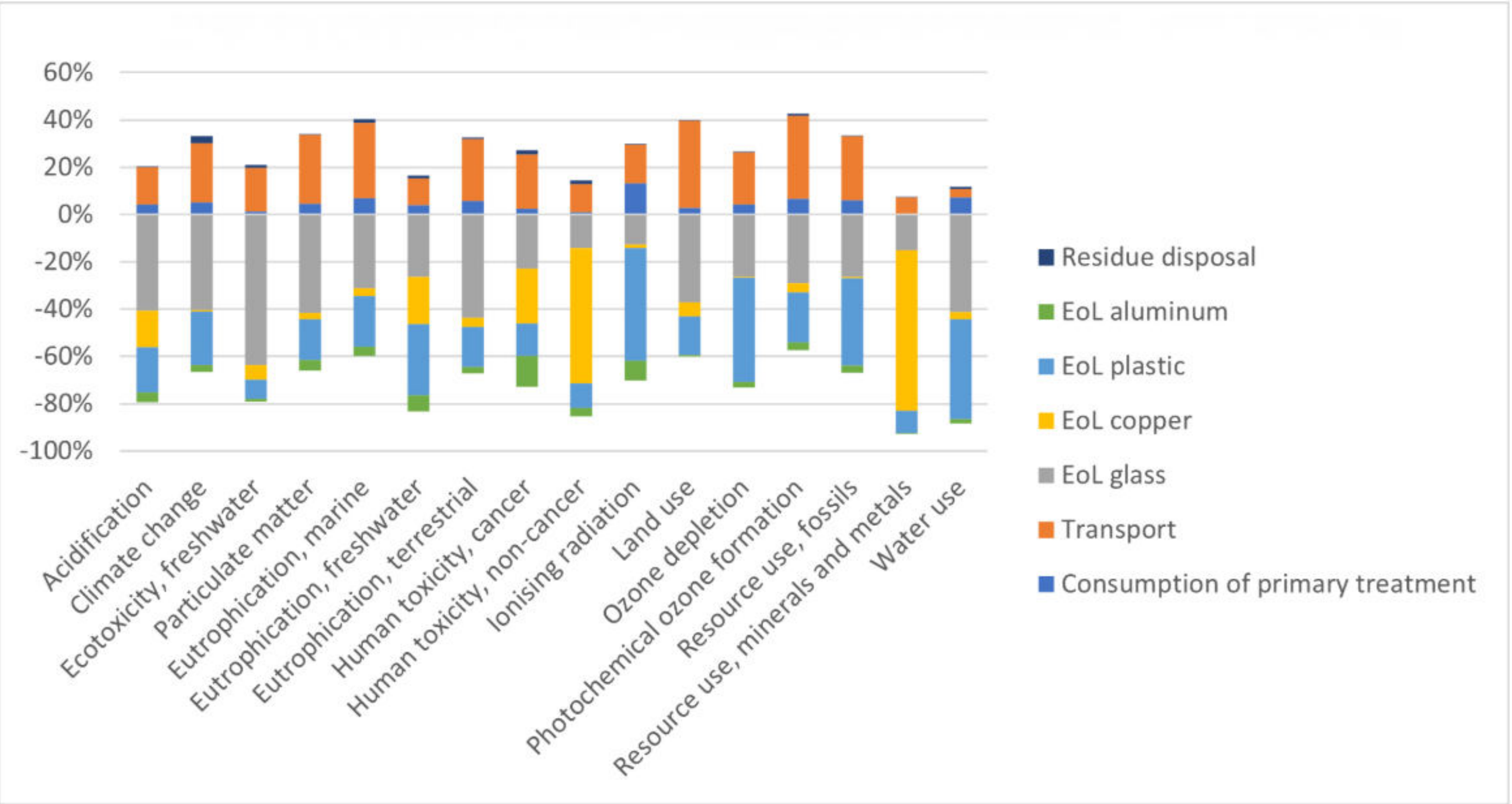
The end-of-life impact analysis of CI(G)S thin-film photovoltaic panels highlights an energy saving of **-407.9** GJ, equivalent to the average annual consumption of approximately **42** Italian households.

Regarding material consumption, PV CYCLE ITALIA achieves an annual saving of **-1.3** kg Sb equivalent for thin-film panels.

Thin-film photovoltaic panels are composed mainly of glass (87% by mass).

Contribution Analysis for the Cl(G)S Thin-Film Photovoltaic Panel

The bar chart illustrates the contribution of each process stage to either the environmental impact or benefit within a given impact category.



LCA Analysis: the end-of-life of professional-origin amorphous silicon photovoltaic panels

PV CYCLE ITALIA managed **77** tons of amorphous silicon photovoltaic panels.

The total avoided impact, thanks to the treatment efficiencies of the plants, amounts to **-12,531.8 kg of CO₂ equivalent**.

This value corresponds to the emissions of **one mid-sized Euro 5 gasoline car** traveling 46,642 km.

Fraction	Amorphous Silicon (a-Si) PV
Copper	0.3%
Aluminium	0.3%
Plastic	0.7%
Glass	97.3%
Other	1.0%

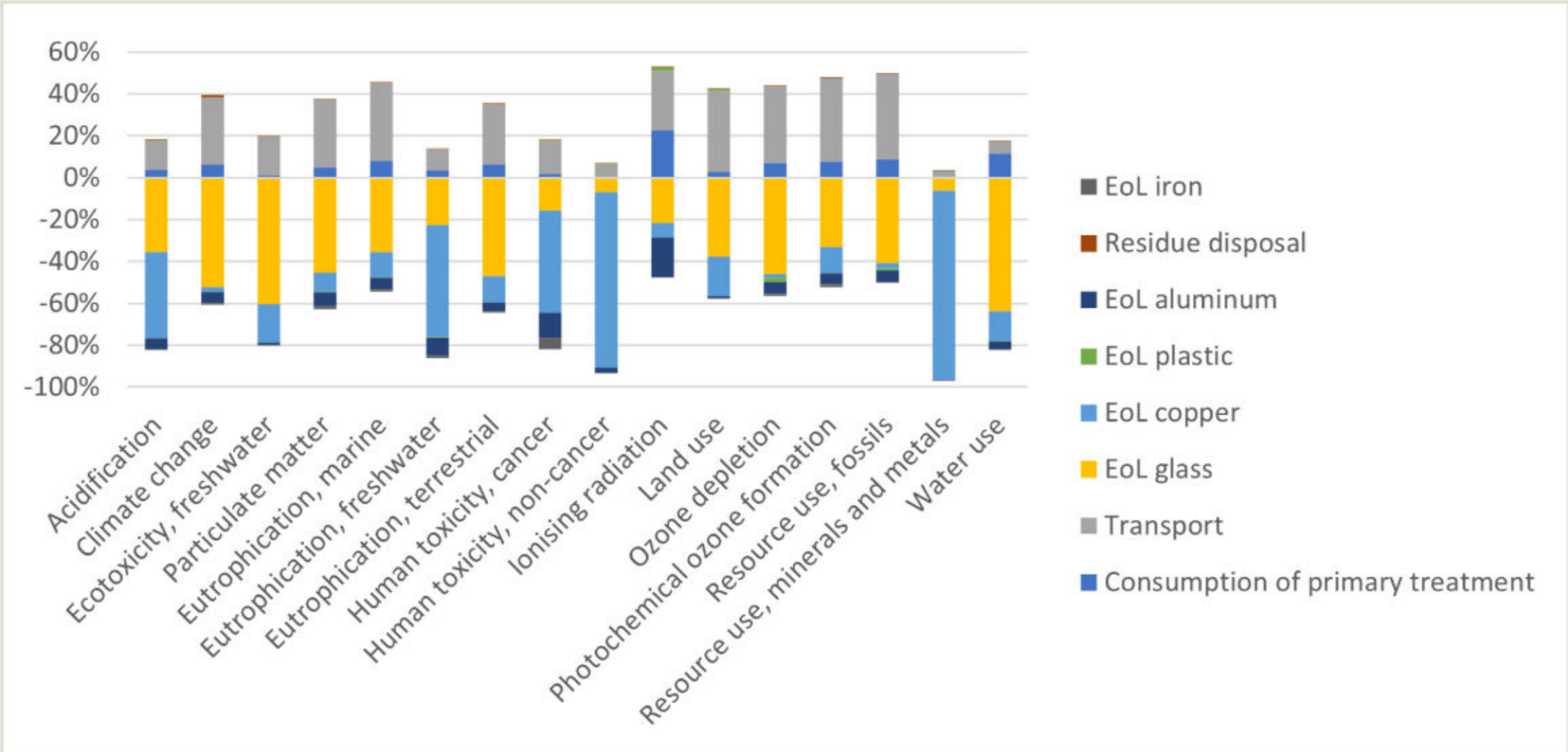
The end-of-life impact analysis of amorphous silicon photovoltaic panels highlights an energy saving of **-4.0 GJ**, equivalent to the average consumption of about **one Italian family** over five months.

Regarding material consumption, PV CYCLE ITALIA achieves an annual saving of **-12.6 kg Sb equivalent** for amorphous silicon panels.

The amorphous silicon photovoltaic panels are composed mainly of glass (97.3%).

Contribution Analysis for the Amorphous Silicon Photovoltaic Panel

The bar chart illustrates the contribution of each process stage to either the environmental impact or benefit within a given impact category.

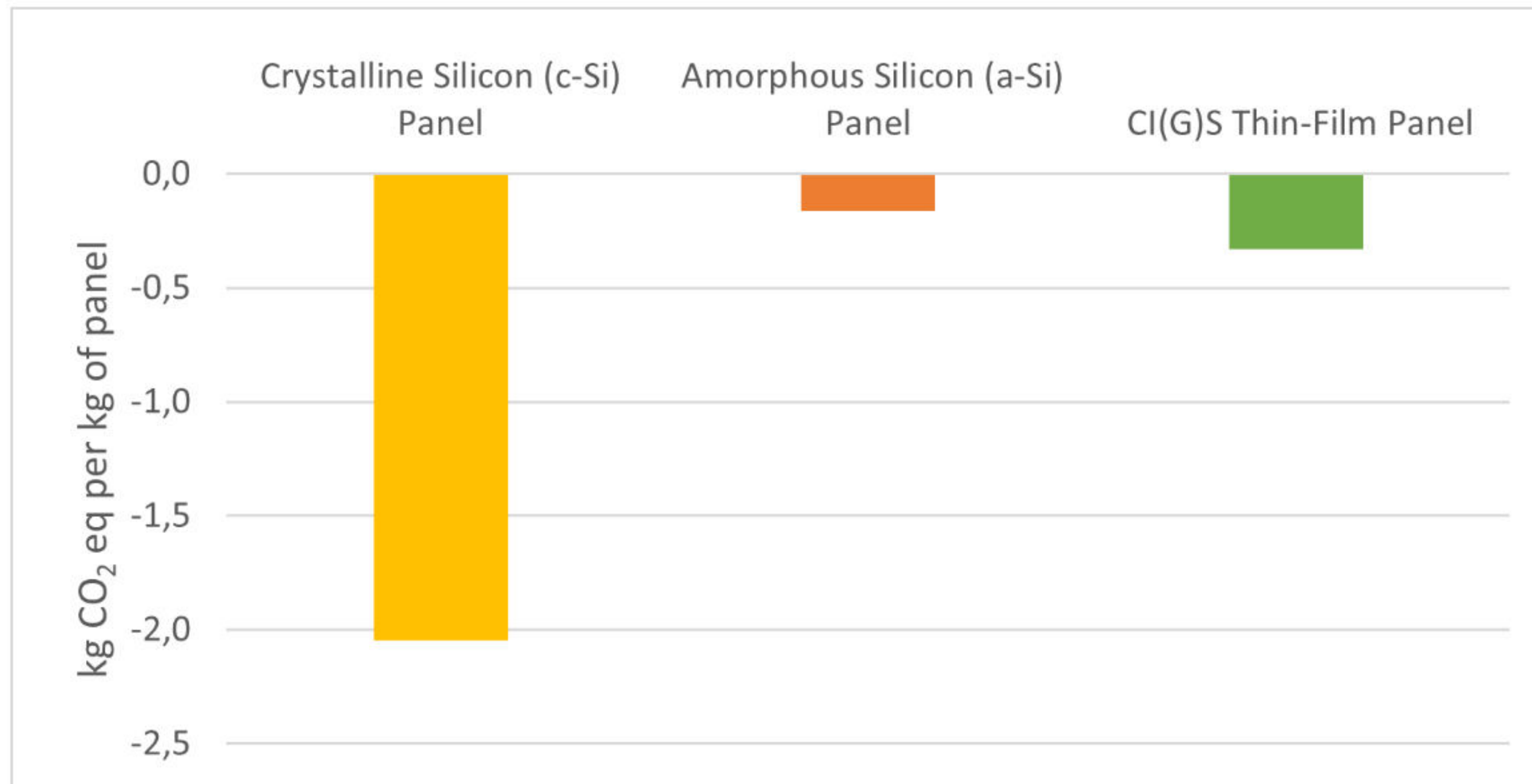


Analysis results: climate change

The comparative analysis highlights that the end-of-life treatment of crystalline silicon panels generates greater environmental benefits compared to amorphous silicon and CI(G)S thin-film panels.

The total avoided CO₂ equivalent emissions are equivalent to those produced by driving approximately 30 million kilometers in a mid-sized Euro 5 gasoline car.

Comparison results among the three types of panels for the climate change impact category





04 Overview of household WEEE groups

Household WEEE are divided into five Groups:

- **R1:** Refrigeration appliances (refrigerators, freezer, air conditioners, etc.)
- **R2:** Large household appliances (washing machines, dishwashers, ovens, hobs, etc.)
- **R3:** TVs (Monitors and screens)
- **R4:** Various electronic products (small appliances, consumer electronics, IT and telecommunications, etc.)
- **R5:** Light sources

The quantities of household WEEE managed by PV CYCLE ITALIA in 2024 are shown in the following table:

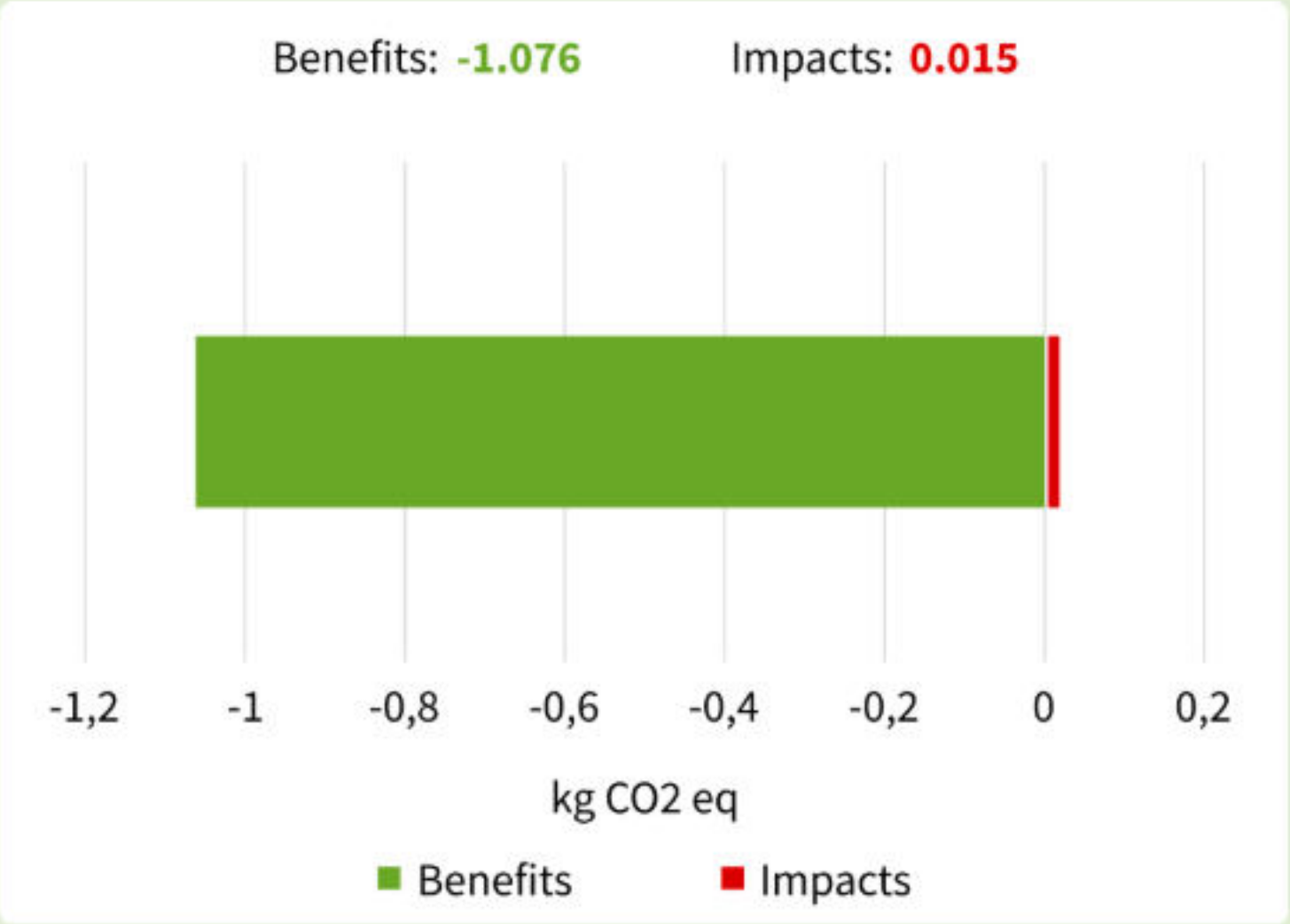
WEEE group	KG managed by PV CYCLE ITALIA in 2024	% of total	tons of CO ₂ eq saved by recycling	GJ of energy saved by recycling	KG of Sb eq
R1	30110	0,36%	-32	-290	-2
R2	85985	1,02%	-75	-685	-3
R3	9069	0,11%	-2	-61	-1
R4	8342247	98,51%	-5823	-94000	-806
R5	822	0,01%	-0,25	1	-0.3
Total	8468233	100.00%	-5932	-95034	-812

Household WEEE Group R1

PV CYCLE ITALIA managed **30.11** tons of **household WEEE Group R1**.

The total avoided impact, thanks to the treatment efficiencies of the plants, amounts to **-31,911.65** kg of **CO₂ equivalent**.

This value corresponds to the life cycle emissions of **a mid-sized Euro 5 gasoline car** traveling **119,075** kilometers.



The end-of-life analysis of household WEEE Group R1 highlights an **energy saving** of **-290** GJ and a **raw material saving** of **-1.5** kg Sb equivalent, thanks to treatment and recycling activities.

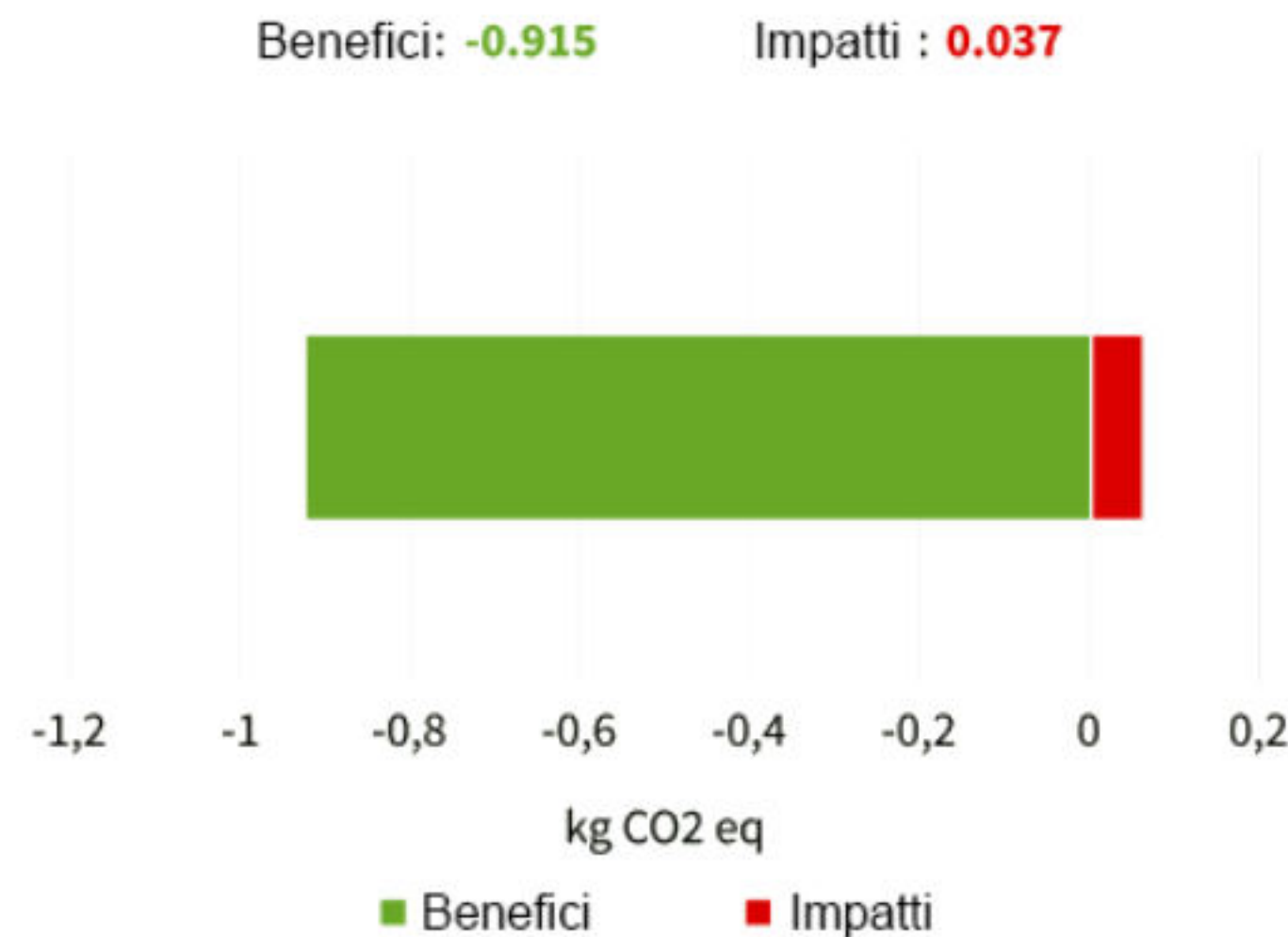
Fraction	kg CO ₂ eq/kg	% benefits	% impacts
Steel	-0.005	0%	
Aluminium	-0.22	21%	
Iron	-0.663	62%	
Wood	-0.001	0%	
ABS Plastic	-0.001	0%	
PP Plastic	-0.012	1%	
PS Plastic	-0.117	11%	
Polyurethane	-0.011	1%	
Copper	-0.042	4%	
Glass	-0.004	0%	
CFC	0.014		92%
Compressor oil	0.001		8%

Household WEEE Group R2

PV CYCLE ITALIA managed **85.98** tons of **household WEEE Group R2**.

The total avoided impact, thanks to the treatment efficiencies of the plants, amounts to **-75,432.78 kg of CO₂ equivalent**

This value corresponds to the life cycle emissions of **a mid-sized Euro 5 gasoline car** traveling **281,466 kilometers**.



The end-of-life analysis of household WEEE Group R2 highlights an **energy saving** of **-684.6 GJ** and a **raw material saving** of **-3.1 kg Sb equivalent**, thanks to treatment and recycling activities.

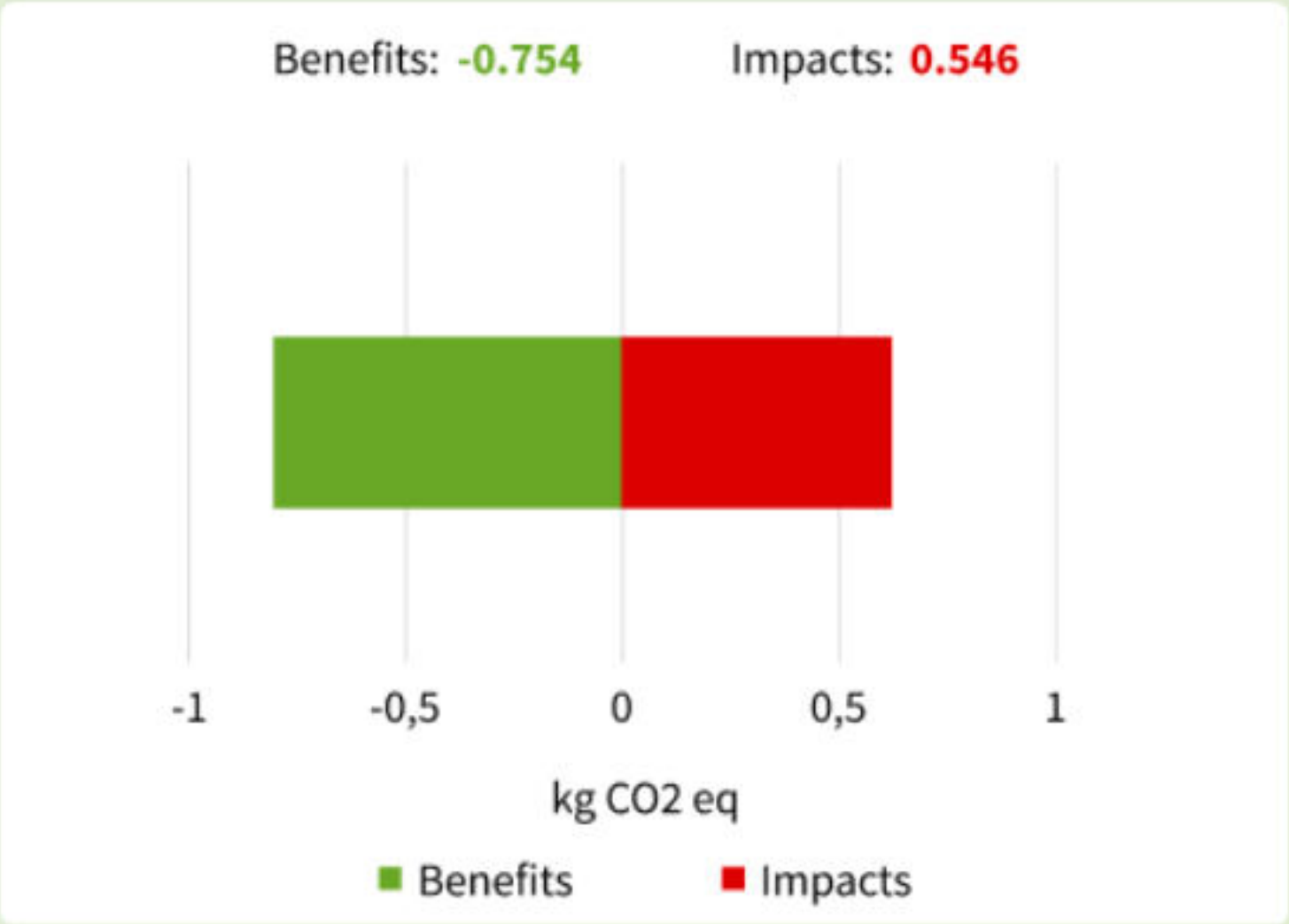
Fraction	kg CO ₂ eq/kg	% benefits	% impacts
Steel	-0,022	2%	
Aluminium	-0,144	16%	
Iron	-0,714	78%	
Wood	-0,001	<1%	
PP Plastic	-0,002	<1%	
Copper	-0,032	3%	
Cement	0,012		33%
ABS Plastic	0,01		27%
PA Plastic	0,003		7%
PS Plastic	0,011		30%
Glass	0,001		3%

Household WEEE Group R3

PV CYCLE ITALIA managed **9.06** tons of **household WEEE Group R3**.

The total avoided impact, thanks to the treatment efficiencies of the plants, amounts to **-1,886.37** kg of **CO₂ equivalent**.

This value corresponds to the life cycle emissions of **a mid-sized Euro 5 gasoline car** traveling **7,039** kilometers



The end-of-life analysis of household WEEE Group R3 highlights an **energy saving** of **-69.9** GJ and a **raw material saving** of **-0.6** kg Sb equivalent, thanks to treatment and recycling activities.

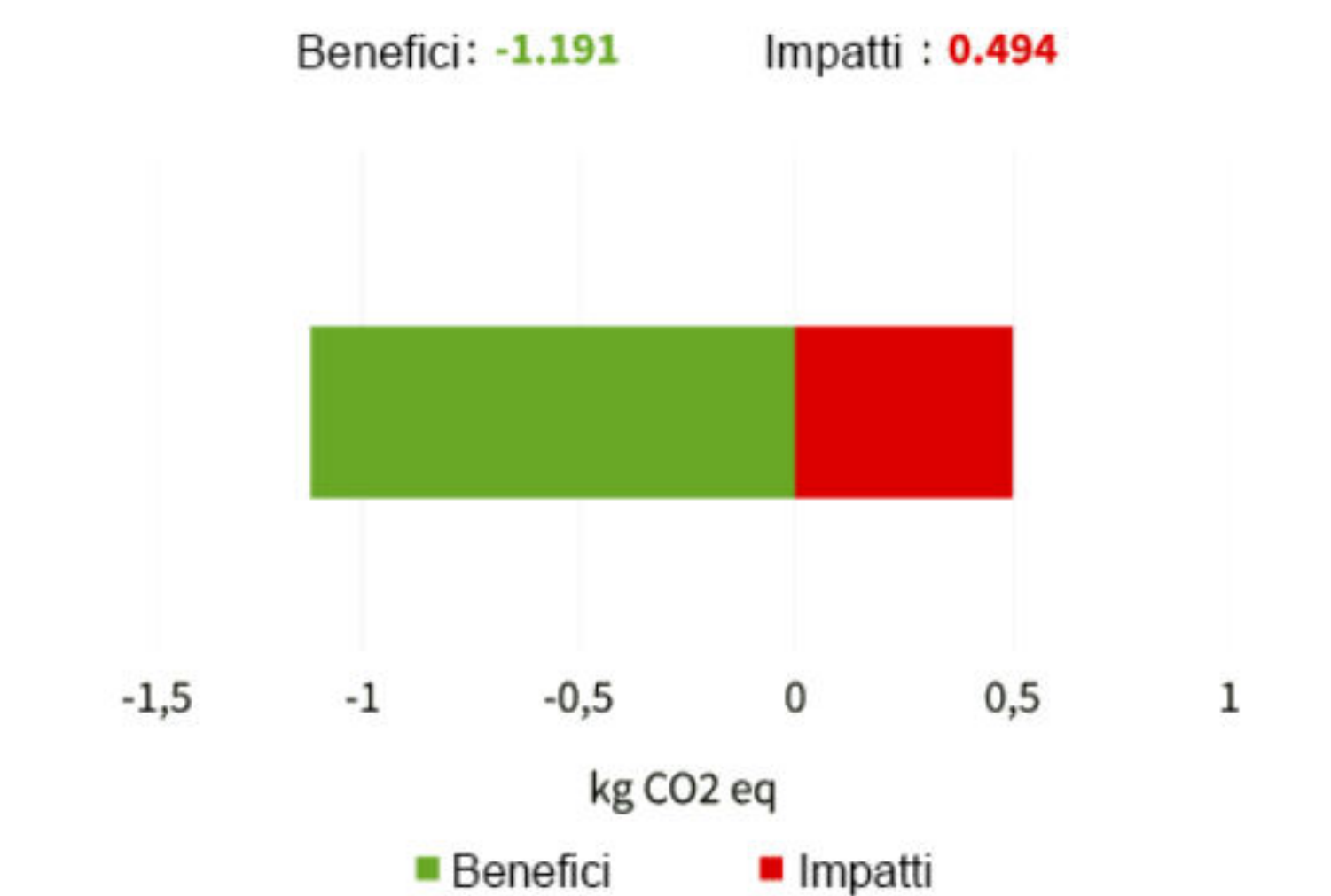
Fraction	kg CO ₂ eq/kg	% benefits	% impacts
Steel	-0.111	15%	
Aluminium	-0.236	31%	
Iron	-0.111	15%	
Wood	-0.001	0%	
ABS Plastic	-0.173	23%	
Copper	-0.122	16%	
Glass	0.035		6%
PCBs	0.029		5%
PC/ABS Plastic	0.336		62%
PMMA Plastic	0.145		26%
PS Plastic	0.001		0%

Household WEEE Group R4

PV CYCLE ITALIA managed **8,342.24** tons of **household WEEE Group R4**.

The total avoided impact, thanks to the treatment efficiencies of the plants, amounts to **-5,822,789.94** kg of **CO₂ equivalent**.

This value corresponds to the life cycle emissions of **a mid-sized Euro 5 gasoline car** traveling **22,000,000** kilometers.



The end-of-life analysis of household WEEE Group R4 highlights an **energy saving** of **-94,074.0** GJ and a **raw material saving** of **-806** kg Sb equivalent, thanks to treatment and recycling activities.

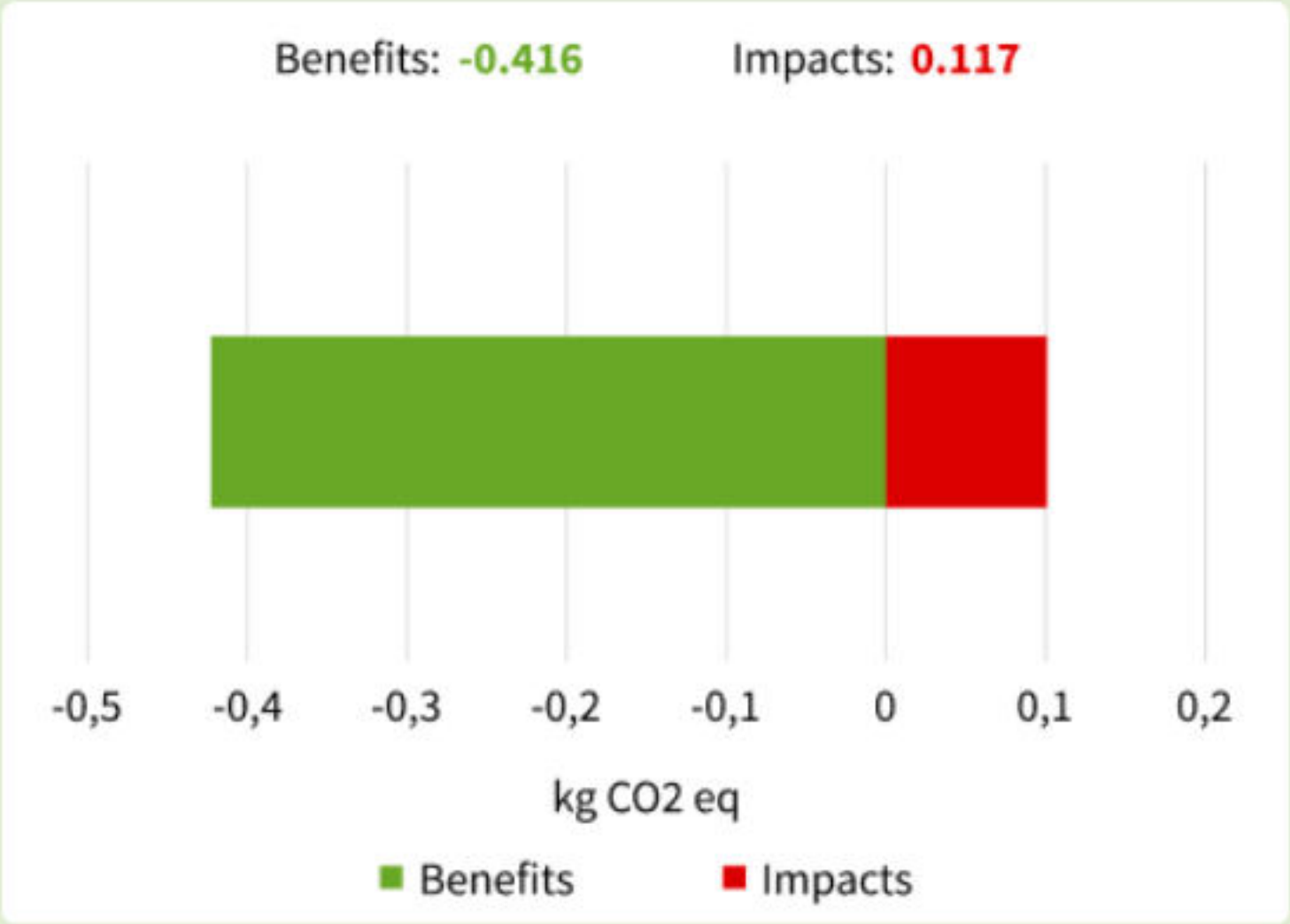
Fraction	kg CO ₂ eq/kg	% benefits	% impacts
Steel	-0.027	2%	
Aluminium	-0.401	34%	
Iron	-0.505	42%	
PS Plastic	-0.113	10%	
Copper	-0.145	12%	
Glass	0.002		0%
Wood	0.005		1%
ABS Plastic	0.337		68%
PC/ABS Plastic	0.15		30%

Household WEEE Group R5

PV CYCLE ITALIA managed **0.82** tons of **household WEEE Group R5**.

The total avoided impact, thanks to the treatment efficiencies of the plants, amounts to **-245.94** kg of **CO₂ equivalent**.

This value corresponds to the life cycle emissions of **a mid-sized Euro 5 gasoline car** traveling **917** kilometers.



The end-of-life analysis of household WEEE Group R5 highlights an **energy saving** of **-1.3** GJ and a **raw material saving** of **-0.03** kg Sb equivalent, thanks to treatment and recycling activities.

Fraction	kg CO ₂ eq/kg	% benefits	% impacts
Aluminium	-0.239	57%	
Iron and Steel	-0.028	7%	
PC Plastic	-0.047	11%	
Copper	-0.051	12%	
Glass	-0.051	12%	
PET Plastic	0.102		87%
Fluorescent powders	0.015		13%

In 2024, the environmental benefits of recycling photovoltaic panels and WEEE — both from professional and household sources — significantly exceeded the impacts associated with transport and treatment.

- **Avoided emissions:** 14,029 tons of CO₂ equivalent, equal to **52** million kilometers driven by a mid-sized Euro 5 gasoline car — a tangible contribution to the fight against climate change.
- **Fossil energy saved:** 197,021 GJ, equivalent to the annual consumption of 20,269 Italian households.
- **Raw materials saved:** 1,643 kg of rare metals (Sb equivalent), equivalent to the weight of 16 Statues of Liberty.

These figures clearly demonstrate that **material recovery makes sense**: it reduces emissions, cuts waste, and conserves resources

The circular economy is not just a sustainable option — it is a necessity.