

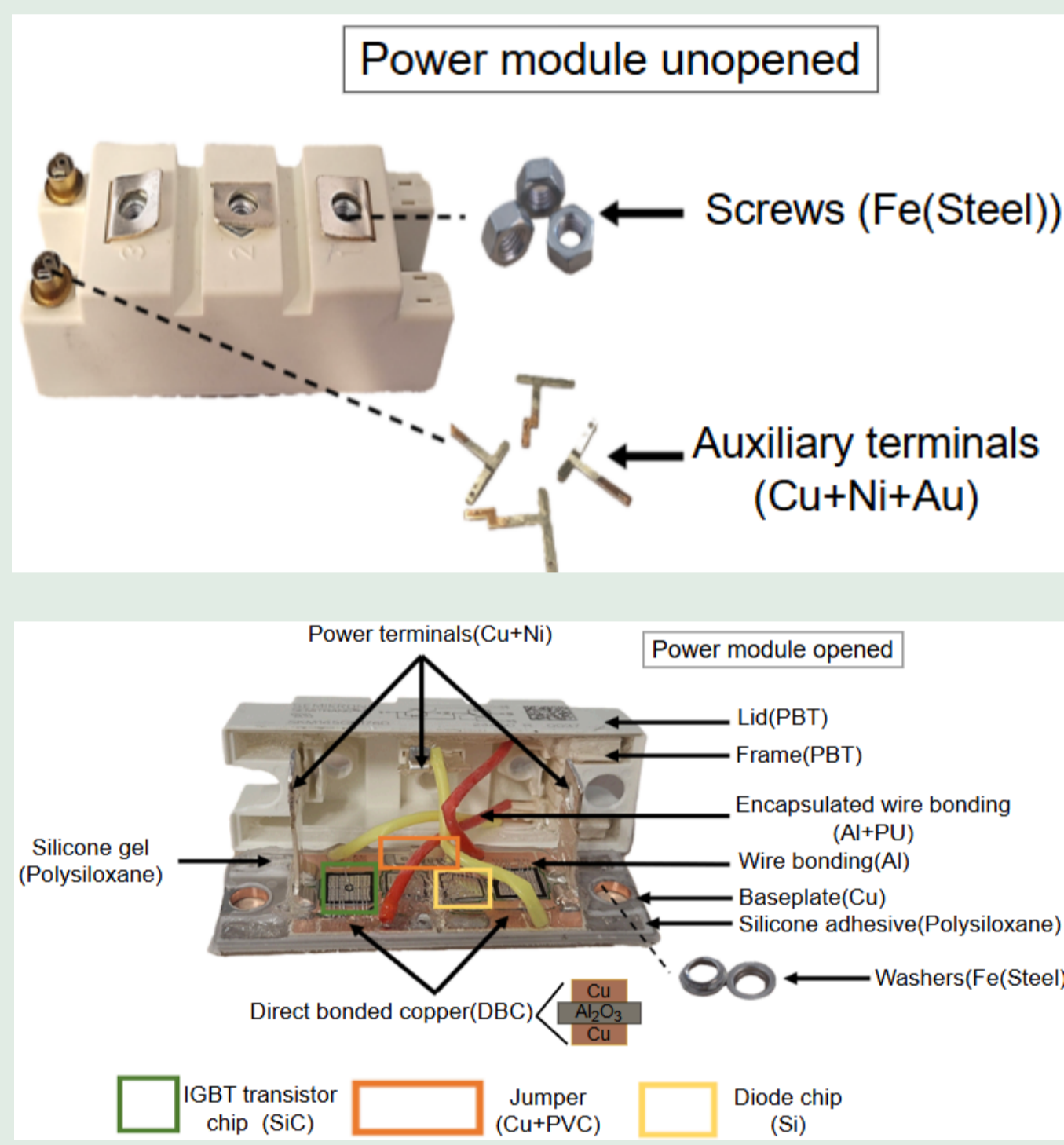
# Investigating Power Module Recycling

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## 1 Recycling challenges of power modules within WEEE

- Global WEEE generation reached **62 Mt** in 2022, while only **42.8%** was collected for recycling in Europe [1,2].
- WEEE generation is increasing faster than recycling, leading to a **declining recycling rate**.
- Power modules, highly integrated** and made of diverse materials, are **difficult to recycle**.

## 2 Material composition of a PM



Wide variety of materials

## 3 Material composition of PMs

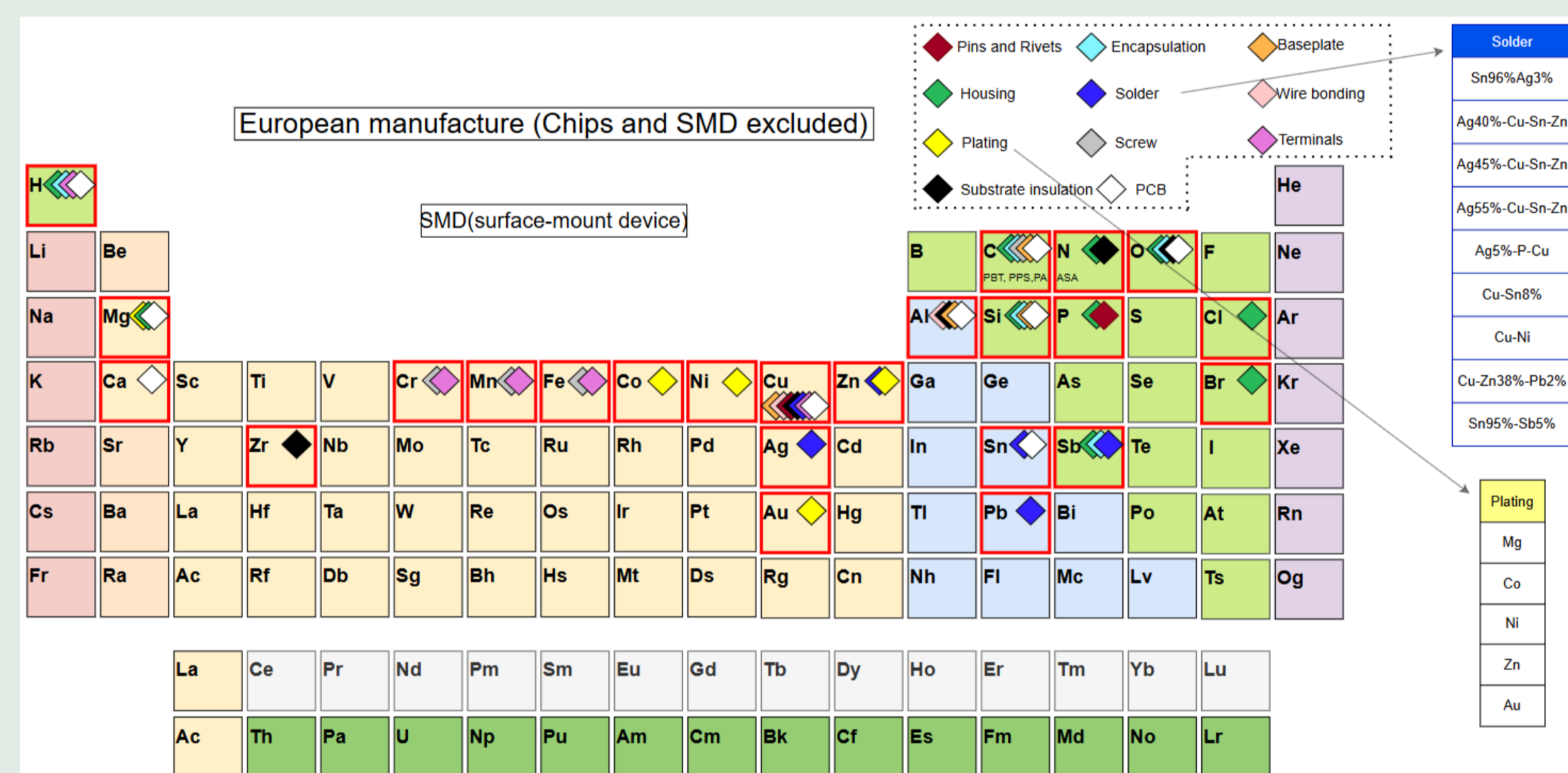


Fig4. Elements covered by all PMs manufactured by a European manufacturer. (Chips and SMD excluded)

- When different types of PMs are considered, the material complexity will increase substantially.

## 5 Life cycle assessment of waste PM recycling

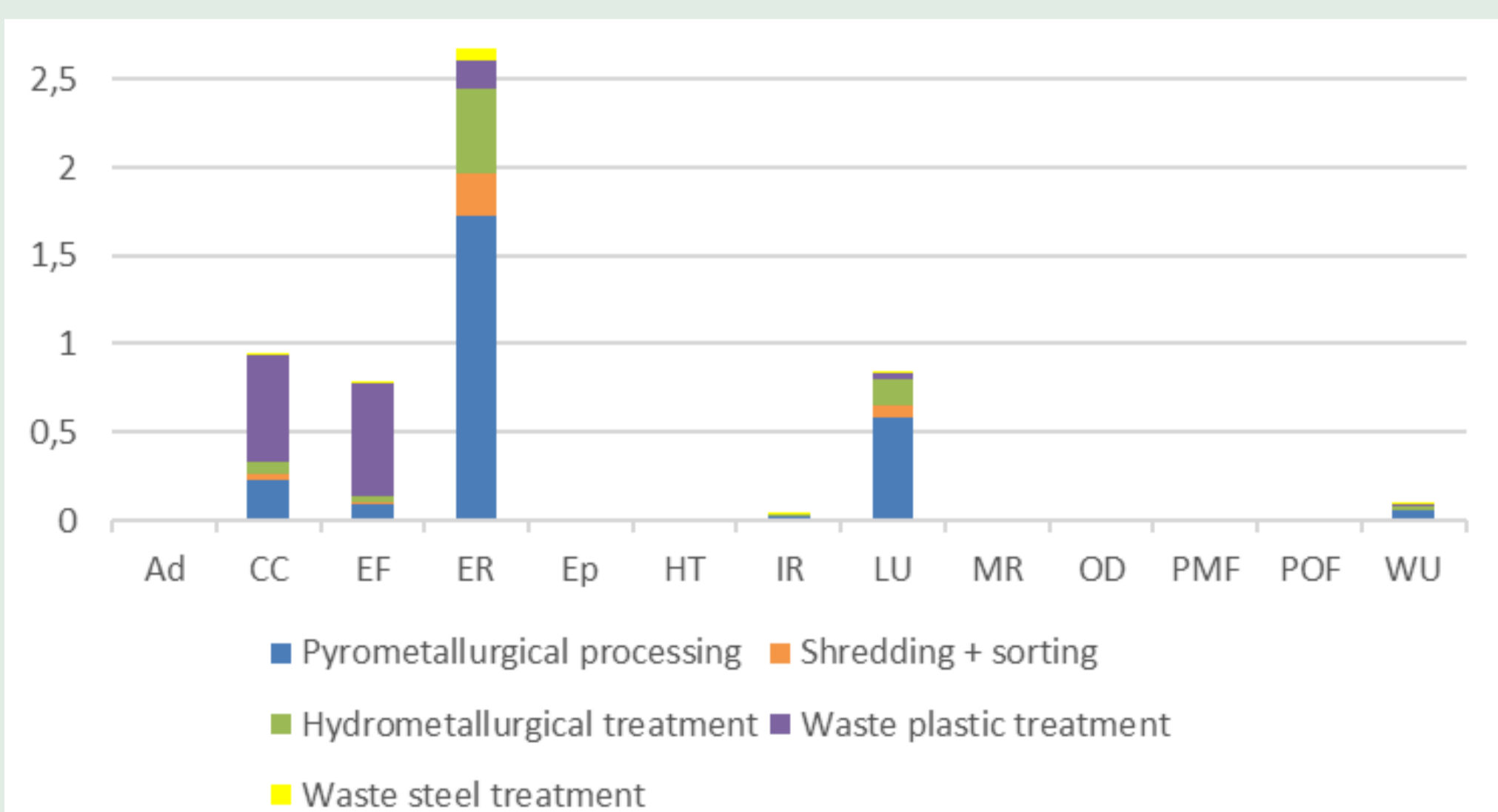


Fig6. Normalisation of environmental impacts of current recycling processes for different impact categories

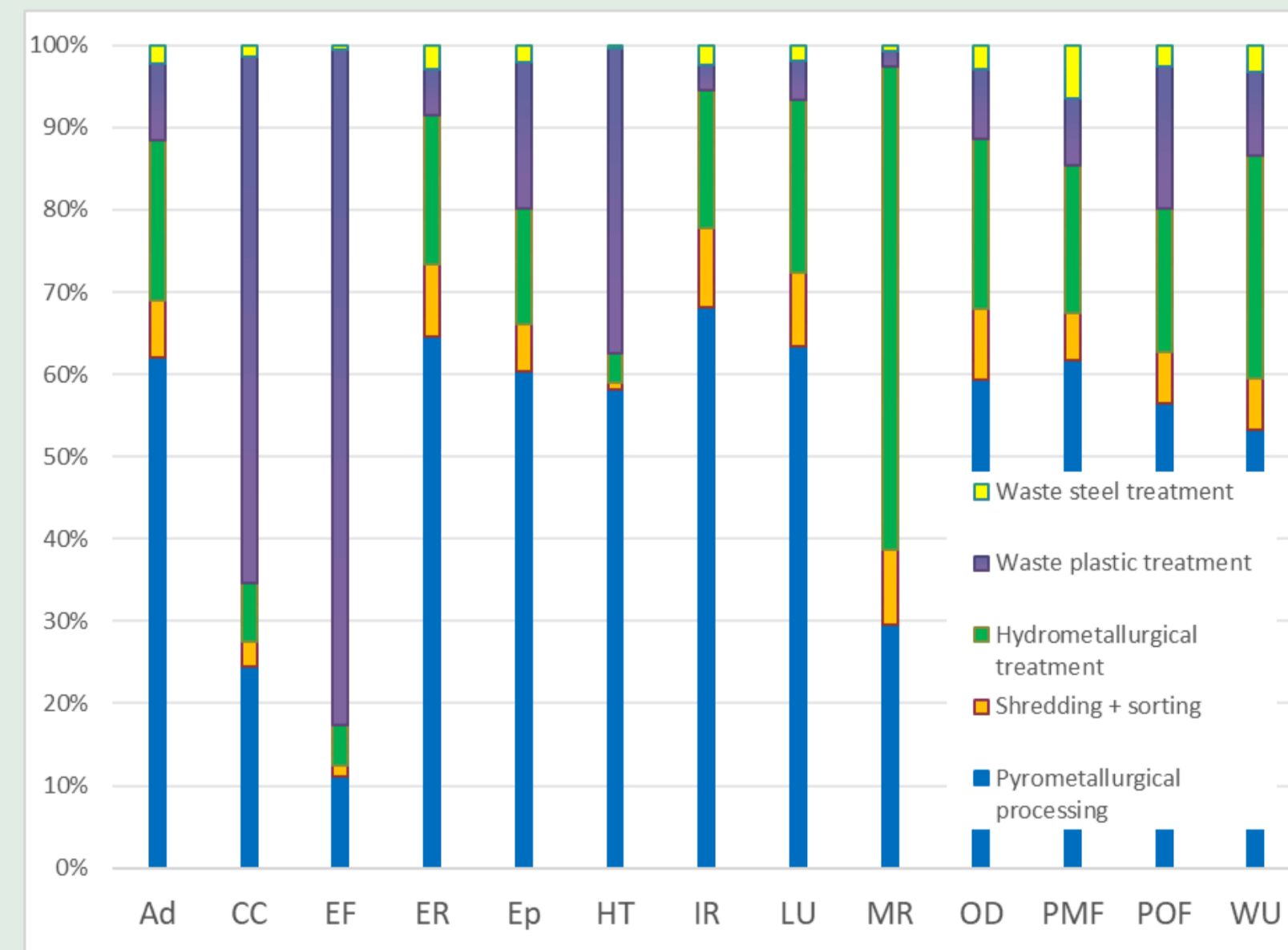


Fig7. Contribution of individual recycling processes to the environmental impact categories of waste PM recycling.

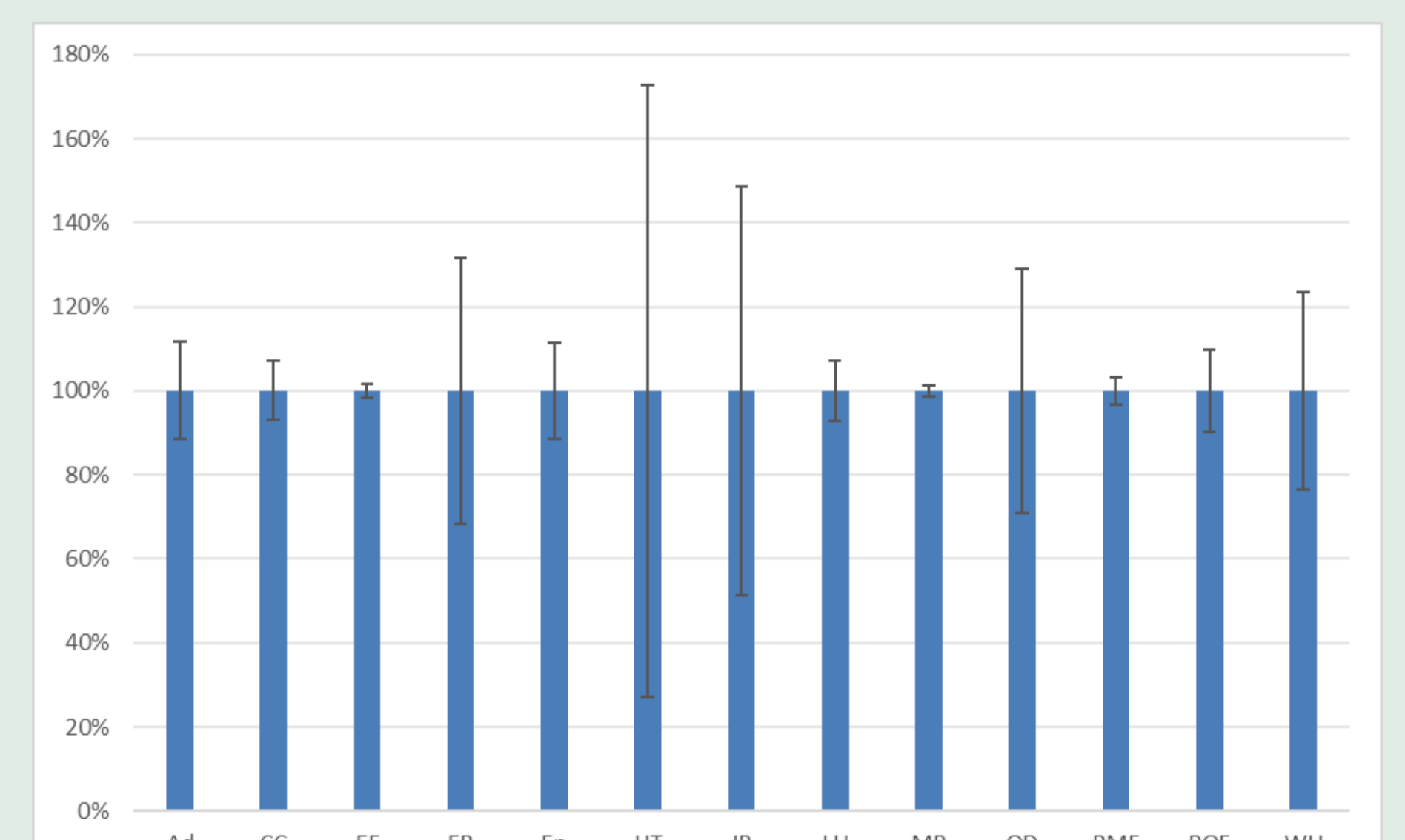


Fig8. Influence of inventory data uncertainties on the environmental impact results of waste PM recycling.

## 6 Conclusion

- Recycling impacts** are mainly driven by **energy-intensive processes**.
- Plastic thermal treatment** and **non-ferrous metal pyrometallurgy** are **key contributors**.
- Material **heterogeneity** and **incompatibility** increase **environmental impacts**.
- Further assessment is required to evaluate the potential benefits of design for recycling strategies on environmental impacts and material recovery.

## 7 Acknowledgement

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## 8 References

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