

# Electronic grade silicon wafer production: review and update of life cycle inventory data

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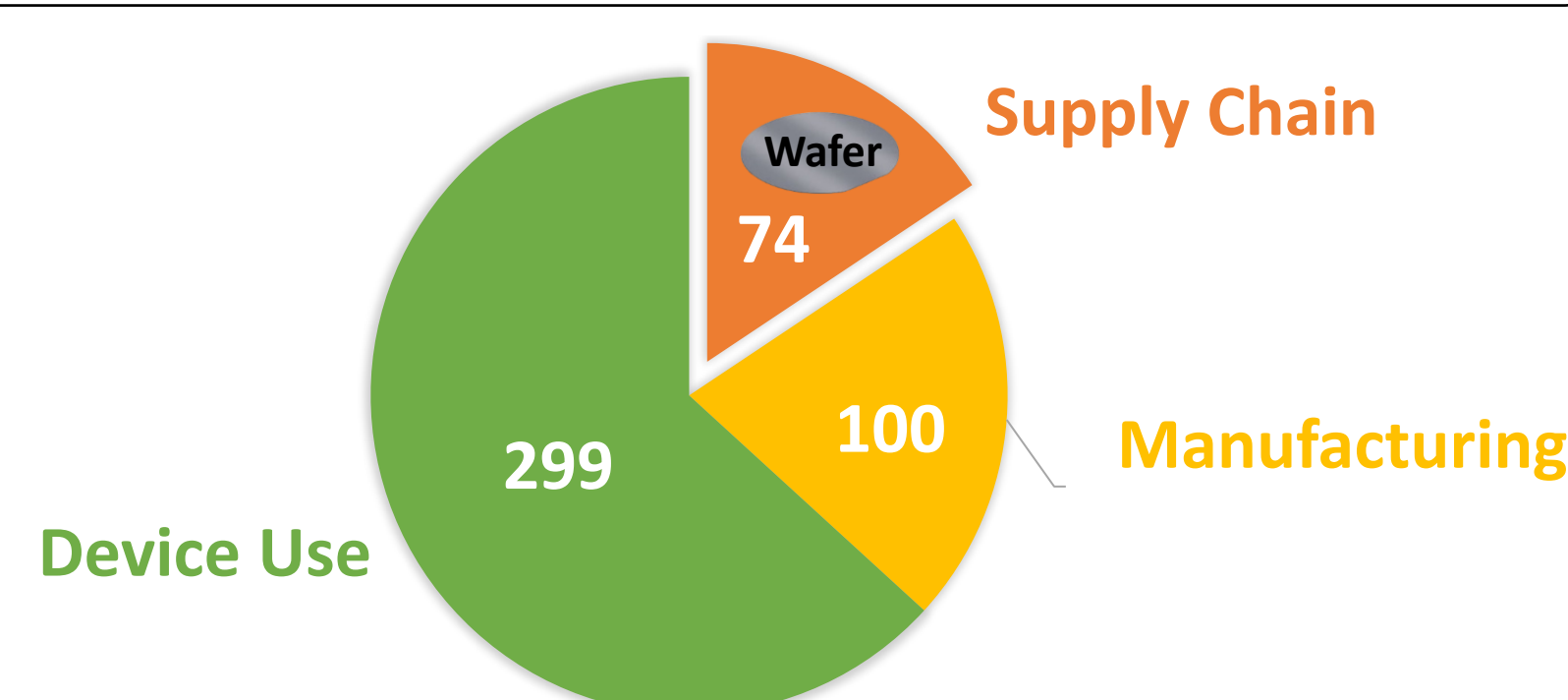
## Semiconductor manufacturing starts with Si wafers

In 2024

→ **280 million wafers**  
were processed globally

→ **100 million m2**  
of Si wafers used each year

Life cycle emissions of the semiconductor industry  
(Megatonnes CO<sub>2</sub>eq, 2021)



Source : SEMI Semiconductor Climate 14 Consortium; BCG Boston Consulting Group, 2023

## Objectives

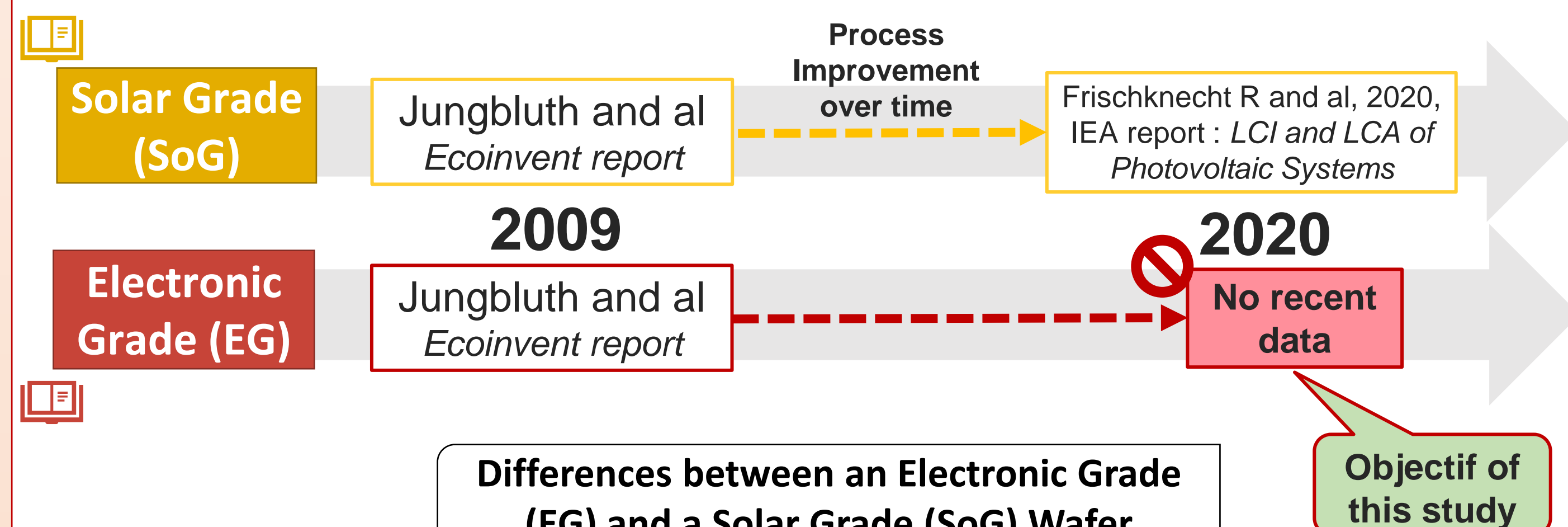


**Product Environmental Footprint (PEF) method :**  
Harmonized method with 16 environmental indicators

**SimaPro**  
**ecoinvent**

Life cycle inventory (LCI) update of  
the production of an **EG Si wafer**  
+  
Life cycle analysis (LCA)

## What we know on environmental impacts of Si wafers manufacturing ?

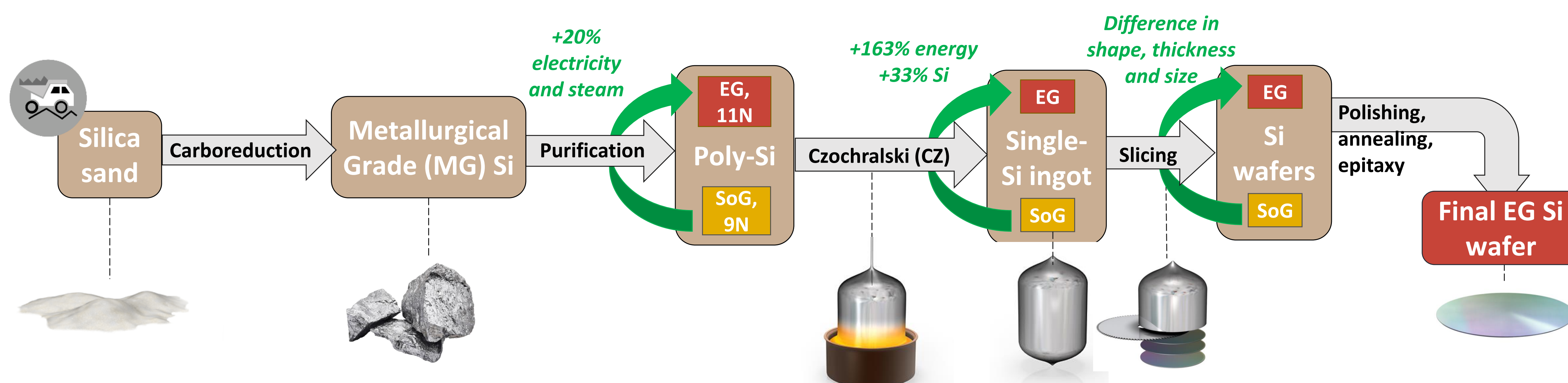


Differences between an Electronic Grade (EG) and a Solar Grade (SoG) Wafer

	EG	SoG
Purity	11N to 13N	9N
Shape	round	square
Thickness	725-775µm	170µm
Size	200mm to 300mm	156 to 162 mm

**No recent available data for the impact of the production an **EG Si wafer**.**  
But for **SoG wafer** : Publicly available and recent data exist.

## EG wafer production adapted from SoG



LCI of **SoG wafer** from :

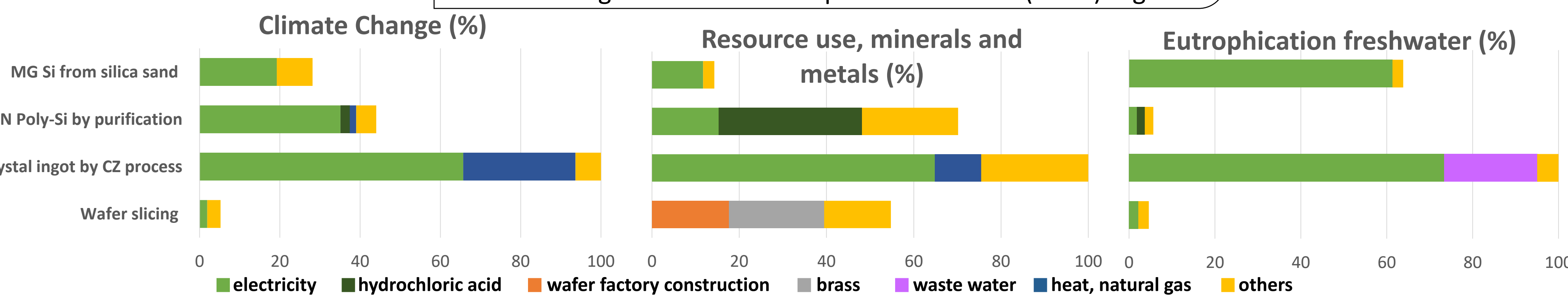
- Frischknecht R and al, 2020

Adapted to **EG** with:

- differences from Jungbluth and al, 2009, PV and electronics
- and additional information from Woodhouse and al, 2019.

## Environmental impacts of EG Si wafers manufacturing (updated)

Main contributors on impact categories (%) :  
1m2 of single-Si Wafer EG 750µm – Asia Pacific (APAC) region

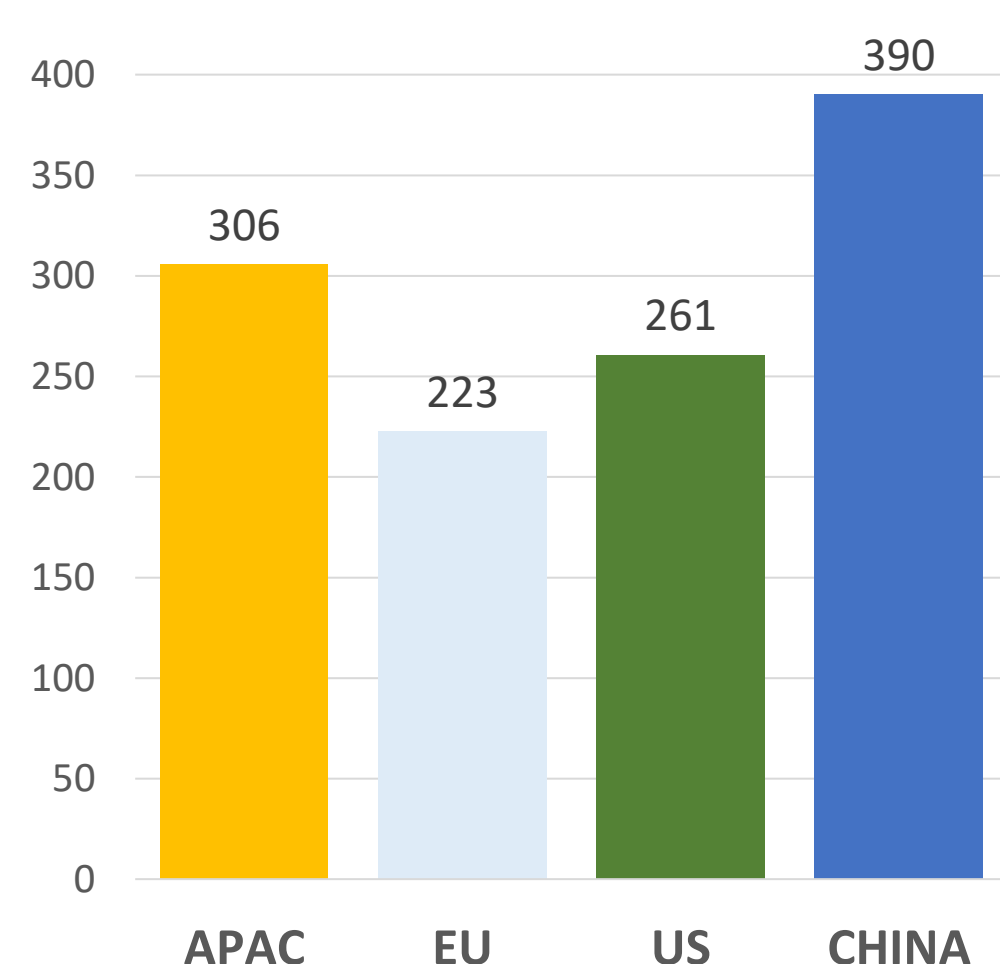


- **CZ process**  
→ most impactful stage in every impact categories
- **Electricity consumption**  
→ main contributor

## Influence of region of manufacturing

1m2 of single-Si Wafer EG  
750µm – 4 regions

Climate Change (kg CO<sub>2</sub> eq)

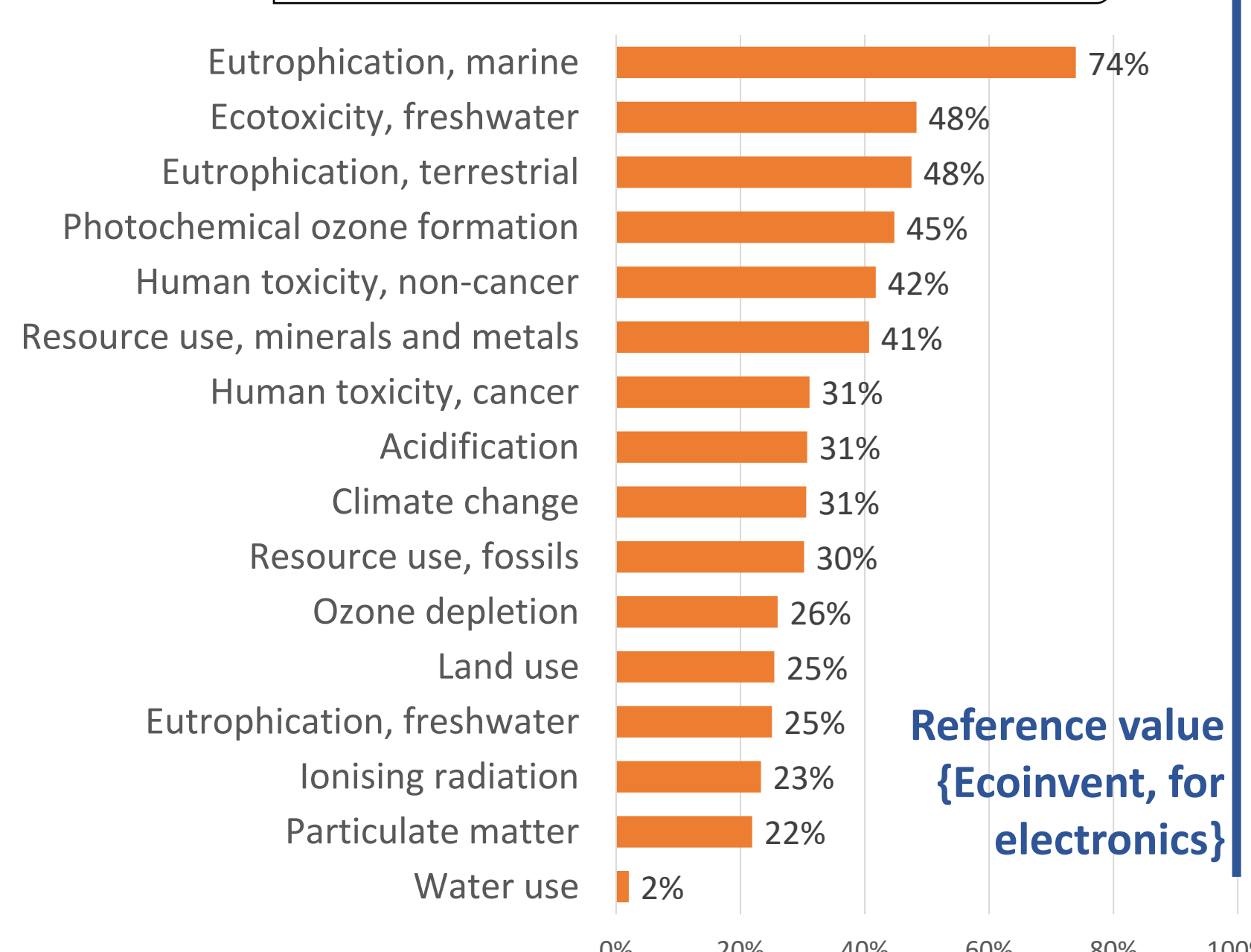


EU region shows lower impacts on 10 impact categories.

→ Mainly due to differences on the electricity mix **EU** mix relies less on fossil fuels

## Comparison of this study (updated) vs. Reference data (ecoinvent database)

1m2 of single-Si Wafer EG 750µm – EU

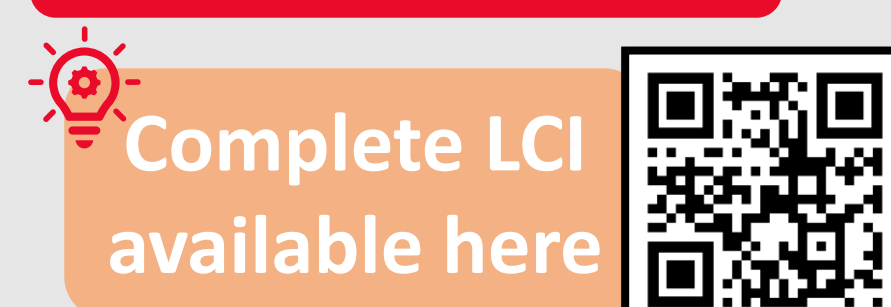


Ecoinvent reference value is **higher** in every impact categories.

Main sources of differences :

- electricity consumption divided by ~6
- Single-Si ingot consumption at slicing step reduced by 38%.

## Conclusion



Complete LCI  
available here

- LCA databases can be outdated → updates are needed as processes improve over time.
- Production region matters - results vary by location.
- Thanks to this update, to reduce the impact of the production of component it is even more important to study **manufacturing steps** rather than wafers production.

### Acknowledgement

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