Comparing Environmental Impact of Future Silicon Solar Photovoltaics Manufacturing in China and North America

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Introduction

- Solar purchasers are seeking more reliable and sustainable solar photovoltaic (PV) sources due to growing concerns about the **sustainability of module manufacturing**.
- **China** has been dominating global solar manufacturing due to low labor and energy costs [1].
- Manufacturers are encouraged to build or expand their facilities in **North America**, particularly in the **US**, due to the tariffs on PV imports and tax credits supporting clean energy production [2].

Life cycle assessment (LCA) is used to estimate the **carbon footprint of solar manufacturing** in China and North America, considering **regional manufacturing capacity** in 2024.

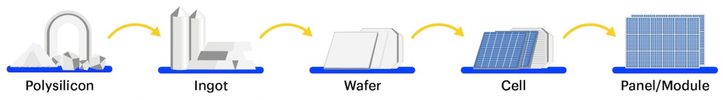


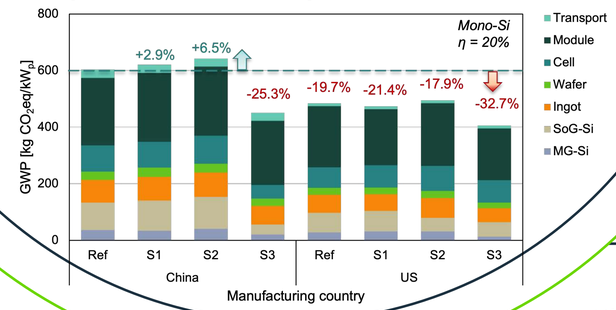
Fig. 1. Key stages of solar module manufacturing [1]

Research Highlights

Map future silicon solar manufacturing in China and North America in 2024 and compare the carbon footprint considering different scenarios.

Future PV supply chain → Life cycle assessment → Scenario analysis

The carbon footprint of solar manufacturing is significantly influenced by the local electricity generation mix, while transportation has a very small contribution.



Results

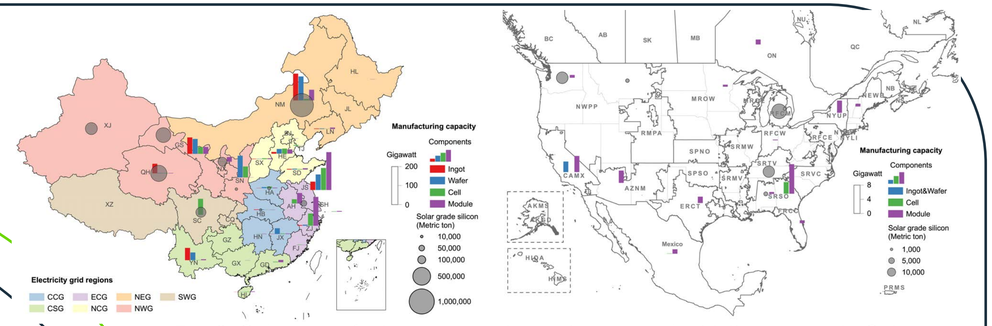


Fig. 3. Solar manufacturing capacity by stage and electricity regions in China (left) and North America (right) in 2024

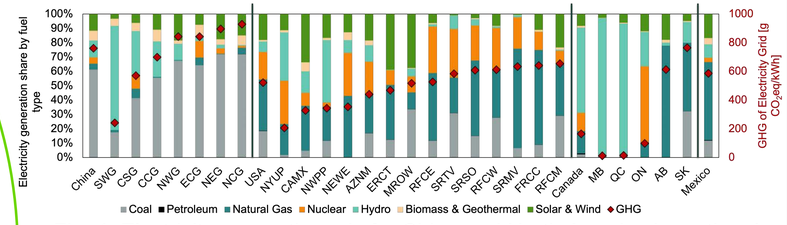


Fig. 4. Electricity generation mix for China and North America by national average and region and associated carbon footprint for 2024

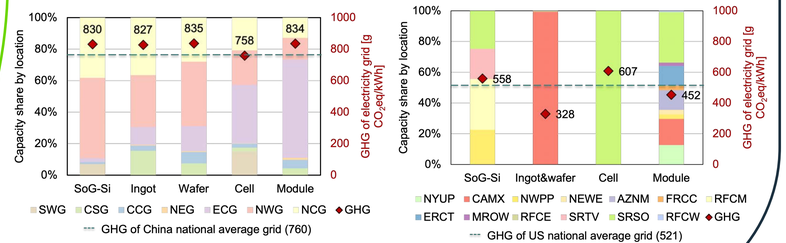


Fig. 5. Manufacturing capacity by region in 2024 and GHG of weighted average electricity for China (left) and North America (right)

Materials And Methods

Table 1. LCA scenarios for quantifying the carbon footprint of solar manufacturing in China and North America

Scenarios	Description
Reference	National average electricity grid.
S1. PV market	Weighted average electricity grid based on the regional capacity for each stage.
S2. Representative manufacturer	Supply chains of representative manufacturers.
S3. Lowest carbon footprint	Lowest carbon emissions for each stage.

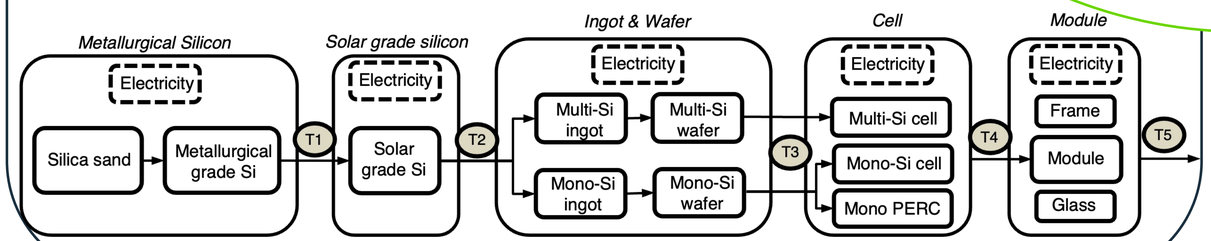


Fig. 2. LCA system boundary including transportation (T1-T5) and electricity adjusted in different scenarios

Discussion and Conclusion

- Silicon solar modules manufactured in China have higher carbon footprint than those in the US due to higher share of coal electricity generation.
- In China, manufacturing of solar modules and components locates mostly where the grid has higher carbon intensity than the national average.
- This work highlights the role of cleaner electricity grid in sustainable solar manufacturing.
- Future work will assess the cumulative energy demand and economic impact.

References

[1] IEA (2022) *Solar PV Global Supply Chains*. International Energy Agency (IEA).

[2] DOE (2022) *Federal Tax Credits for Solar Manufacturers*.

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