



Photovoltaics and Embodied Carbon Emissions

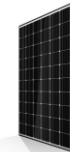
Opportunities For Additional Avoided GHG Emissions



Low Carbon PV – The What

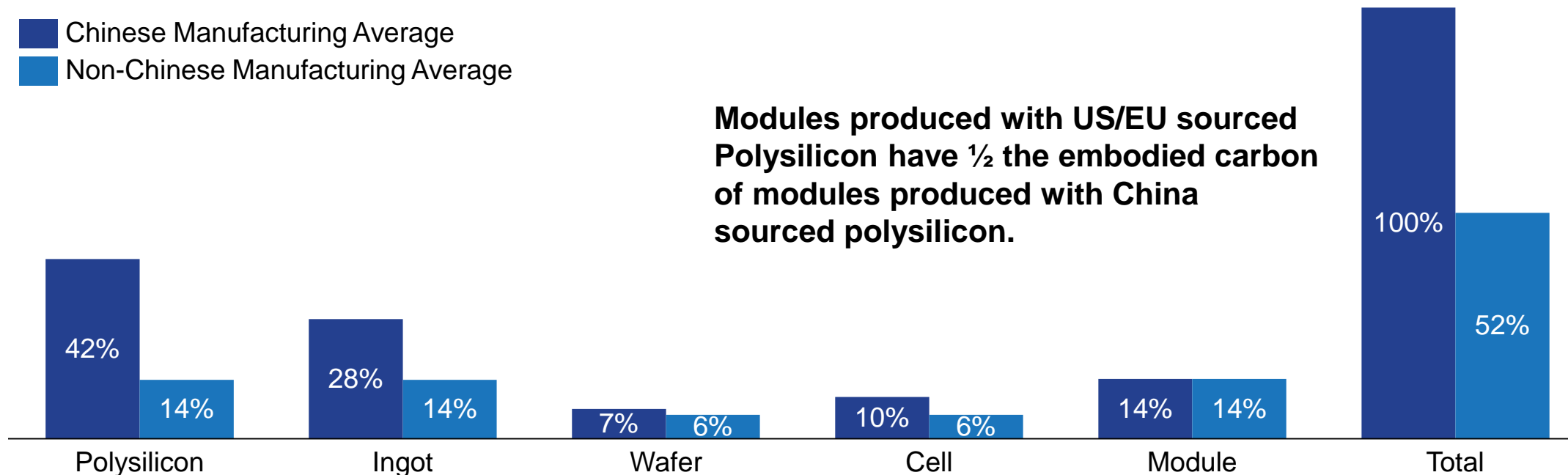
- Solar photovoltaic (PV) is the fastest growing global energy source because of its superior greenhouse gas performance.
- Not all PV is created equal – supply chain emissions (embodied carbon) can be significant and vary widely.
- Embodied carbon effects on the lifecycle greenhouse gas (GHG) performance of PV are material.
- Better sourcing of PV modules can reduce global GHG emissions equal to 640 million fewer cars on the road or 770 fewer coal fired power plants in the next five years.
- These GHG reductions can be achieved at no additional cost.

Embodied Carbon Impact of Solar PV Supply Chain Emissions



% Of Embodied GHG Emissions In Finished Module

■ Chinese Manufacturing Average
■ Non-Chinese Manufacturing Average



Modules produced with US/EU sourced Polysilicon have 1/2 the embodied carbon of modules produced with China sourced polysilicon.

Low Carbon PV – The How

- Polysilicon for PV is energy intensive to produce resulting in “embodied” GHG emissions in PV modules.
- Polysilicon produced in the US and EU average 1/3 the embodied carbon of polysilicon produced in China.
- PV produced with US/EU polysilicon would result in 3 billion fewer tons of supply chain carbon emissions than Chinese polysilicon-based PV over next 5 years projected PV deployment.
- PV purchasers can avoid these emissions by specifying PV modules made with US/EU produced polysilicon (regardless of where the modules are assembled).
- These reductions are essentially free; there is excess lower carbon polysilicon capacity in both the US and EU in a highly commoditized market.

Data Analysis

Year	2019	2020	2021	2022	2023
Projected Global PV Deployment (MW)	129,345	141,060	152,452	161,065	169,270
US vs. China Poly kg CO2/watt difference	4.30	4.30	4.30	4.30	4.30
Embodied carbon US vs. China polysilicon based PV modules (metric tonnes)	556,183,500	606,558,000	655,543,600	692,579,500	727,861,100
					Total 3,238,725,600

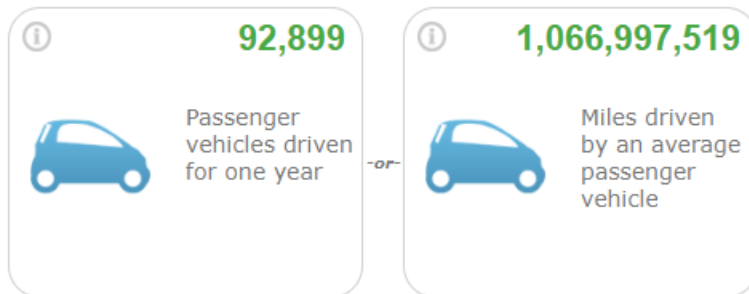
Global projections in avoidable greenhouse gas emissions through the use of PV modules produced with US or EU polysilicon vs. Chinese polysilicon. Reductions are independent of the source of PV modules.

Role of Embodied Carbon In Typical Solar Project

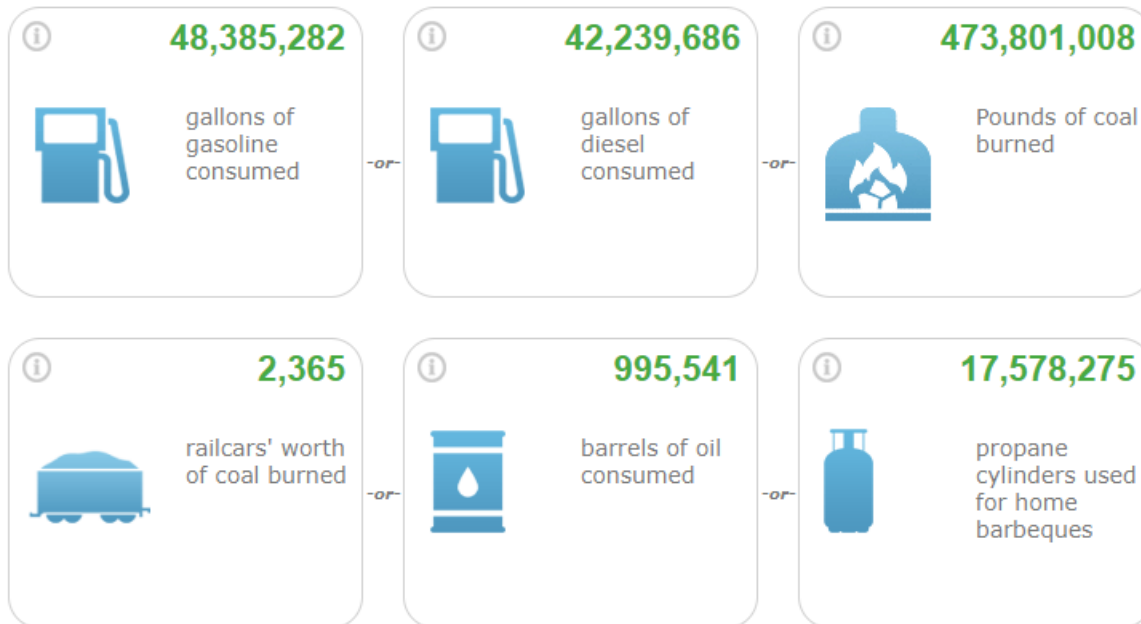
100MW Low Carbon PV Project Avoids 430,000 Tonnes of Embodied Carbon Through Use of Low Carbon Polysilicon

Equal to:

Greenhouse gas emissions from



CO₂ emissions from



<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>