

Techno-economic, Decarbonization, and Decision Making

Samantha Reese Industrial Summer Study 2023 Detroit, MI

Bottoms-up Cost Analysis

• Evaluate early TRL work

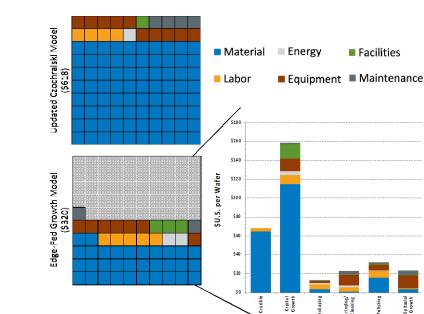
– Example: Ga2O3 Potential

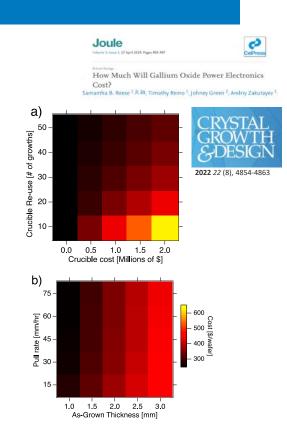
Czochralski Method



Edge-defined Film-fed Growth Method





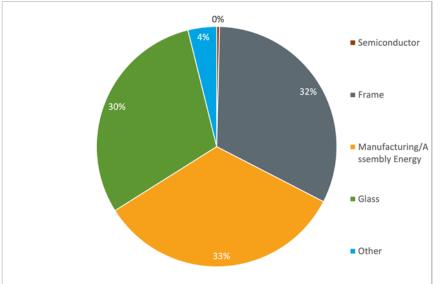


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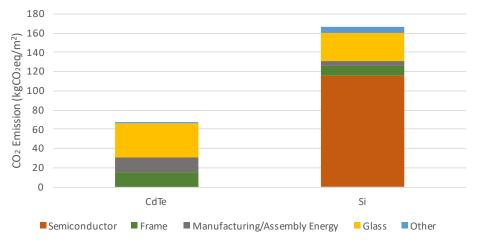
Sources: Reese, S.B., Remo, T., Green, J. and Zakutayev, A., 2019. How much will gallium oxide power electronics cost?. *Joule*, *3*(4), pp.903-907. https://doi.org/10.1016/j.joule.2019.01.011 Heinselman, K.N., Haven, D., Zakutayev, A. and Reese, S.B., 2022. Projected Cost of Gallium Oxide Wafers from Edge-Defined Film-Fed Crystal Growth. Crystal Growth & Design. https://doi.org/10.1021/acs.cgd.2c00340

Economics of Emissions

- Understand where emissions are coming from
- Implications against other technologies



CO₂ Contributions by Material

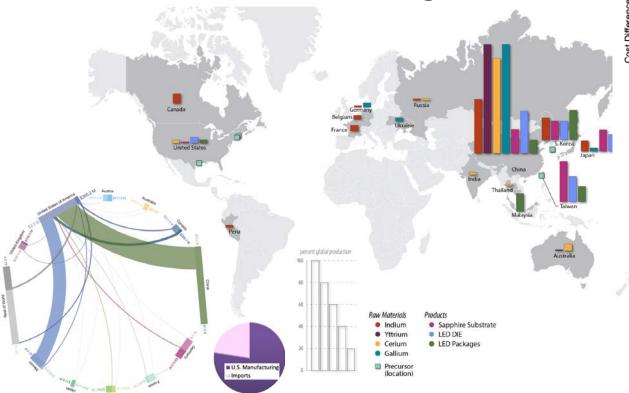


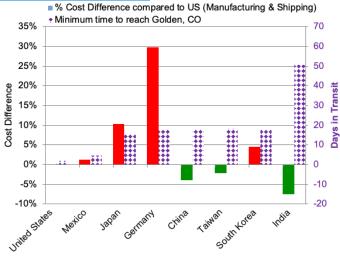
Carbon tax could mean ~\$0.02-0.04/W difference for Silicon vs. CadmiumTelluride manufactured in US

Hope M. Wikoff, Samantha B. Reese, Matthew O. Reese, Embodied energy and carbon from the manufacture of cadmium telluride and silicon photovoltaics, Joule, 2022, ISSN NREL | 3 2542-4351, https://doi.org/10.1016/j.joule.2022.06.006.

Supply Chain

• Understand value chain and logistics







Reese, S.B., Horowitz, K., Mann, M. and Remo, T., 2020. Research note: LED lighting–A global enterprise. Lighting Research & Technology, 52(7), pp.849-855. https://doi.org/10.1177/1477153520901757

Questions?

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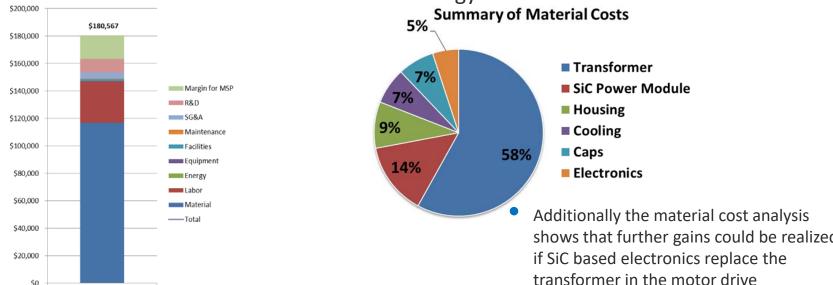
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NREL/PR-6A20-86873



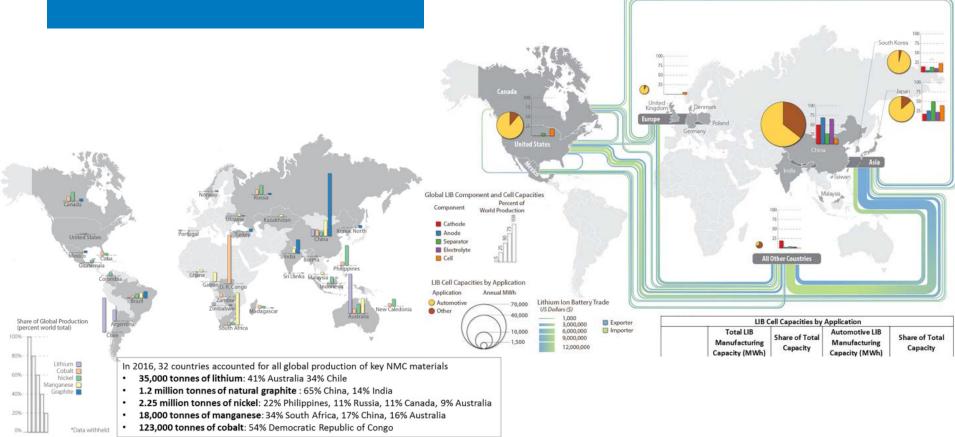
System Manufacturing Cost Comparison

- The minimum sustainable price (MSP) of new technology can be calculated and compared to incumbent technology
- In this example a medium voltage variable frequency motor drive using SiC power electronics is comparable in price to incumbent technology based on Si



Horowitz, Kelsey, Timothy Remo, and Samantha Reese. A manufacturing cost and supply chain analysis of SiC power electronics applicable to medium-voltage motor drives. No. NREL/TP-6A20-67694. National Renewable Energy Lab.(NREL), Golden, CO (United States), 2017. https://doi.org/10.2172/1349212

Lithium Ion Batteries



Mayyas, Ahmad, Darlene Steward, and Margaret Mann. "The case for recycling: Overview and challenges in the material supply chain for automotive li-ion batteries." *Sustainable materials and technologies* 19 (2019): e00087.