Price contributions of raw materials to clean energy technologies

Steffen Schlosser* and Tobias Naegler
Deutsches Institut für Luft- und Raumfahrt (DLR)
* Corresponding author
e-Mail address: steffen.schlosser@dlr.de

Introduction

Energy system transformation strategies are often developed using cost-optimizing energy system models. Therefore, cost assumptions for clean energy technologies play a central role in scenario assessments.
Usually, the raw materials necessary for the transformation are (implicitly) assumed to be available in unlimited quantities.
Bottlenecks for the raw material supply, which could result in increasing technology costs, are not considered.
In this study, we examine the cost share of the key raw materials in the total costs of central clean energy technologies. This is a prerequisite to analyse the susceptibility of technology costs to material price spikes.

Definition of case study

Technologies investigated:
- Solar photovoltaics (PV)
- Onshore and offshore wind power
- Battery storage systems

Investigation of different state-of-the-art subtechnologies for each technology class.

System boundaries:
- PV module/battery cell/wind turbine
- Balance-of-system (BOS)

Typical system boundaries for reference technologies in energy system models.

Specific price assumptions for each subtechnology. Identical system boundaries for raw materials and technology costs.

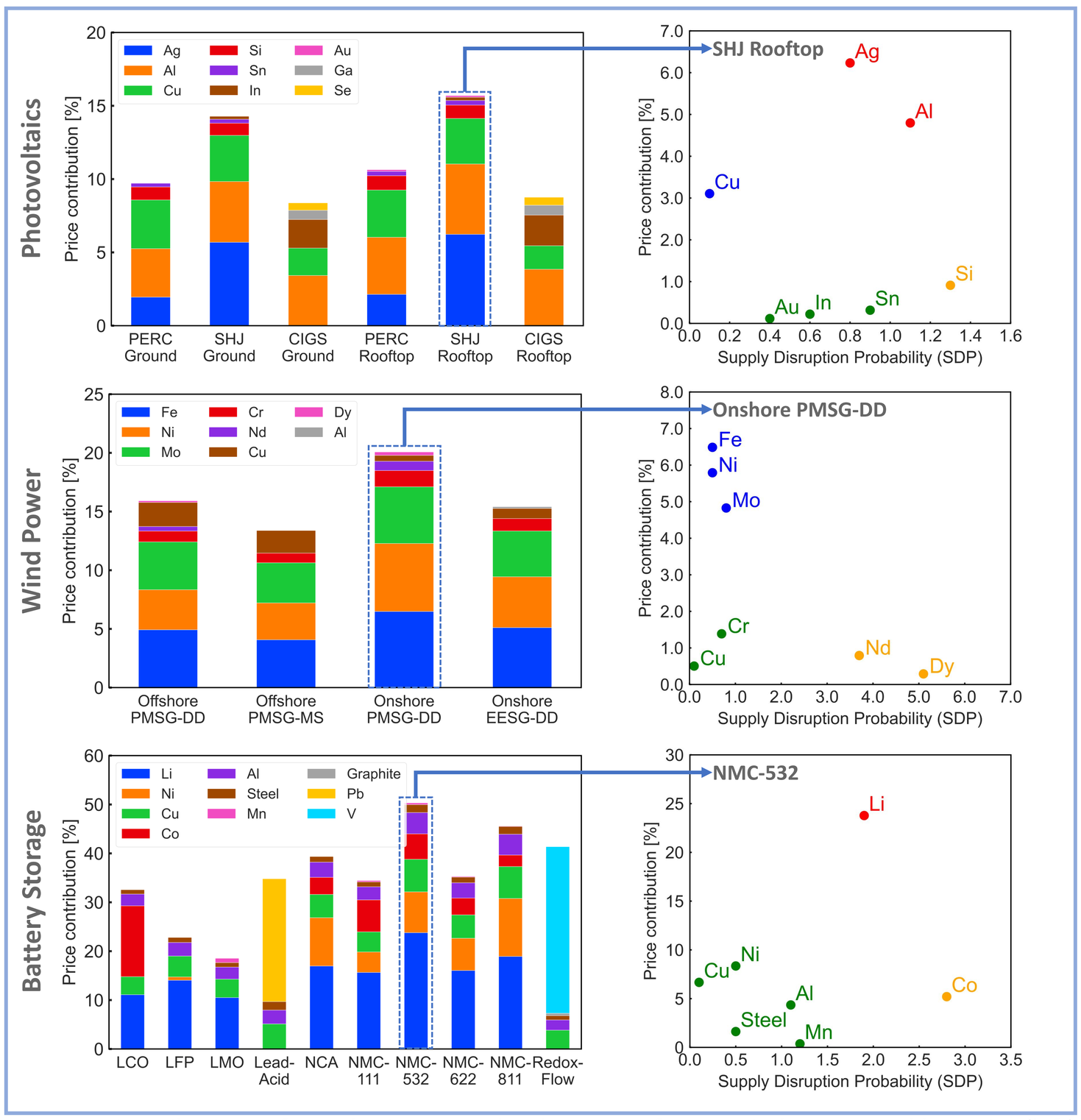

Figure 1: Contributions of metal prices to technology costs for PV, wind power, and batteries (left) and a detailed analysis of raw material price contributions vs. supply disruption probabilities for the subtechnology with the highest material price contribution in each technology class (right).

Price contributions of materials

The contributions of the raw materials to the total technology cost is investigated.

Ranges of calculated material price contributions to total technology costs:
- Photovoltaics: 9 % to 16 %
- Wind power: 14 % to 20 %
- Battery storage: 19 % to 50 %

- ➢ Different ranges of the material price contributions across technology classes
- ➢ Related to different process routines and energy needs for production
- ➢ Similarities of the materials price contributions within a technology class can largely be assigned to the BOS
- ➢ Possible sources of uncertainty are e.g. material qualities, transport costs

Material price contributions and Supply Disruption Probability

Focus on subtechnologies with the highest materials price contribution.
Investigate relation of price contribution and supply disruption probability (SDP):

- ➢ High price contribution of a material with a high SDP results in a high expectation value for significant price increases on the technology level
- ➢ Necessary to identify materials, which should be addressed in terms of material efficiency and/or substitution

Conclusions

Classification of materials according to their price contribution and SDP:

- ➢ PV and wind power: Major materials like Aluminum and Iron have higher price contributions than “critical” raw materials (CRMs) used in PV cells and permanent magnets
- ➢ Batteries are more susceptible to price spikes of CRMs, i.e. Lithium and Cobalt

Future work:
- ➢ Evaluation of price spike scenarios
- ➢ Development of a SDP vs raw material price contribution metric

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