UNIKASSEL VERSITÄT

Center for Environmental Systems Research

Technology Assessment Artificial Photosynthesis

Life cycle assessment and Location analysis

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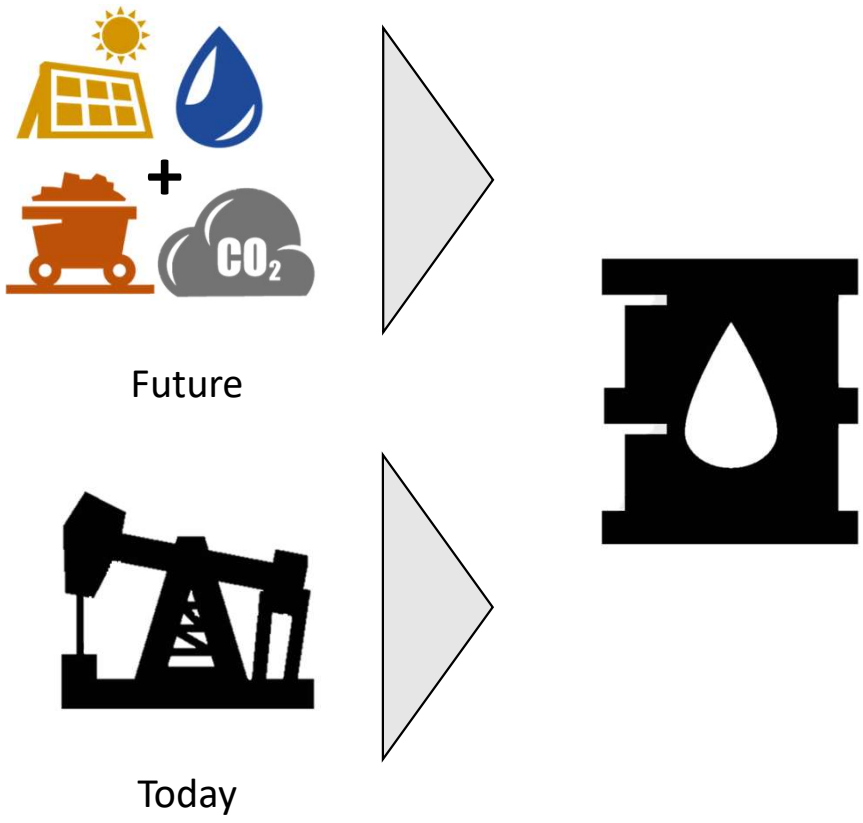
Key Questions



What are the environmental impacts of AP technologies now and in the future?

Which locations are promising for their application?

Environmental assessment

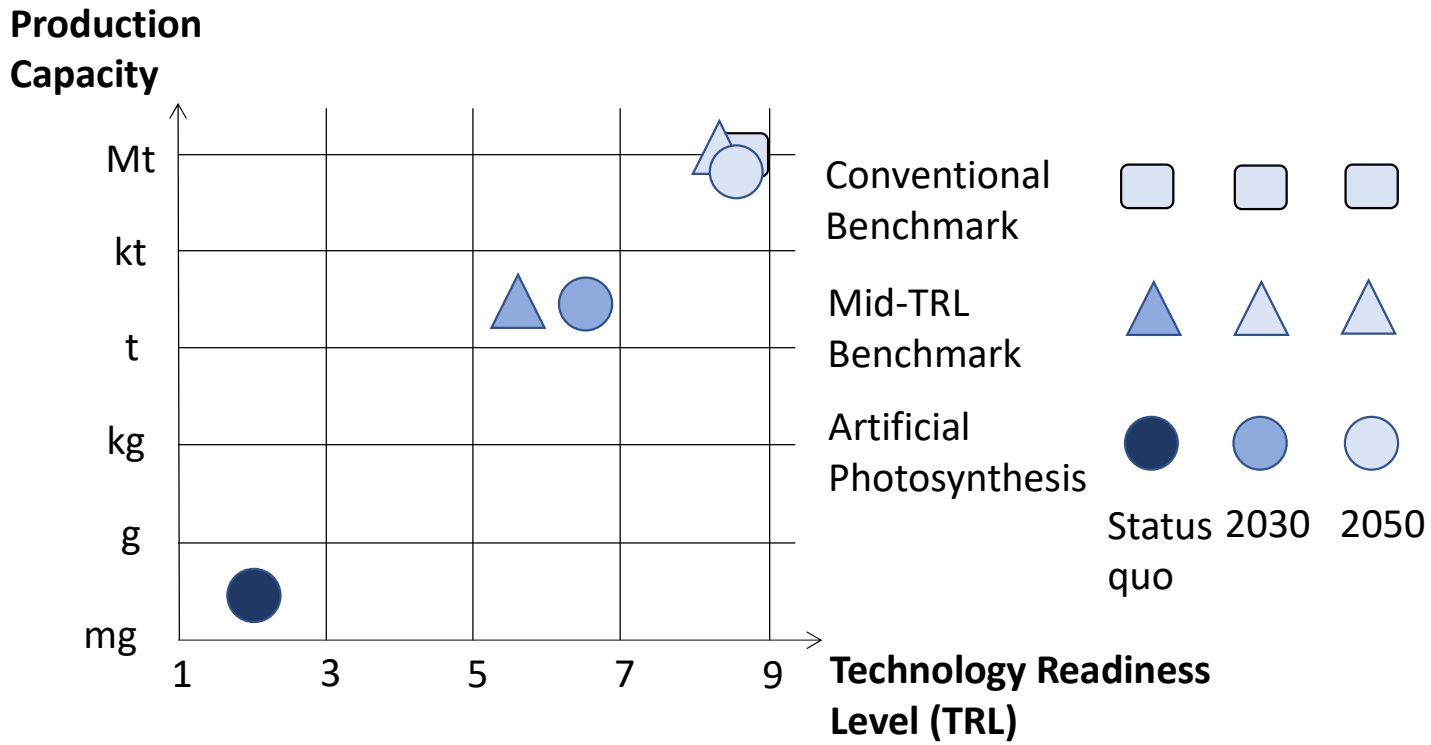
Methods

Key Targets: *Estimation and comparison of actual and future environmental impacts and their drivers*

1. Step
Literature Research

2. Step
LCA for the Status quo

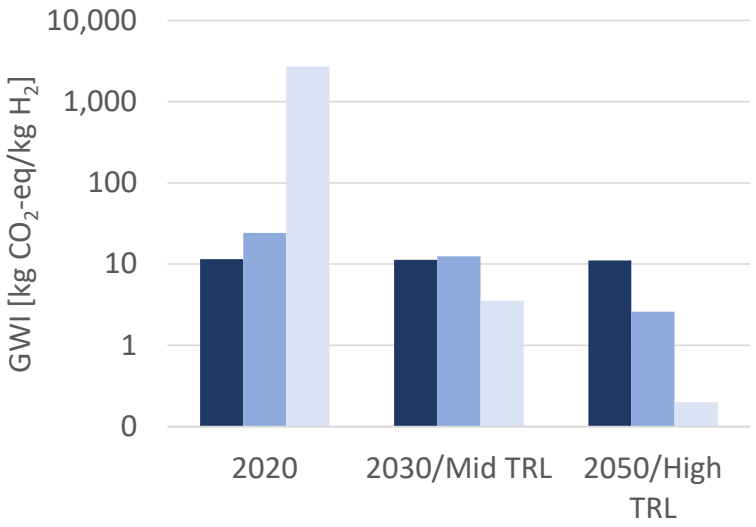
3. Step
Scenario Analysis



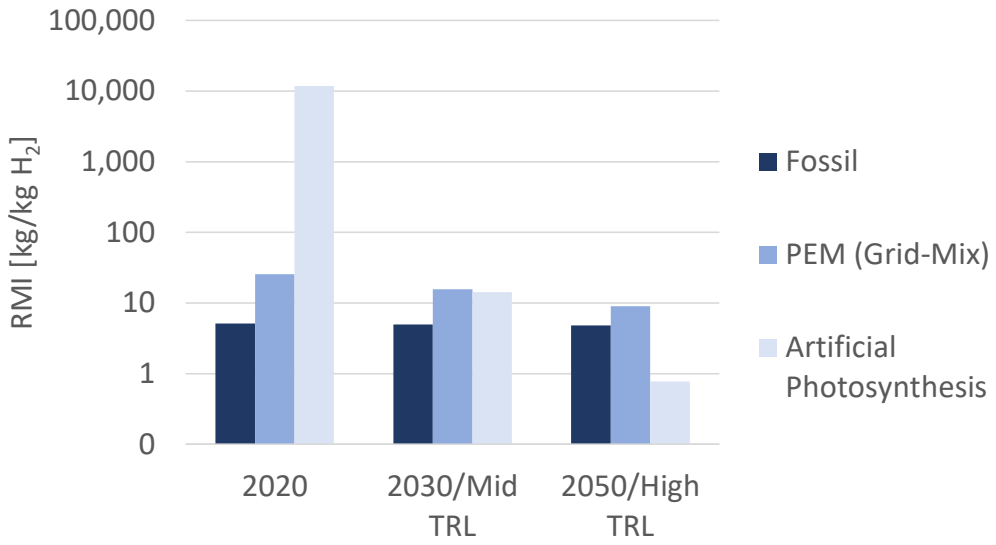
Environmental assessment

Hydrogen – Environmental Impacts (cradle-to-gate)

Global Warming Impact (GWI)



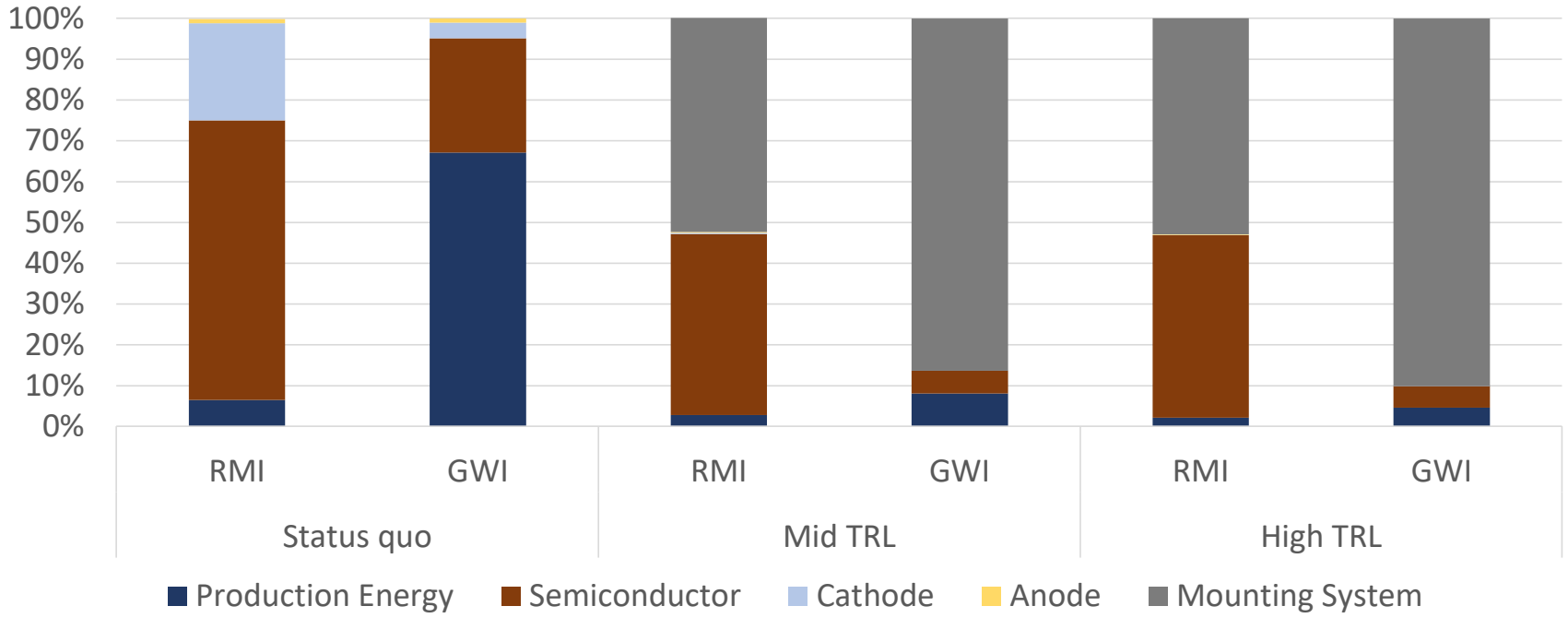
Raw Material Input (RMI)



- In the status quo the environmental impacts of AP-Technologies are magnitudes higher than the benchmark values
- Under the considered technology development, comparative advantages are achievable in the future

Environmental assessment

Hydrogen – Contribution Analysis

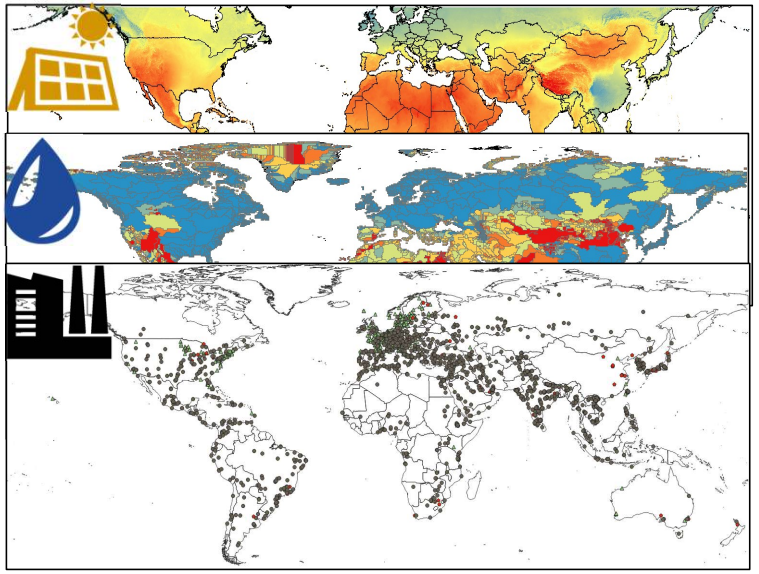


- Semiconductor and cathode material, and production energy are major drivers of the environmental impacts
- Due to increased material efficiency and plant lifetime in the future, the components cause a minor impact while materials for plant installation gain more importance

Location Analysis

Method

Geospatial analysis of resource availability



Identification of exemplarly regions

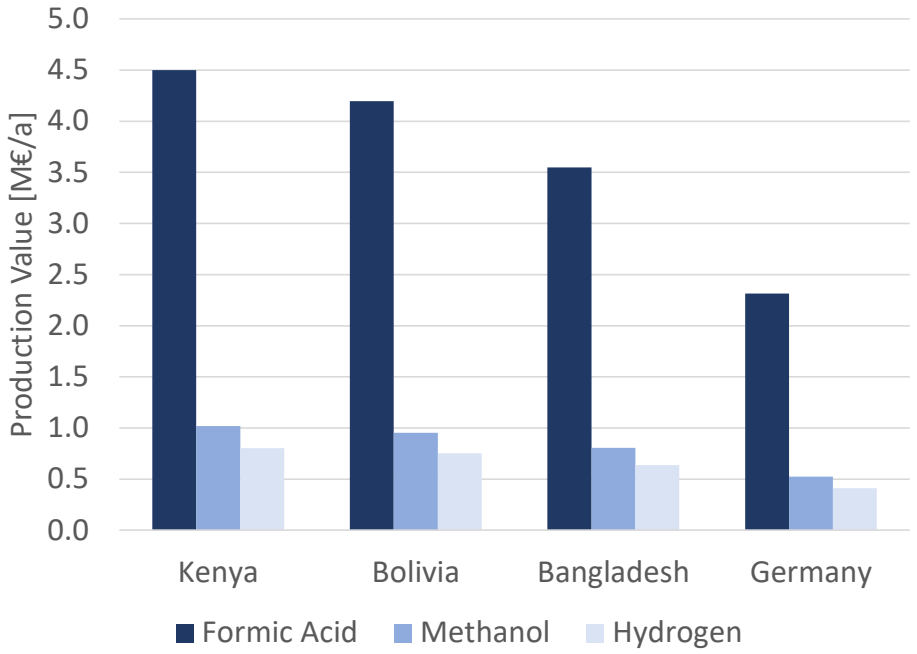
- Typical characteristics for resource availability
- Where can trade-offs be expected?
- What technologies can be used to avoid trade-offs?

Assessment and comparison of production potentials

- Variation of technical parameters,use cases and products
- Production amount
- Production value
- Break-even Capex

Location Analysis

Results



Reference Area: 1 km²
Solar-to-Chemical Efficiency: 1 %

- The production potential is closely related to the energy demand, market price and location
- Water and CO_2-availability play a minor role, compared to the irradiation conditions
- A location in Germany shows a lower potential (50 %) compared to locations with very good irradiation conditions

Conclusions

- Technologies for Artificial Photosynthesis show much higher environmental impacts in the status quo due the low TRL
- The high material and production energy, especially for semiconductor production, are the main drivers of environmental impacts
- If technical parameters which are comparable to benchmark technologies are achieved, the environmental impacts are potentially lower
- Regions with very good irradiation conditions show low availabilities of other required resources
- Direct air capture and desalination technologies could help to exploit those regions without setting off irradiation advantages

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Thank you very much for your attention!

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