Environmental Footprints in Life Cycle Assessment: Water Scarcity Footprint

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Water footprint no SDG monitoring indicator!

**Target 6.4:** Increase water-use efficiency and ensure freshwater supplies

**Indicator 6.4.2:** Level of water stress: freshwater withdrawal as a proportion of available freshwater resources

The water footprint is not listed as monitoring indicator, although it is a useful tool, also for other Targets (6.1, 6.3, 6.5).
Water is a global resource

Global virtual water trade according to Hoekstra & Mekonnen (2012).
Lion’s share is hidden in upstream supply

Teleconnections from fertilizer demand, exemplary for a sugar mill in Brazil according to own illustration.

Organisational water footprint according to Forin et al. (2021).
Water scarcity on regional, not global scale

Water stress indicators according to Alcamo et al. (2003) (on top), Pfister et al. (2009), Berger et al. (2014) and Boulay & Pfister (2013) (right, from top down).
Target questions

1. How can human water use be defined?
2. How can system-wide human water use be accounted for comprehensively?
3. How can regional water scarcity be assessed?
Life cycle assessment as option

According to Europäisches Komitee für Normung (2016) a water footprint assessment

- is based on a life cycle assessment
- is modular and includes relevant geographical and temporal dimensions
- identifies quantity of water use and changes in water quality
- utilizes hydrological knowledge
- identifies potential environmental impacts

Water footprint in life cycle assessment according to WULCA.
Quantitative Water Scarcity Footprint (WSF) - Schomberg et al. (2021)

1. Quantification of relevant water flows
   - evapo(transpi)ration losses
   - transfer: water transfers (beyond basin boundaries)
   - output: product-incorporated water

2. Weighting with AWARe
Qualitative WSF - Schomberg et al. (2021)

1. Calculation of virtual dilution volume
   - recharge: water pollution through emissions
   - aluminium emissions as proxy for water pollution
   - division of aluminium load by spatially-explicit natural (geogenic) background concentration

2. Weighting with AWaRe
Our most important findings

Schomberg et al. (2021):

- content: The WSF of lithium from brine increases by several orders of magnitude when brine evaporation is taken into account.
- methodological: A comprehensive assessment of evapo(transpi)ration is necessary taking into account all water sources on land.

Water scarcity footprint of a lithium-ion battery storage.
Our most important findings

Schomberg et al. (2022):

- content: Several case studies of renewable electricity generation show a higher WSF than coal electricity.
- methodological: For the big picture, the WSF should be accompanied by the resource and climate footprints.

![Graphs showing global warming impact and water scarcity footprint](image)

Global warming impact and water scarcity footprint of four case studies of electricity generation in comparison.
Our most important findings

Schomberg et al. (2022):

- Content: Several case studies of renewable electricity generation show a higher WSF than coal electricity.
- Methodological: For the big picture, the WSF should be accompanied by the resource and climate footprints.

Global warming impact and water scarcity footprint of four case studies of electricity generation in comparison.
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- content: Several case studies of renewable electricity generation show a higher WSF than coal electricity.

- methodological: For the big picture, the WSF should be accompanied by the resource and climate footprints.

Key developments for further progress towards sustainability?

Global warming impact and water scarcity footprint of four case studies of electricity generation in comparison.
The presented WSF meets the SDG requirements, but reducing the availability of clean water through pollution is not covered in the SDG framework and WSF is not called for as a life cycle wide footprint indicator.
Further developments

1. Better integration of water quality: Reduced water quality can contribute to water stress.

2. Better regionalisation of upstream supply: More than 90% of associated water use is hidden in the upstream supply chain.
Thank you for your attention!

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Schomberg et al. (2021): https://www.nature.com/articles/s43247-020-00080-9
Schomberg et al. (2022): https://www.nature.com/articles/s43247-022-00521-7
References I


References II


Backup II

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VDV_{s,i,dem} \ [m^3 \text{ FU}^{-1}] = \frac{\text{load, } s \ [\text{kg FU}^{-1}]}{c_{\text{geo},s} \ [\text{kg m}^{-3}]} \]

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