WANDEL

Water Resources as important factor in the Energy Transition at local and global scale

The Water Scarcity Footprint of four case studies of electricity generation

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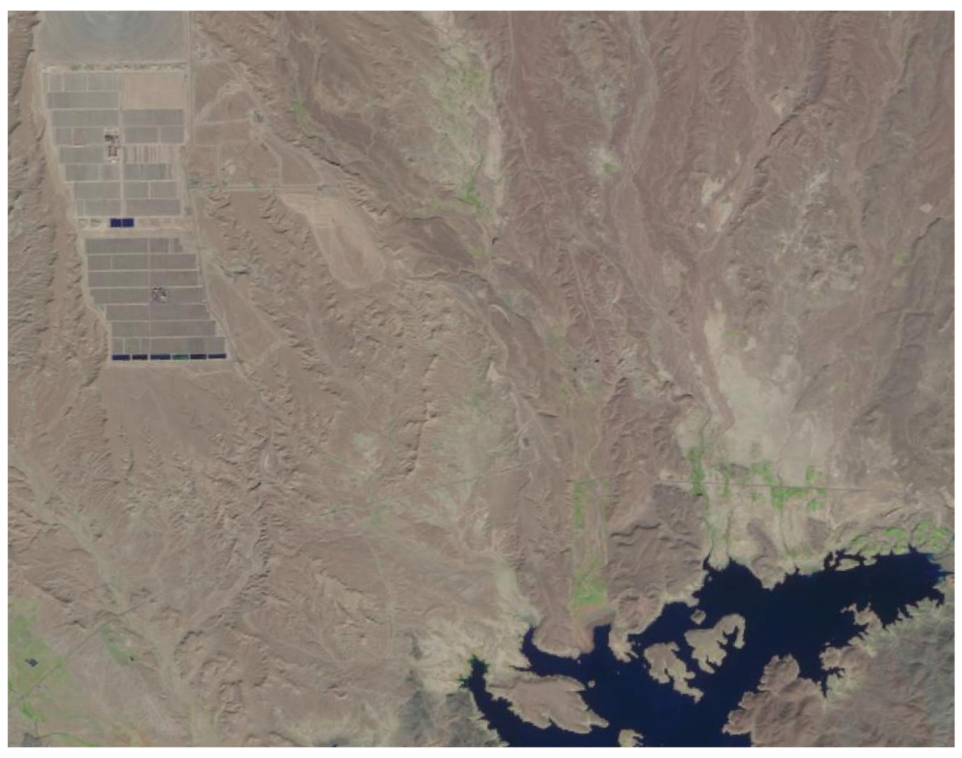
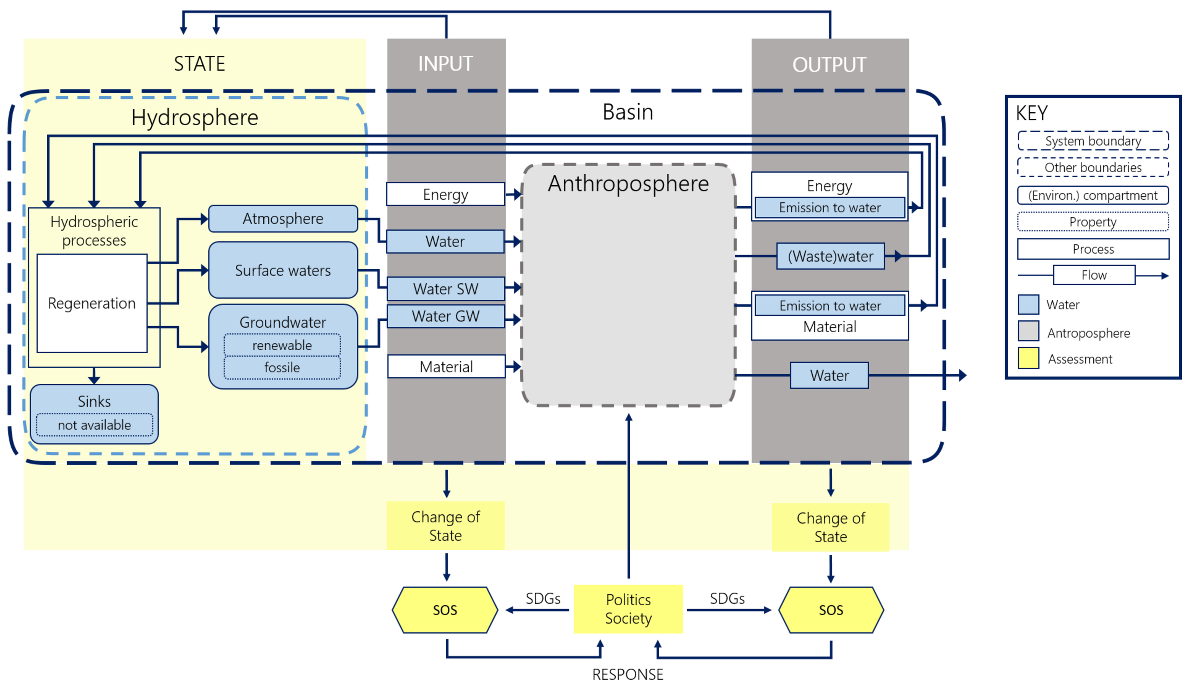


BACKGROUND

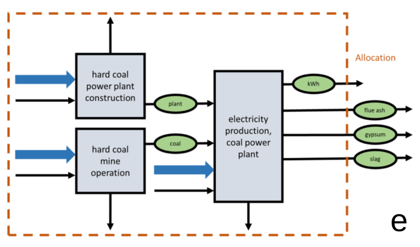
The Project WANDEL wants to answer the questions whether water availability for electricity generation can accelerate the global energy transition or hinder it instead. While the promotion of a specific technology may help to reduce carbon footprints, it could have other adverse environmental effects, on-site or remotely. For example, the solar panels in the Moroccan desert in the satellite image on the left are cleaned with water, while the reservoir on the bottom left is essential to the residents of the region. The water footprint is a promising tool to determine the life-cycle wide water use of different system on local and regional level and to compare them against the background of regional water availability. Scaled to a global level, these results can help answer questions about the global energy transition.

AN ENHANCED WATER SCARCITY FOOTPRINT CONCEPT

In order to be able to compare different systems spatially explicit on a global level, existing water scarcity footprint (WSF) concepts for Life Cycle Assessment (LCA) are extended [1]: 1) The common risk is defined in accordance with the DPSIR concept [2] as the potential change of natural freshwater availability, that exceeds the Safe-Operating-Space (SOS) [3], caused by water use along human supply chains. 2) Water use is conceptualised in LCA within a consistent hydrological framework. 3) The upstream supply chains of seven important resources, namely aluminium, cement (from clay, gypsum and limestone) coal, copper, iron ore, lithium and phosphate, are re-gionalised on mine site level with water use data. They are linked to the supply chains of the case studies to include the up-stream supply in the spatially explicit LCA-WSF analyses.

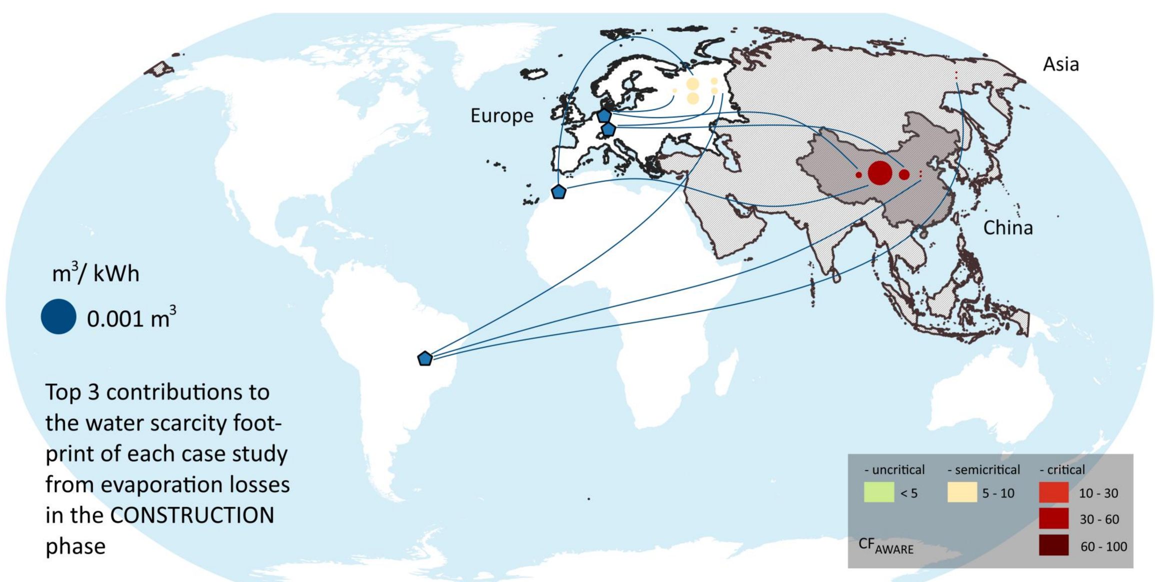


THE FOUR CASE STUDIES



Three systems of renewable electricity generation are compared: Run-of river hydropower at the Danube, Germany (a), concentrated solar power in Quarzazate, Morocco (b) and burning of sugar cane residues in Rio dos Patos, Brazil (c). A coal-fired power plant at the Weser, Germany (d), serves as reference for conventional systems. After a precise description of the systems (e), the LCA-WSF is determined for the construction phase of the facility (buildings, infrastructure, machinery) related to 1 kWh and for the operation phase, which is the generation of 1 kWh.

RESULTS



Water uses are regionally weighted using AWARE [4] and can directly be compared. (b) has the highest WSF of 216 l/kWh during operation due to cooling and cleaning of the solar panels, followed by (c) with 9 l/kWh due to evaporation losses from the boiler system and (d) with 6 l/kWh (2 l/kWh due to cooling), while the WSF during operation of (a) can be neglected. The operation WSF is in general rather located on-site, except for (d) due to the need for imported coal. All construction WSFs are remotely for which the top 3 contributors are shown in the map above, respectively. Water quality is considered as well in the qualitative WSF. It identifies treatment of waste and tailings along the supply chain as highest contributions.

KEY FINDINGS

The developed concept is well suitable to compare different systems and their upstream supply in an LCA framework to identify hotspots of water use. The qualitative WSF is still based on rough calculations, but reveals mostly mining as a threat to water quality.

(b) should consider dry cooling to reduce impacts on water availability, while (c) could aim for efficiency improvements.

(d) has a small WSF in comparison, which shows that the WSF alone can not answer questions of global problem shifting. Thus, other environmental indicators have also been considered within WANDEL.

Sources:

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