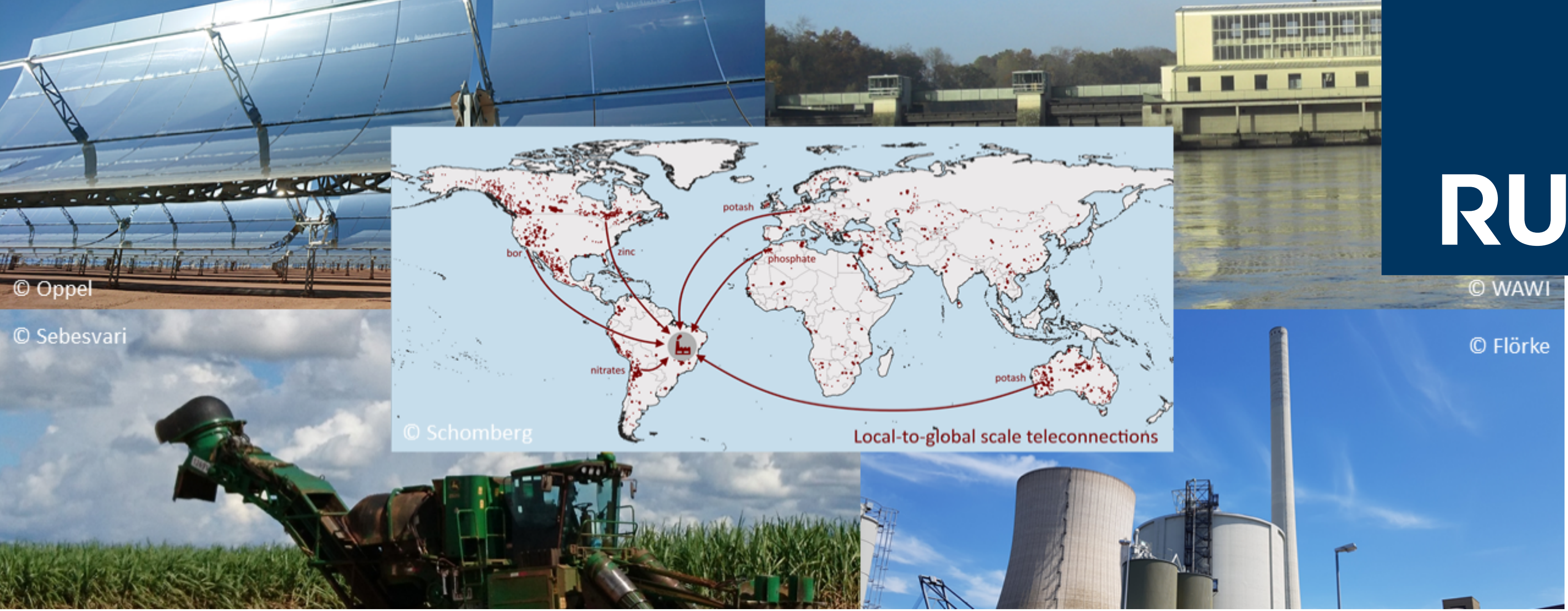

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Water resources as important factor in the energy transition

Prof. Martina Flörke

GRoW Final Conference, 20-21 October 2020, Berlin, Germany

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

GRoW
WATER AS A GLOBAL RESOURCE

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WANDEL Consortium

Coordination:	Prof. Martina Flörke (RUB) Prof. Rüdiger Schaldach (CESR)
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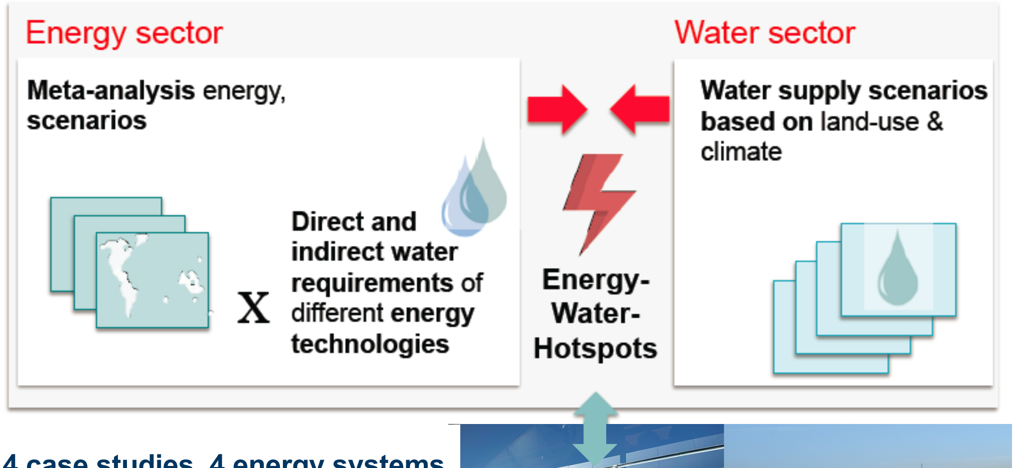
Will water scarcity drive the energy transition?

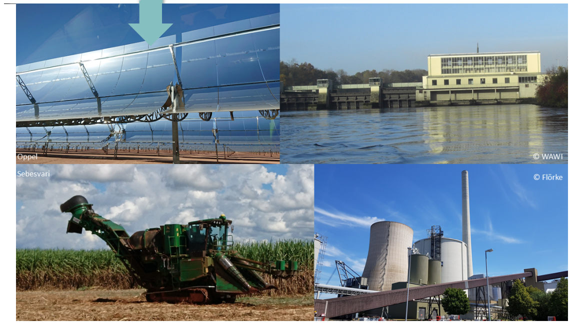
Global Level



Regional Level

4 case studies, 4 energy systems

- **Coal power plant (Germany)**
- **Concentrated Solar Power (Morocco)**
- **Sugarcane bagasse (Brazil)**
- **Hydropower (Germany)**



Aim and overarching questions

1. Will water scarcity limit the use of conventional energy systems, thereby accelerating the energy transition?
2. Will restrictions on water resources delay or even hinder the implementation of a global energy transition?

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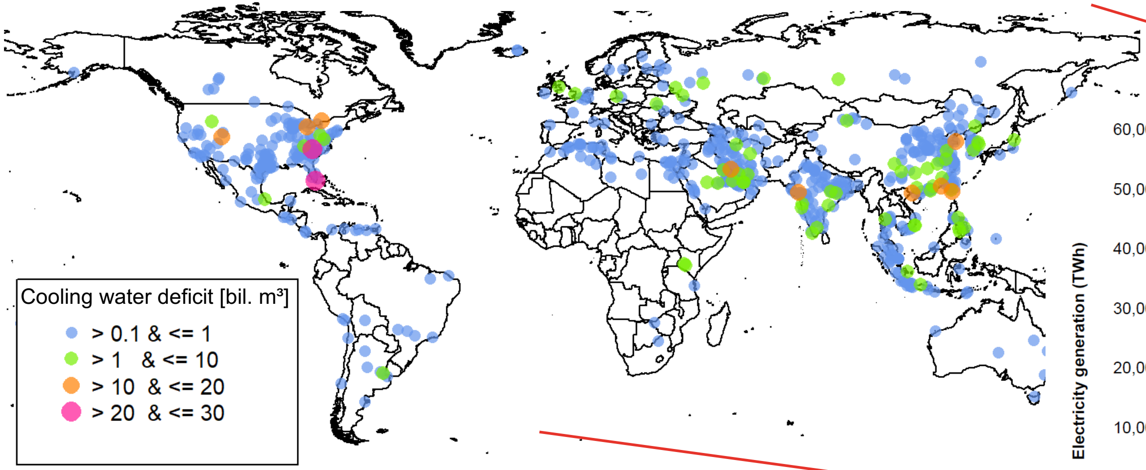
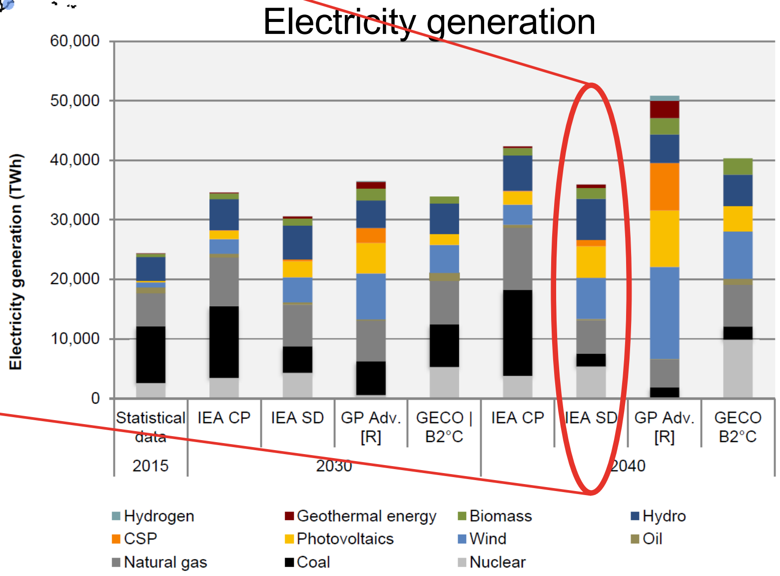
Will water scarcity limit conventional energy systems?

Sustainable Development Scenario 2040 (IEA SD)

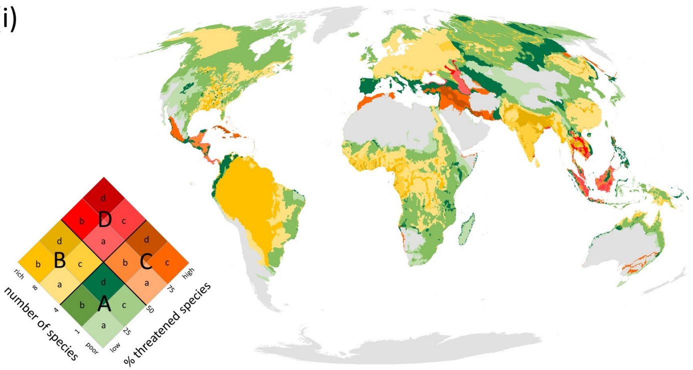




Terrapon-Pfaff et al. (2020)

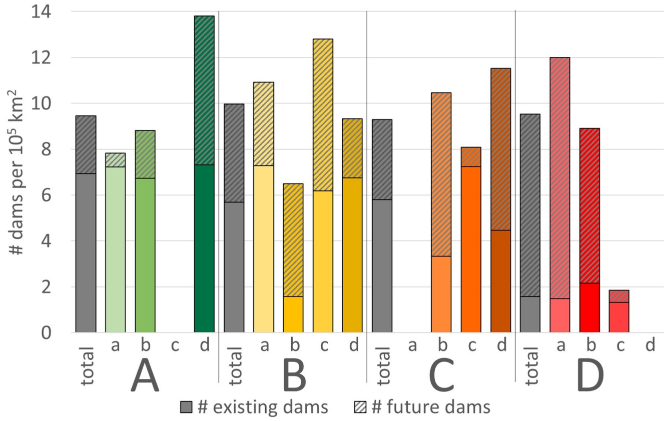
- 13% reduction in GHG emissions
- Regional cooling water deficits
- Additional technological changes required
- Energy transition strategies should consider water demand

(i)



Will restrictions on water resources delay or hinder the implementation of a global energy transition?

(ii)



Zarfl et al. (2019)

Impact of large hydropower dams on freshwater megafauna

- areas that deserve major attention for conservation
- conflicts between climate mitigation and biodiversity conservation

Coal power plant at the Weser, Germany

Analysis of direct effects and technical solutions

- Reference case for conventional energy systems
- Large-scale modeling accounting for water availability at Oberweser
- Analysis of water use and distribution along the Weser river considering competing users (e.g., navigation, (hydro)power generation, other withdrawals)
- Reservoir management according to given targets

Chain of 6 hydropower plants at the Danube, Germany

Analysis of energy production and technical solutions

- Developing a user-friendly simulation tool
- Analysing the effects of different management scenarios along the entire barrage chain
- Identifying the potential of energy supply from hydropower and related environmental impacts

CSP plant in Drâa Valley, Morocco

Analysis of direct effects and technical solutions

- Estimating future water demand (*all sectors*) based on different socio-economic scenarios
- Estimating future water resources based on climate change projections
- Identifying water saving measures (*all sectors*) and evaluation with MCA
- Participation of local stakeholders

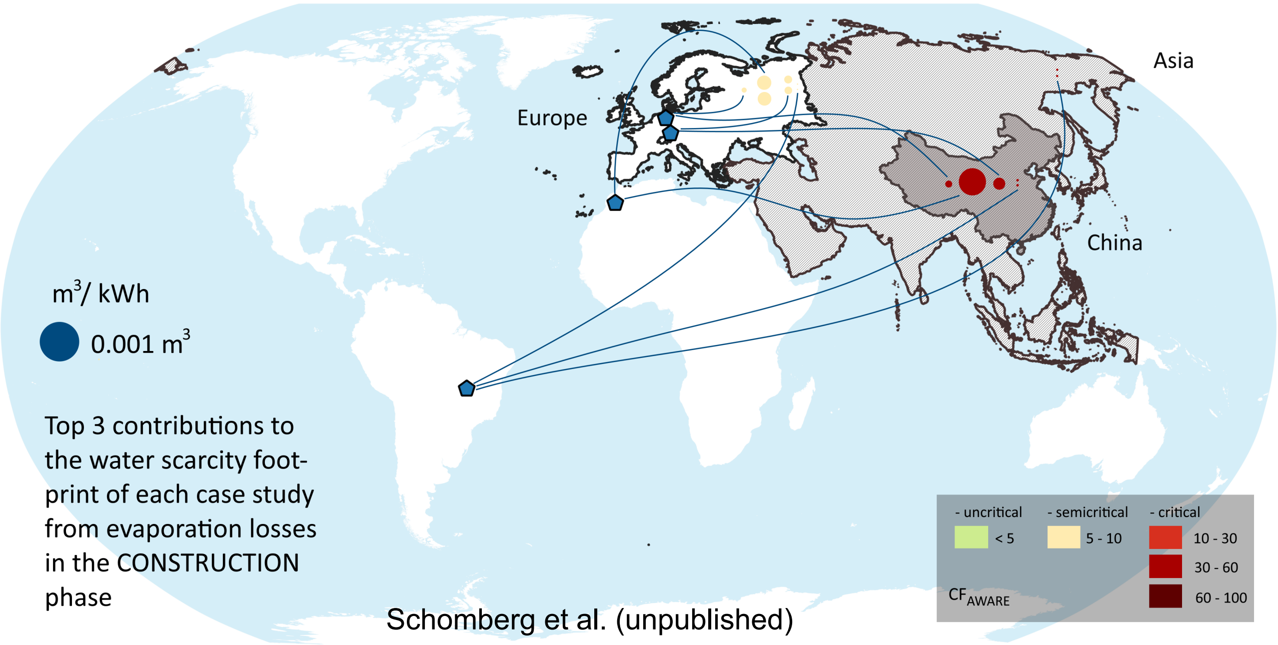

(Data source: Report SocialCSP 2015)

Sugarcane mill in Rio dos Patos basin, Brazil

Analysis of direct effects and technical solutions

- Carrying out a drought risk assessment (for industrial and agricultural systems)
- Combustion of bagasse requires water for cooling
- Shift in start of rainy season and high temperature occurence
- Increasing vulnerability due to lack of drought early warning system and absence of agriculture drought insurance

Where are the hotspots of water use in the renewable energy supply chain?



Top 3 contributions to the water scarcity foot-print of each case study from evaporation losses in the CONSTRUCTION phase

Schomberg et al. (unpublished)

Water Scarcity Footprint

- to compare different energy systems with life cycle assessment
- to identify hotspots of water use in the upstream supply chain (on-site and remote)
- to assess water use with respect to regional water scarcity

Sustainability Indicators in comparison

	construction				operation			
	coal	hydro	CSP	bagasse	coal	hydro	CSP	bagasse
Land Footprint [points]	0.0001	0.0004	0.0095	0.0000	0.01	0.00	0.00	0.01
Material Footprint [TMR kg]	0.01	0.12	0.09	0.00	0.96	0.00	0.01	0.06
Climate Footprint [kg CO2-Eqv.]	0.03	0.02	0.09	0.00	1.05	0.00	0.03	0.05
Energy Footprint [kWh Eqv.]	0.01	0.06	0.23	0.03	3.3	1.1	0.1	0.1
Water Scarcity Fp. [l/kWh]	0.2	0.7	3.5	0.0	6.2	0.0	215.5	8.9
Human Health [points]	0.000	0.001	0.004	0.000	0.04	0.00	0.00	n.n.
Ecosystem Quality [points]	0.0001	0.0004	0.0021	0.0000	0.033	0.000	0.0005	0.001

WSF

Schomberg et al. (unpublished)

Sustainability Indicators in comparison

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	construction				operation			
	coal	hydro	CSP	bagasse	coal	hydro	CSP	b[illegible]
	0.0001	0.0004	0.0095	0.0000	0.[illegible]1	0.00	0.00	[illegible]
[illegible]nt [TMR kg]	0.01	0.12	0.09	0.00	0.[illegible]6	0.00	0.01	0.06
	0.03	0.02	0.09	0.00	1.[illegible]5	0.00	0.03	0.05
	0.01	0.06	0.23	0.03	3.3	1.1	0.1	[illegible]
Water Scarcity Fo[illegible]	0.2	0.7	3.5	0.0	6.2	0.0	215.5	[illegible]
	0.000	0.001	0.004	0.000	0.04	0.00	0.00	-0.01
	0.0001	0.0004	0.0021	0.0000	0.033	0.000	0.0005	0.001

low for coal, high for hydropower due to different energy yields

CSP with highest impacts in construction

waste bagasse with very low impacts in construction

coal needs more energy for operation than it produces

hydropower almost no impacts during operation

Schomberg et al. (unpublished)

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Securing water and energy – a global & local challenge!

Key findings & solutions

- Existing potential conflicts between climate mitigation and conservation of water resources and biodiversity
- Assessing the sustainability of energy projects should be determined comprehensively along the entire energy supply chain to avoid problem shifting of harmful environmental impacts

- Modelling tools and training simulator to optimize electricity production & reduce impacts
- Water and energy efficiency improvements to reduce on-site demand
- Additional water storage to overcome future drought events
- Considering institutional capacity in the target regions is mandatory to assess both water and energy security
- Participatory approach is important to stimulate long-term & dynamic thinking, and raise awareness for environmental conservation and reflection of management practices

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Thank you for your attention!

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