



**ENGINEERING SOLUTIONS FOR SUSTAINABILITY:  
MATERIALS AND RESOURCES 3**

# Toward a Circular Economy

February 18–19, 2017 | Denver, Colorado





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### *Session 4: Water*

# Water Footprinting

## Communicating Mine Site Water Performance in a Circular Economy

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*Maureen Upton, Dave Hoekstra, Patrick Williamson – SRK Consulting*



# Circular Economy

- “Closing the loop” requires us to think beyond just the efficiency and waste of primary resources
- The impacts of material production to environmental processes and society also need to be considered
- The over allocation and scarcity of water resources is a growing issue
- Addressing this in a circular economy requires methods to understand water resource impacts at all stages of a materials life



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# Water and the Mining Industry

Mining operations have complex interactions with water resources

- Stable access of water is required for ore processing
- Large-scale land transformations, land clearing, the storage of mine wastes, dewatering of aquifers and the diversions of water around sites can all significantly impact regional hydrology.
- Significant water quality risks can also be associated with mining.

Due to these factors, water is often a trigger for social unrest and opposition to mining projects.



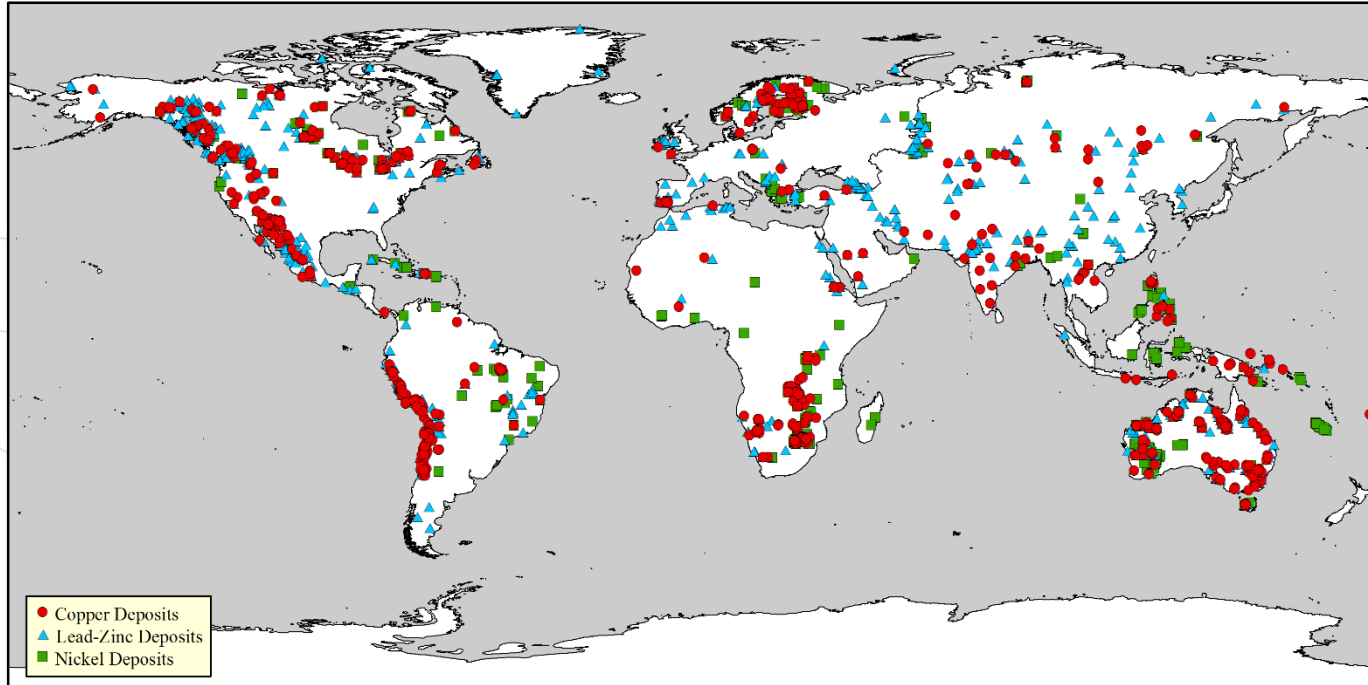
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# Mineral Projects Face a Range of Regional Contexts



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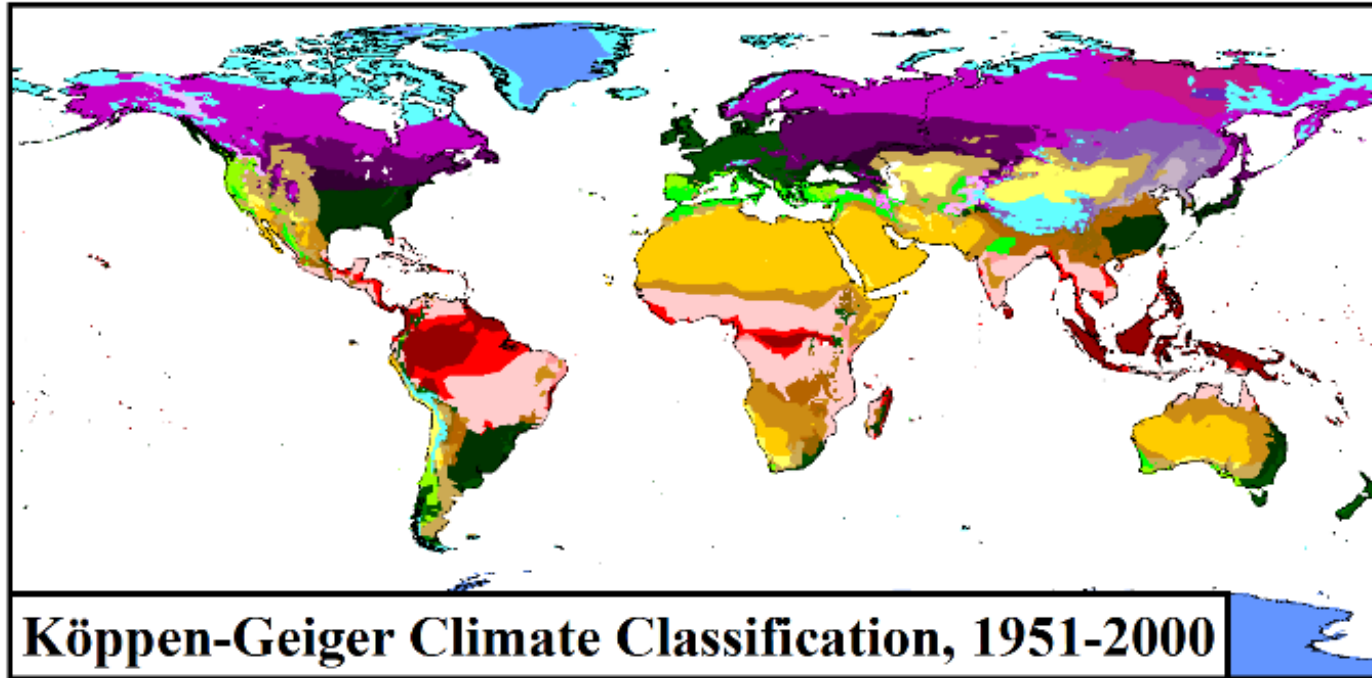
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Northey et al., 2017. Global Environmental Change, Under Review.

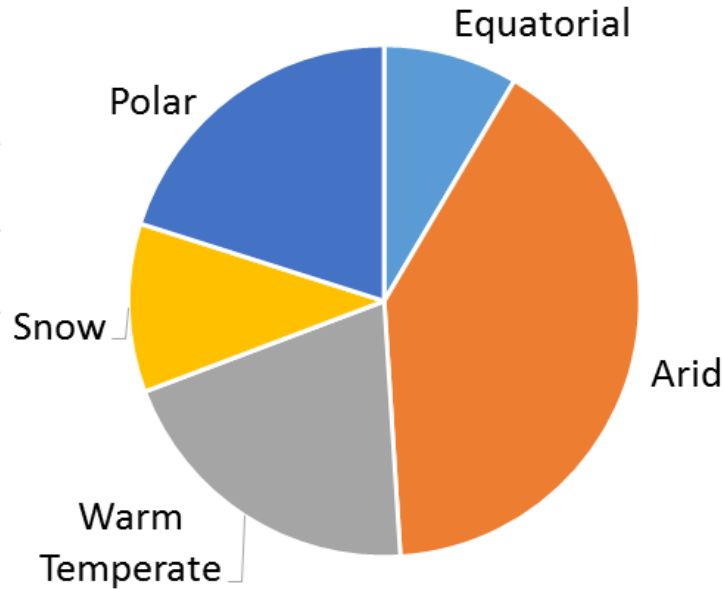


# Mineral Resources are Located in Different Climates

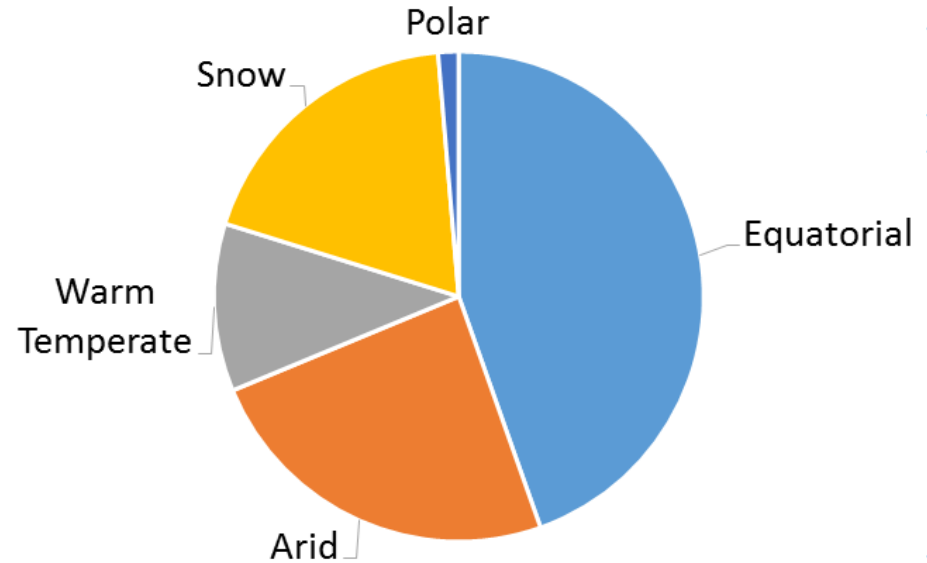


# Mineral Resources are Located in Different Climates

## Copper



## Nickel



Northey et al., 2017. Global Environmental Change, Under Review.



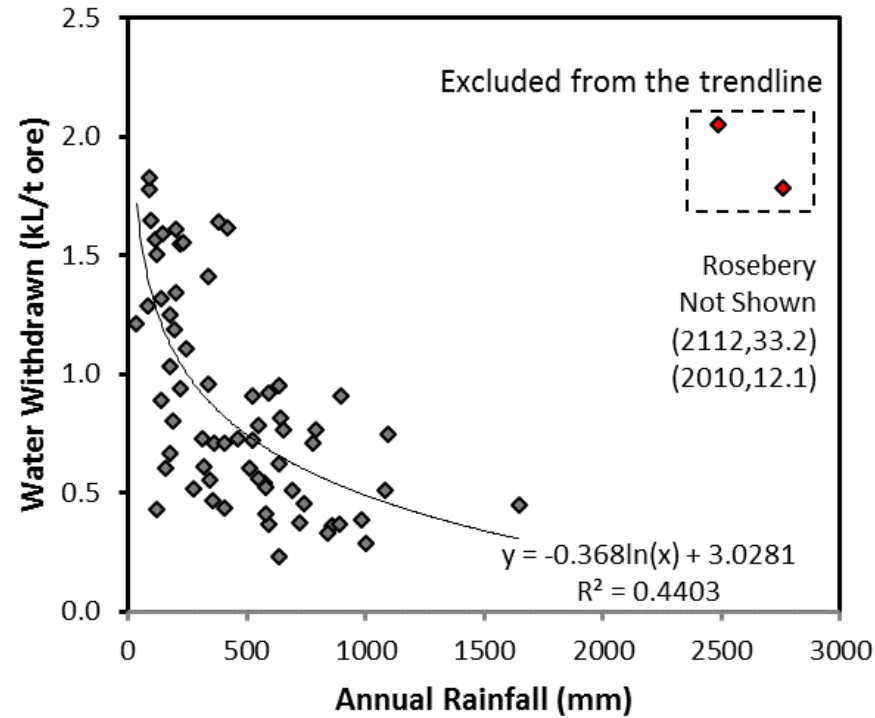
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# These Climates Influence Mine Site Water Balances



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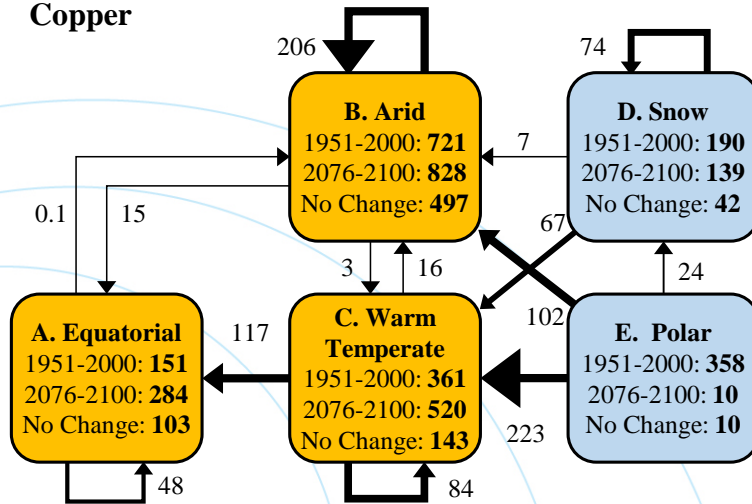
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# These Climates Are Also Shifting Through Time

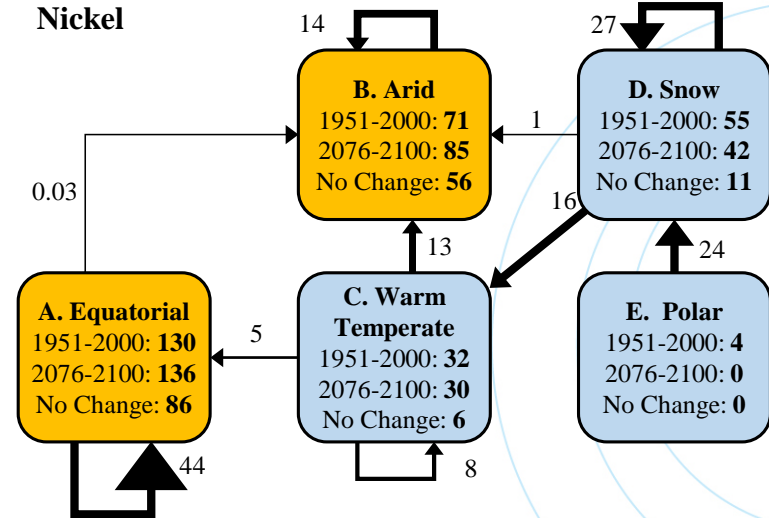
## Copper

### Copper



## Nickel

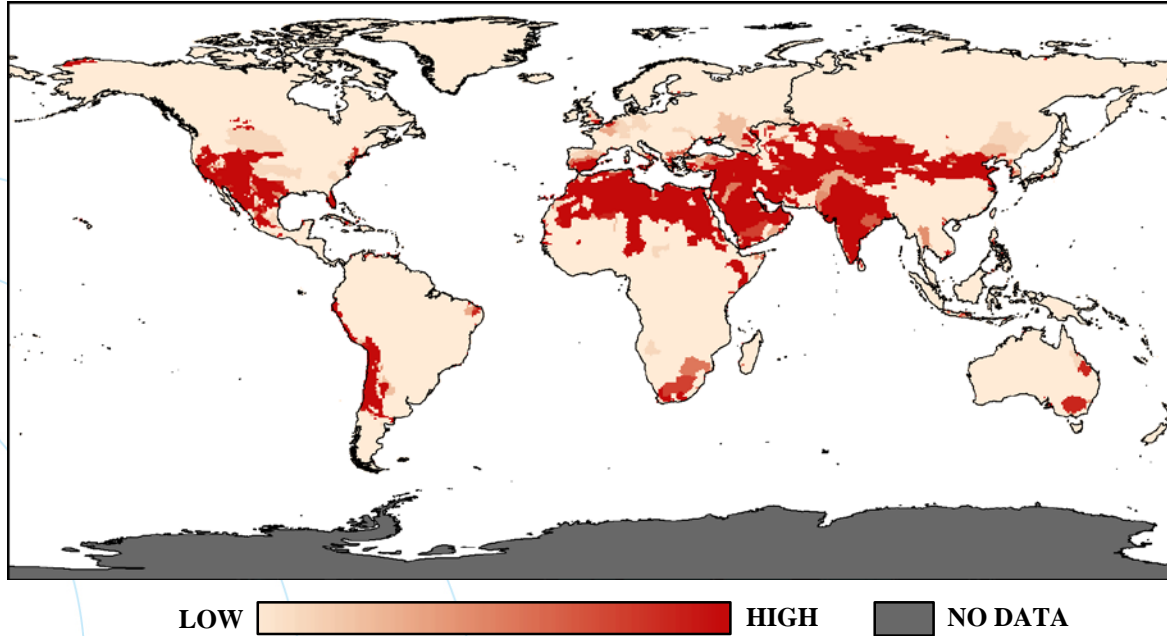
### Nickel



Northey et al., 2017. Global Environmental Change, Under Review.

# Water Contexts Vary Substantially Between Regions

## Water Stress Index



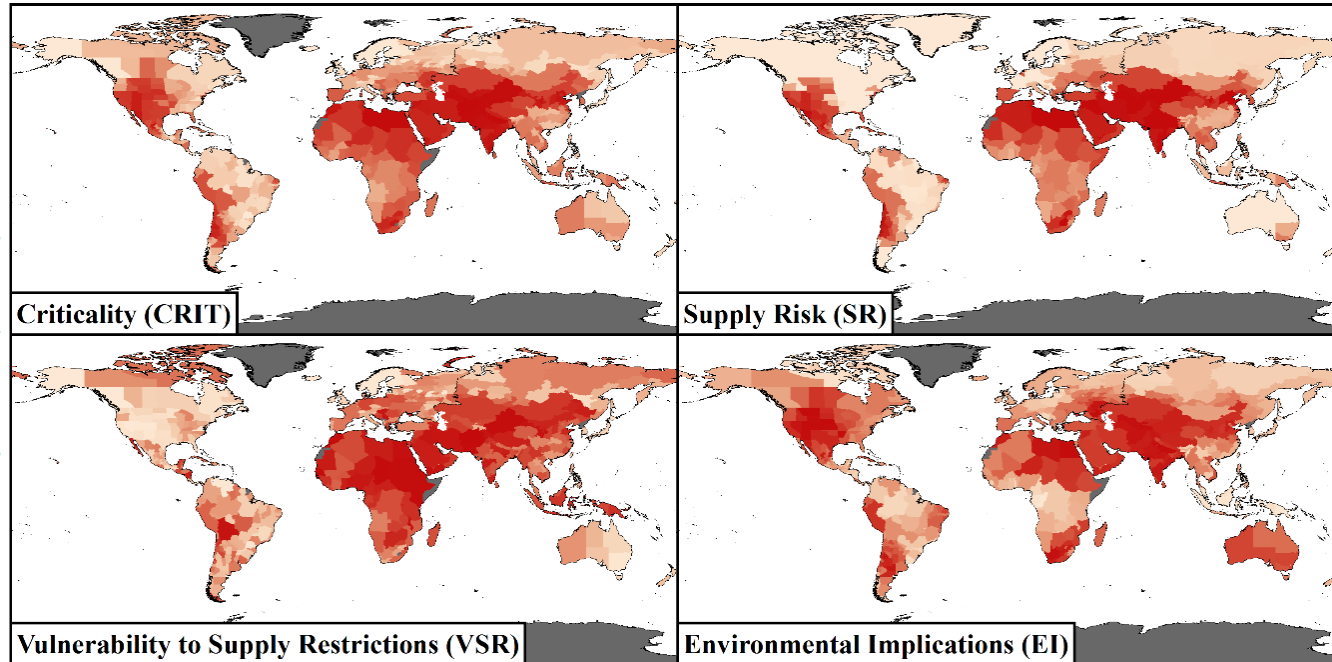
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# Water Contexts Vary Substantially Between Regions



LOW

HIGH

NO DATA

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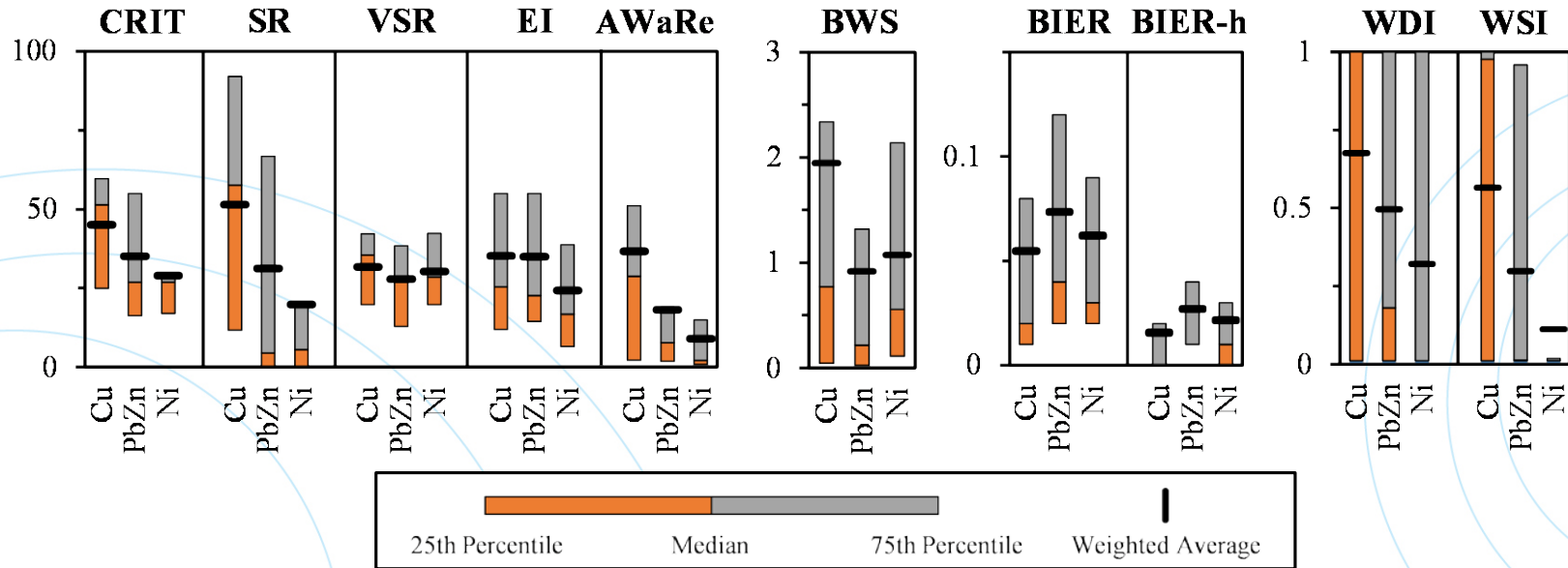
Sonderegger et al., 2015. Environmental Science and Technology, 49, 12315-12323.

Page 9 of 18

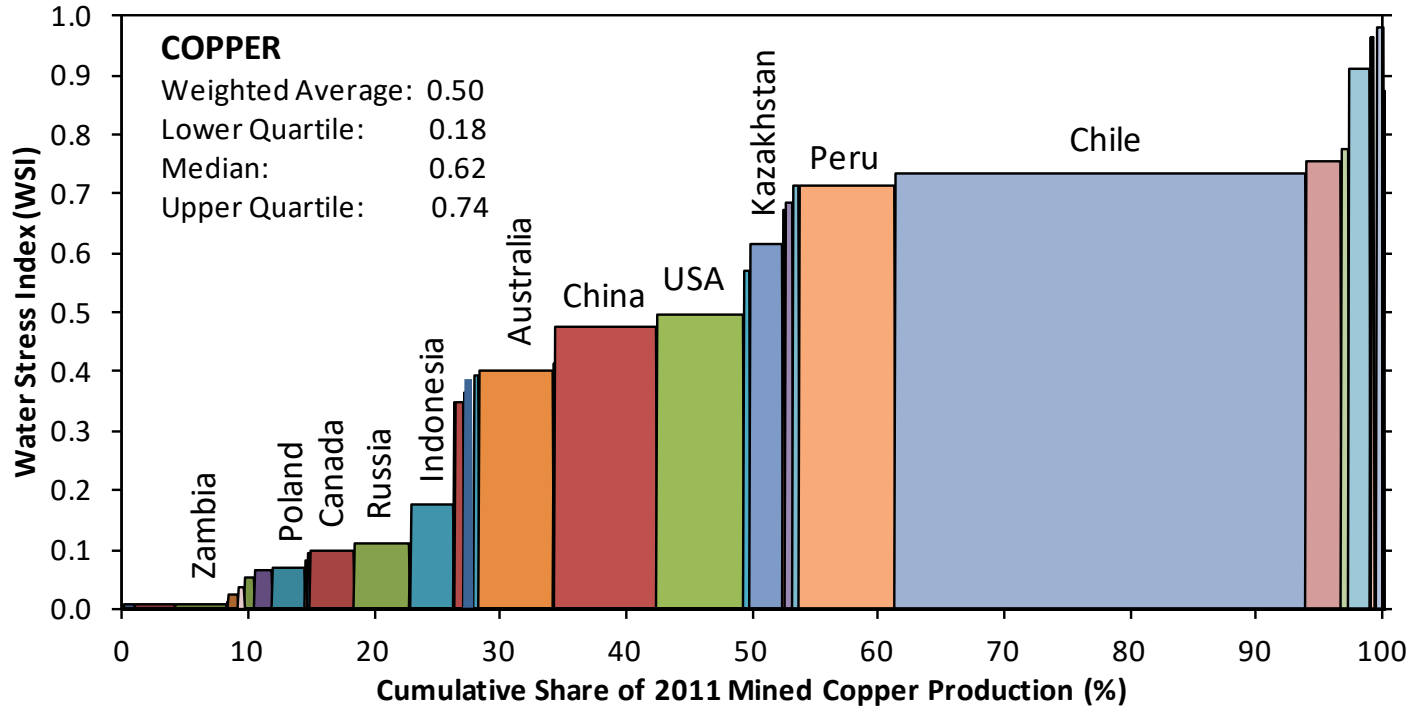
Session 3



# The exposure to water risks varies for different sectors of the mining industry

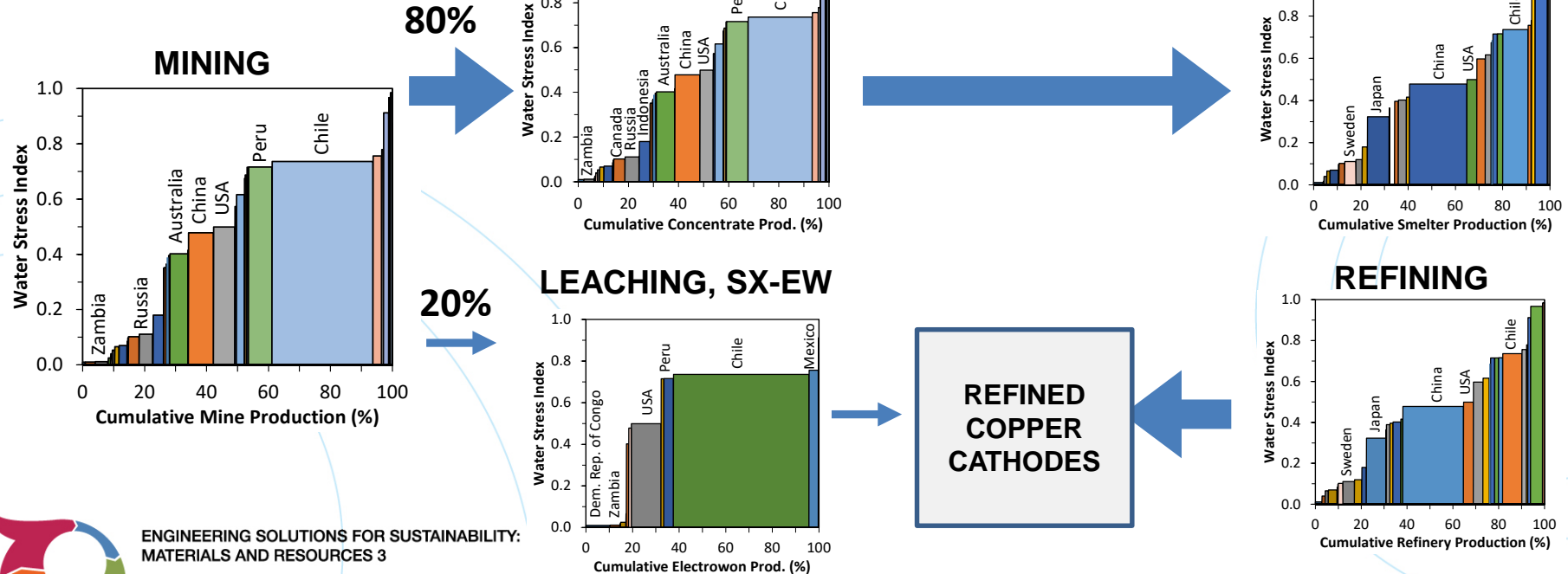


# The Copper Industry is Highly Exposed to Water Scarcity and Stress





# Exposure Differs Throughout Mineral Supply Chains



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Northey et al., 2014. Minerals Engineering, 69: 65–80.

# Variability in mine water interactions and local contexts creates challenges when measuring mine-site water performance

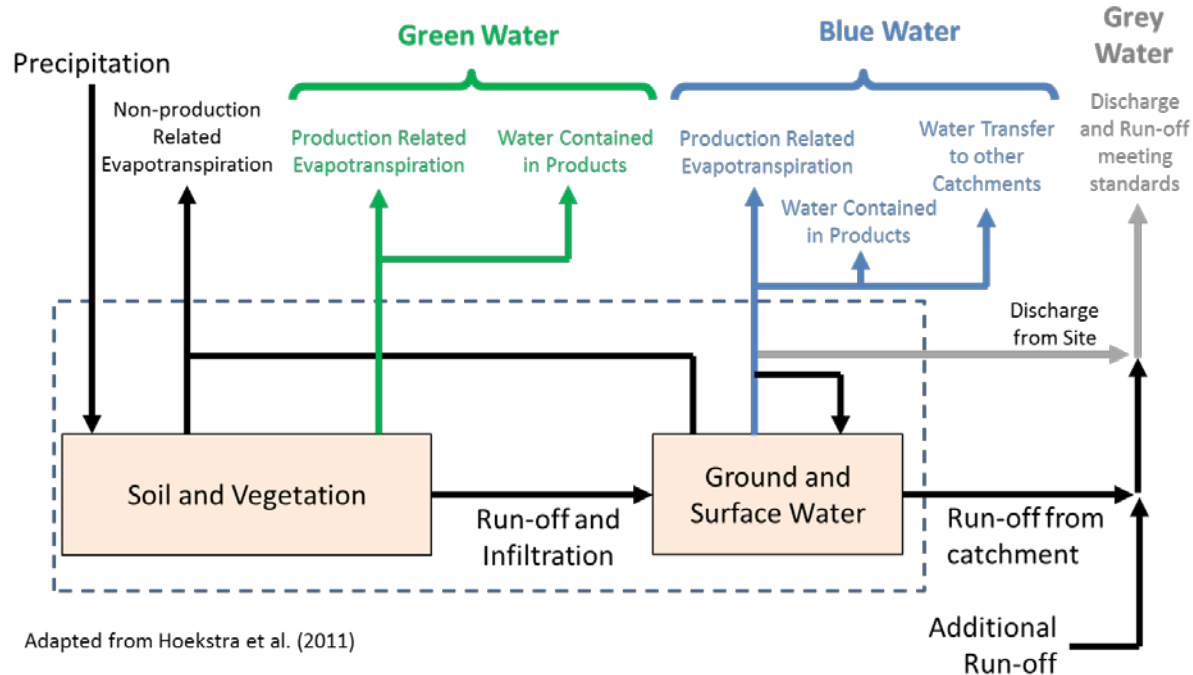
Approaches need to be able to account for differences in:

- Complex mine site water balances
- Highly variable water quality impacts
- Local hydrological contexts and risks

“Water Footprinting” methods provide a standardized approach to addressing these issues

# Water Footprint Network Standards

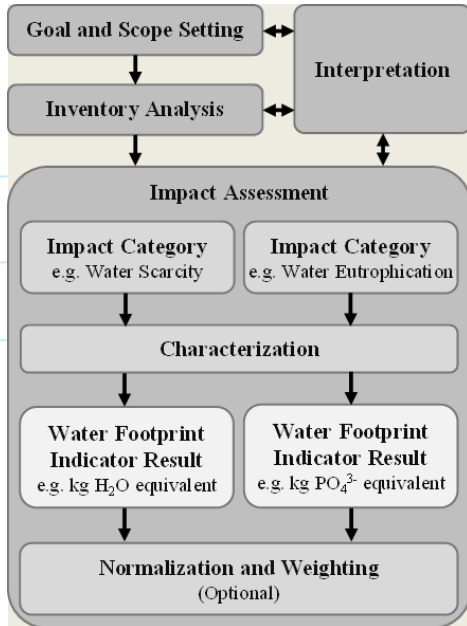
Water Footprint Network Standards (Hoekstra et al. 2009; 2011)



Adapted from Hoekstra et al. (2011)

# ISO14046:2014

## Environmental Management – Water Footprint



1. Goal and scope setting
2. Inventory Analysis
  - Quantifying water flows, sources, sinks, quality, accumulation and diversions.
3. Impact Assessment
  - What are the consequences of this water use?
  - Enables adjustments for factors such as the local water stress index (WSI).
4. Interpretation



# Benefits of Using Water Footprinting Methods

- Facilitates strong stakeholder relations
  - Provides complex data in a format that is easily accessible to a range of industry stakeholders
  - Facilitates comparisons with relevant regional users (e.g. agriculture)
- Improves a companies internal understanding of water use and risks
  - Developing a water footprint will quickly identify weaknesses in mine site water balance models
  - Provides an understanding of the potential hot-spots for process improvements.
  - Enables local water scarcity and quality to be accounted for when comparing multiple operations.
  - Assessment of indirect water use can identify water related risks in a mine's supply chain.
- Integrates easily with other assessment methods used in the circular economy
  - e.g. carbon footprinting, life cycle assessment, material flow analysis



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## Thank you

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