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Approaches for Sustainable Hydropower use in Austria

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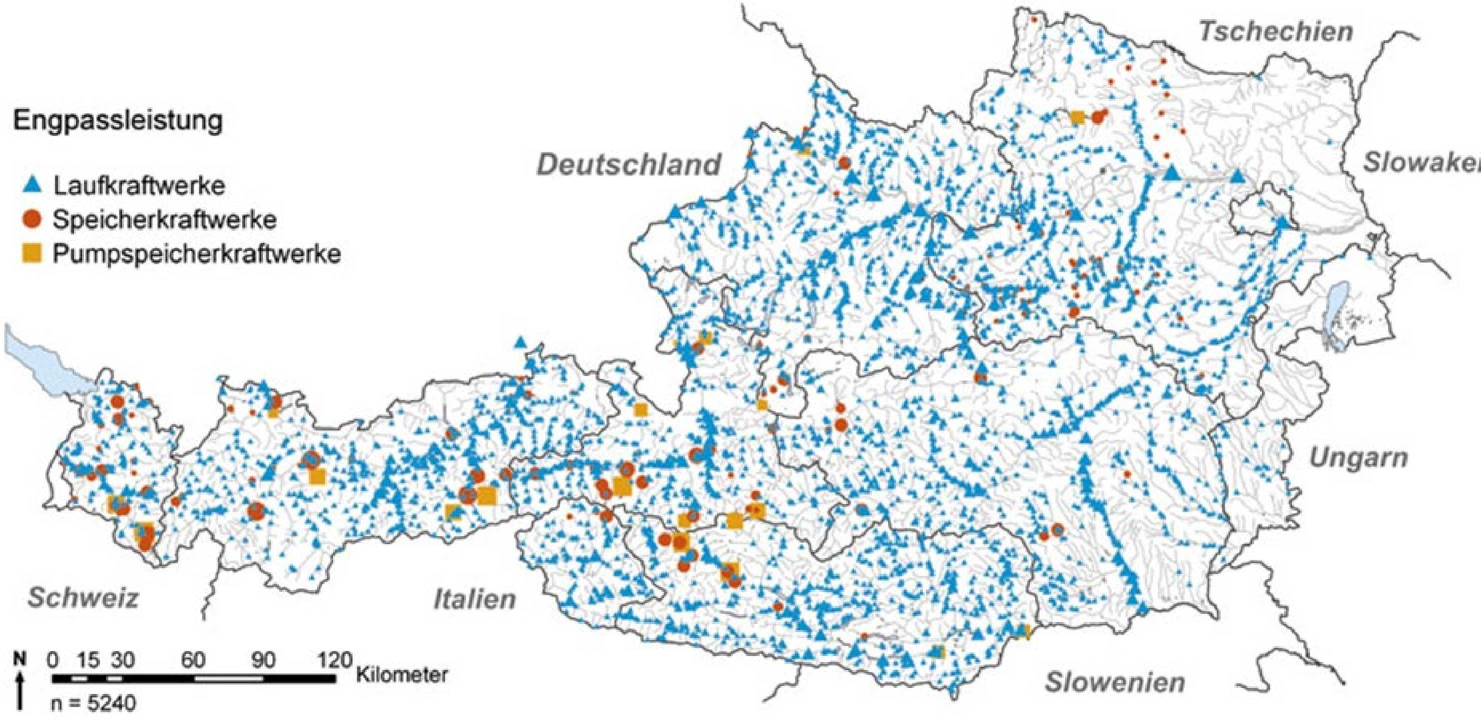
The 2nd International Conference on
Sustainability in Hydropower 2023
–Ecological mitigation, best practises and governance

Hydropower Use in Austria

- High importance for Austrian electricity supply:
  - 2/3 of total Austrian electricity production, 60% of total Austrian electricity demand
- 3.076 Hydropower plants (total capacity 14,6 GW)
  - 2.962 Run-of-River plants
  - 114 storage plants
  - 95% small hydropower plants (<10 MW) <10% of installed capacity, ca. 13% of annual production
- ca. 2.000 Micro-plants (for self supply)

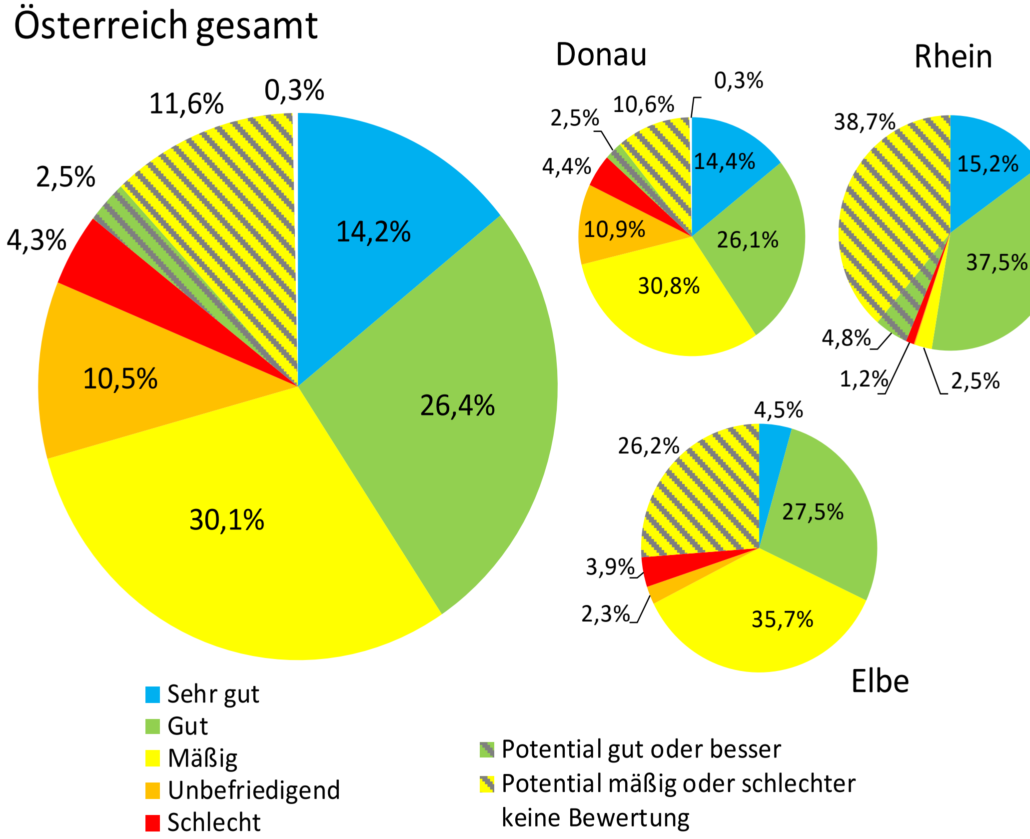


Ecological Status Austrian Rivers >10 km²

32.100 km, ca. 8.100 water bodies
85,9% natural, 12,3% HMWB 1,8% AWB

57% fail objectives WFD

2/3 of the Austrian fish species
are endangered



Main Pressures	**Share of Hydropower Sector**
• Continuity interruptions: 26.679	→11%
• Impoundments: 1.334 km (4,2%)	→73%
• Water abstractions: 2.134 km (6,6%)	→82%
• Hydropeaking: 807 km (2,5%)	→ 100%
• Hydromorphological alterations: 9722 km (30,3%)	→ ??% (14% impoundments)

Goals to be met…

- Increase of renewable energies
  - to mitigate climate change and
  - to overcome the energy crisis
- Protection and sustainable use of waters
- Protect endangered species and habitats
- Increase biodiversity and restore Ecosystems

Energy crisis!

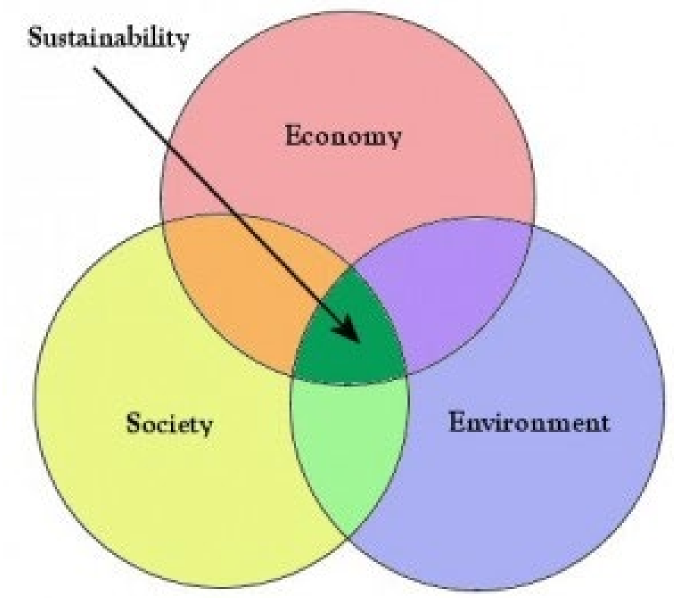
Climate crisis!

Biodiversity crisis!

Challenge of balancing conflicting interests!

Sustainable Management

„sustainable hydropower use"



Restoration
Mitigation

Manage hydropower development

in compliance with Green standards and legal requirements

Austrian Strategy for sustainable hydropower development

- **Green standards to minimise impacts on aquatic ecology**
  Mandatory mitigation measures for new and existing hp plants
- **To boost hidden potential as win –wins**
  Upgrading technical efficiency at existing plants and improving aquatic ecology at the same time
- **Strategic planning for appropriate site selection**
  balancing conflicting interests - making use of synergies
- **Research and innovation**
  - to increase knowledge,
  - find tailormade solutions
  - minimise impacts on hydropower use

Green standards

Mandatory mitigation measures legally fixed (relevant for new and existing hydropower plants)

Ecological continuity
(fish passes)

© verbund

Ecological flow

(quantity, dynamics)

Generally: **Minimising negative effects on river ecology**

Impoundment:
change of river character,
losses in habitat diversity

Hydropeaking: rapid flow fluctuations

Strategic planning for new hydropower development

Decision support tool for balancing conflicting interests

- „Criteria Catalogue Hydropower“

Strategic planning for appropriate site selection

- on regional level
  - cumulative effects
  - synergies
  - other renewable options

Decisions to be transparent, uniform and reproducible

How to resolve conflicting goals and interests?

A joint effort…

- Early involvement of all stakeholders
- Integrative approaches and close cooperation between administration, hydropower sector and science
  - ⇨ find joint solutions for complex problems
- develop strategies and approaches that are shared by all so that they can be implemented quickly
- establish a common basis beyond dispute (e.g. joint research projects)
  - ⇨ fact-based decisions
  - ⇨ Mutual understanding of concerns and difficulties
  - ⇨ Acceptance for joint decisions

Example: Hydropeaking

- 725 km of rivers impacted by hydropeaking
  → fail good ecological status
- High importance: peak power generation, regulatory power and flexibility
  →designated as HMWB

Joint research projects

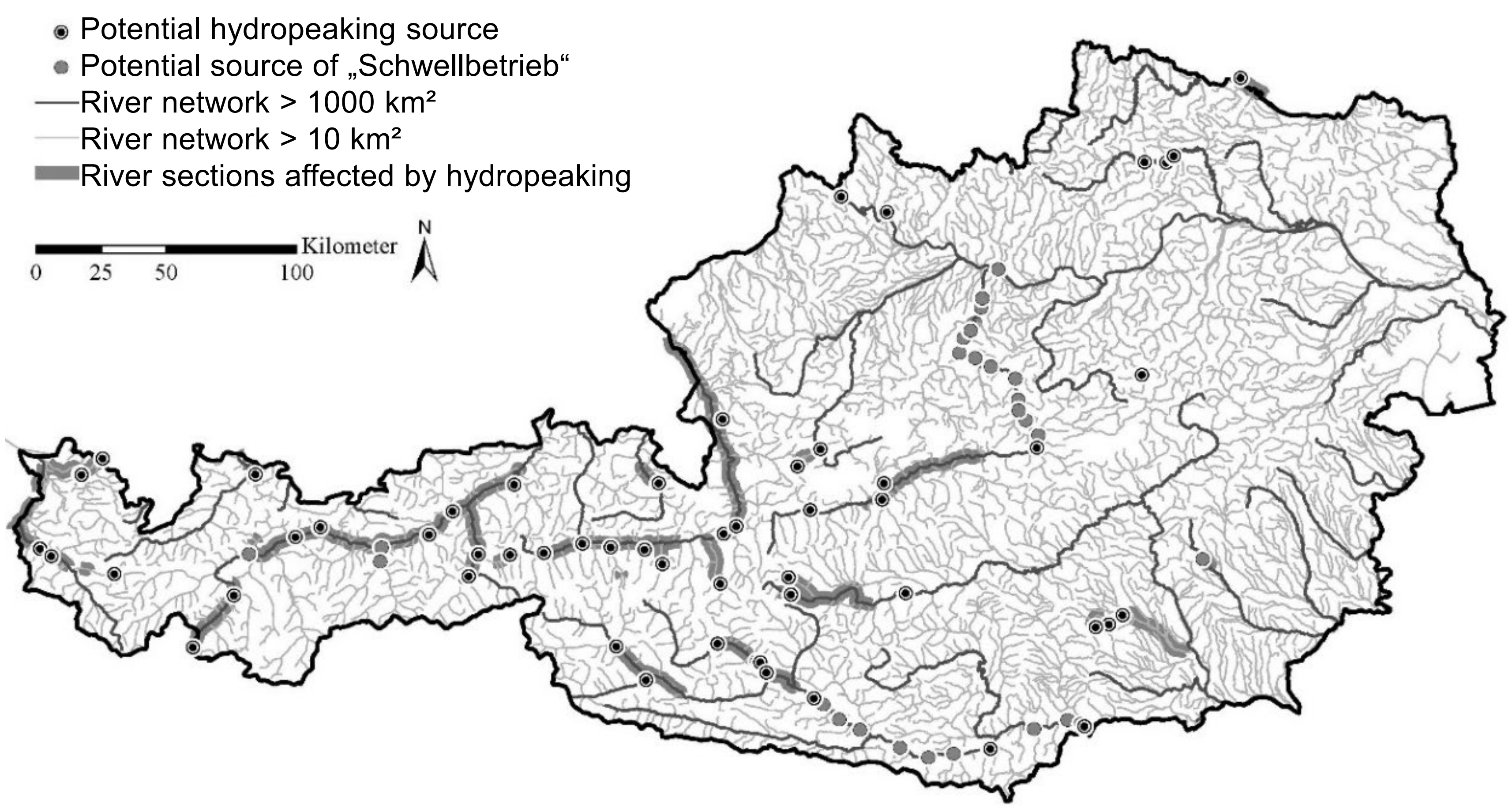
- Effects on ecology
- Effective measures and their effect on energy production
- Methodology for assessing good ecological potential
  →basis for feasibility studies

River basin management includes obligation to prepare feasibility studies for all rivers affected by hydropeaking

Hydropeaking in Austria

Around 800 km of rivers are affected by hydropeaking

Most waterbodies are designated as HMWB



More than 80 potential hydropeaking sources identified

Strong differences in hydrological situations!

BMLRT (2017): Nationaler Gewässerbewirtschaftungsplan 2015.
Greimel, F., Zeiringer, B., Höller, N., Grün, B. & S. Schmutz (2017): Anhang zu technischer Bericht A - Kurzfristige Abflussschwankungen in Österreich. Ergänzung zu Endbericht: Suremma.

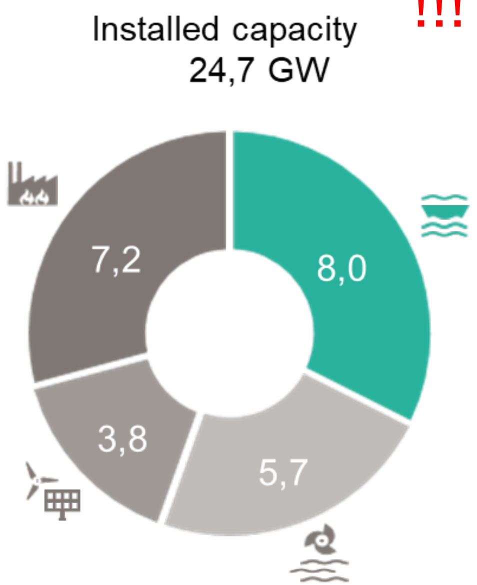
Hydropeaking in Austria

Around 800 km of rivers are affected by hydropeaking

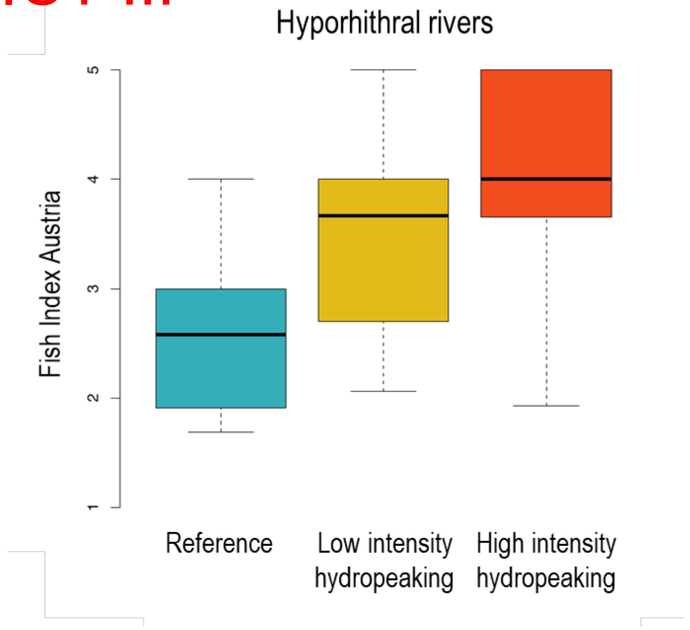
Energy and Climate crisis!

More than 80 potential hydropeaking sources identified

!!! CONFLICT !!!



- Storage hydropower plants represent one third of the Austrian power plant capacity!
- Flexible energy production needed!



- Poor Ecological status!
- Grayling vulnerable!
- Danube Salmon endangered!
- Macroinvertebrates affected!

Most waterbodies are designated as HMWB

Biodiversity crisis!

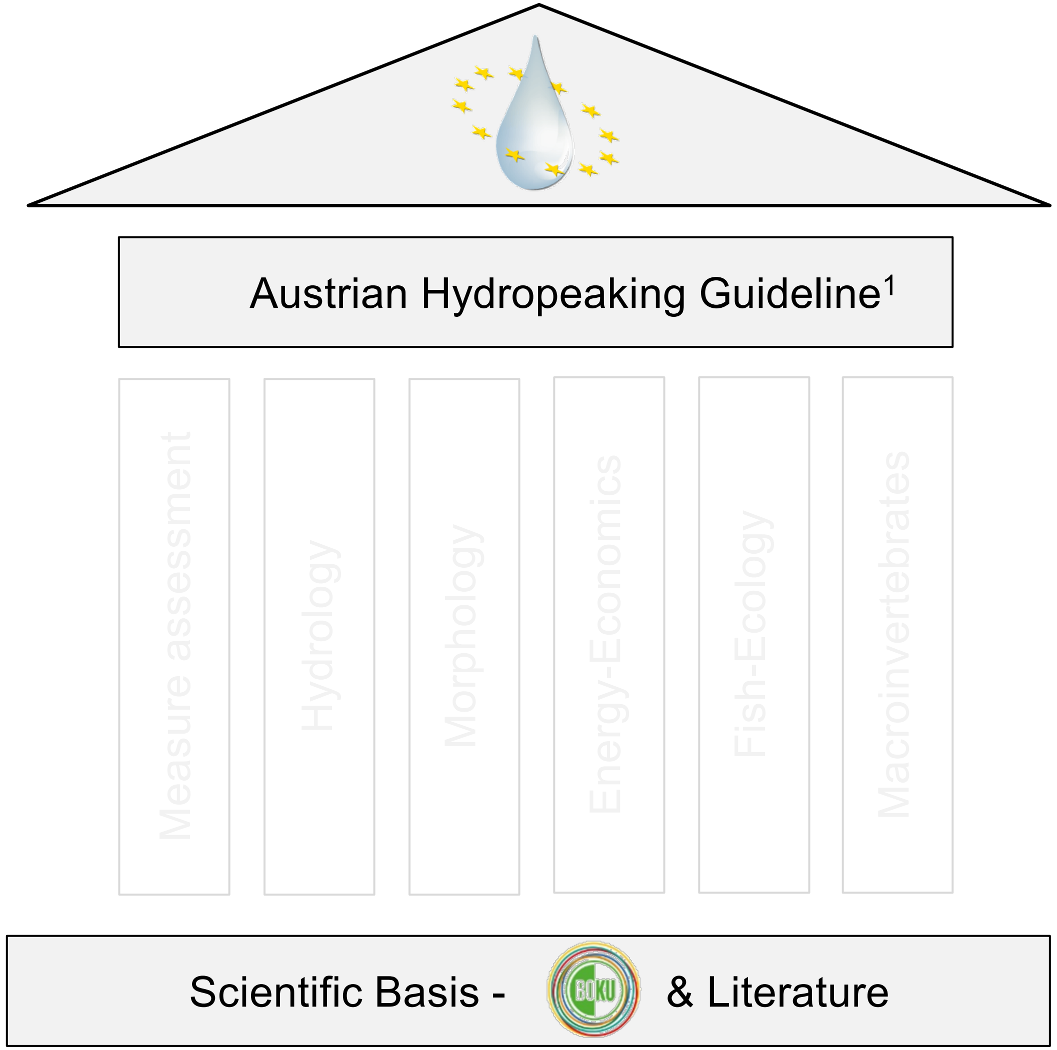
Strong differences in hydrological situations!

MITIGATION in heavily modified water bodies[1]:

- Impact on use
- Ecological benefits

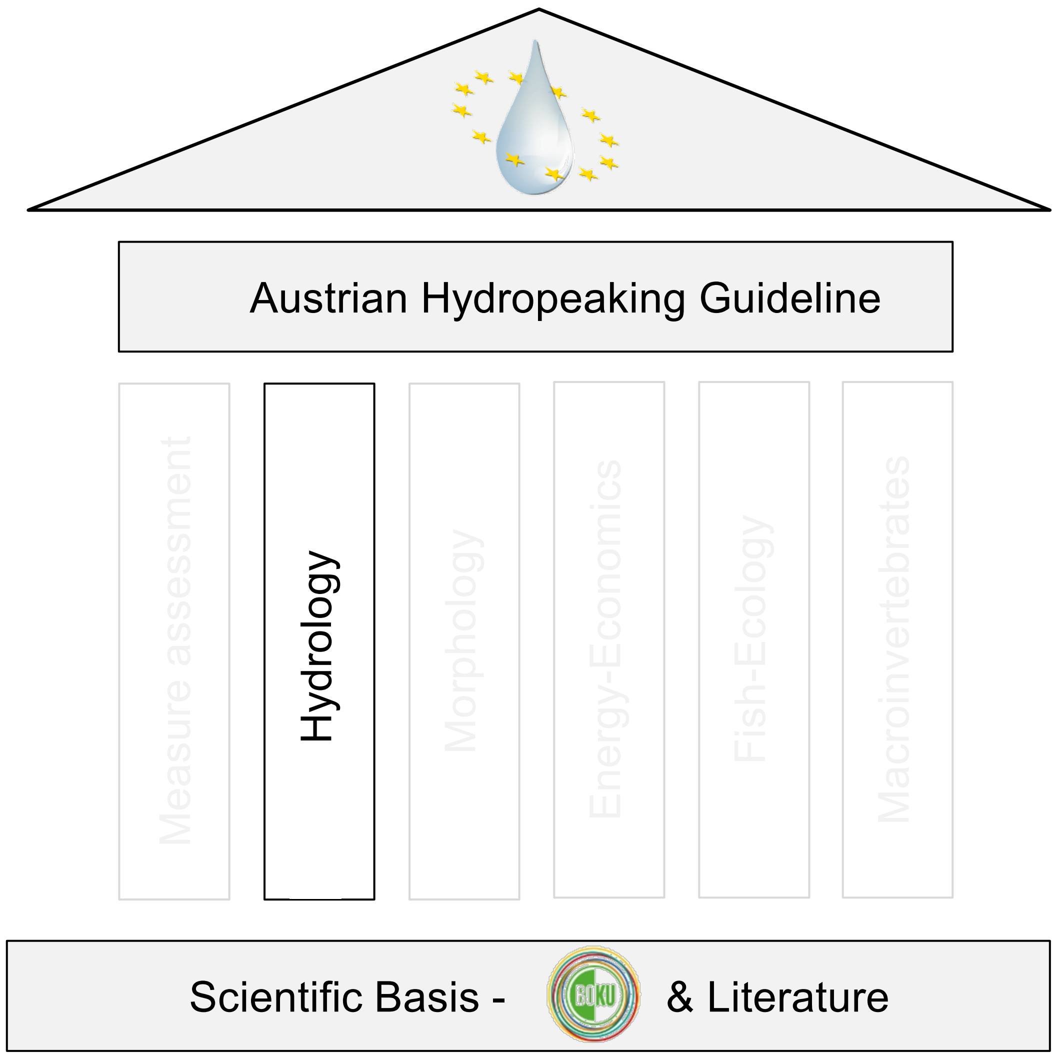
[1]European Commission, 2020: Guidance Document No. 37 Steps for defining and assessing ecological potential for improving comparability of Heavily Modified Water Bodies, CIRCABC.

Austrian Hydropeaking Guideline

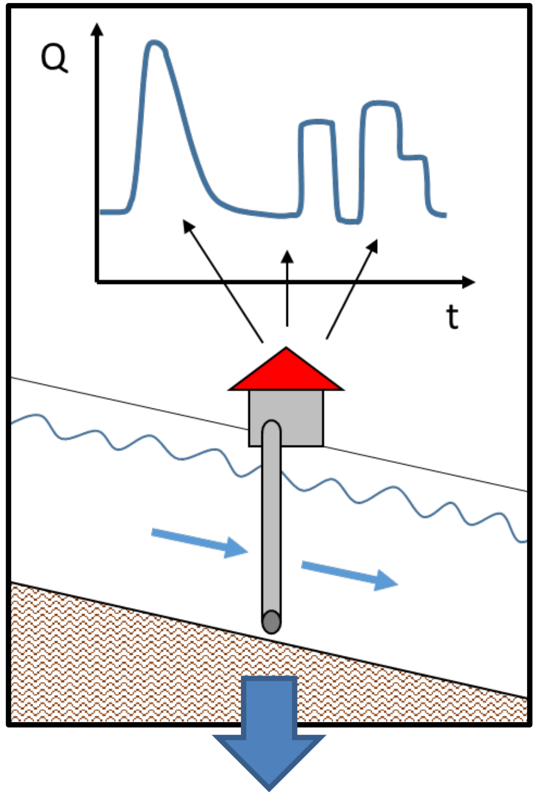


[1]Ofenböck, G. (in prep.). Austrian Hydropeaking Guideline.

Austrian Hydropeaking Guideline - Hydrology

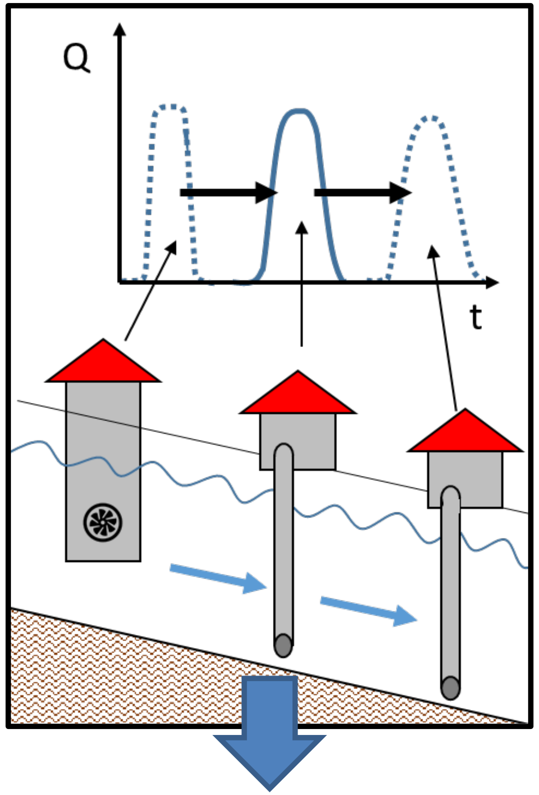


Eulerian perspective



Pre- and Post-Monitoring

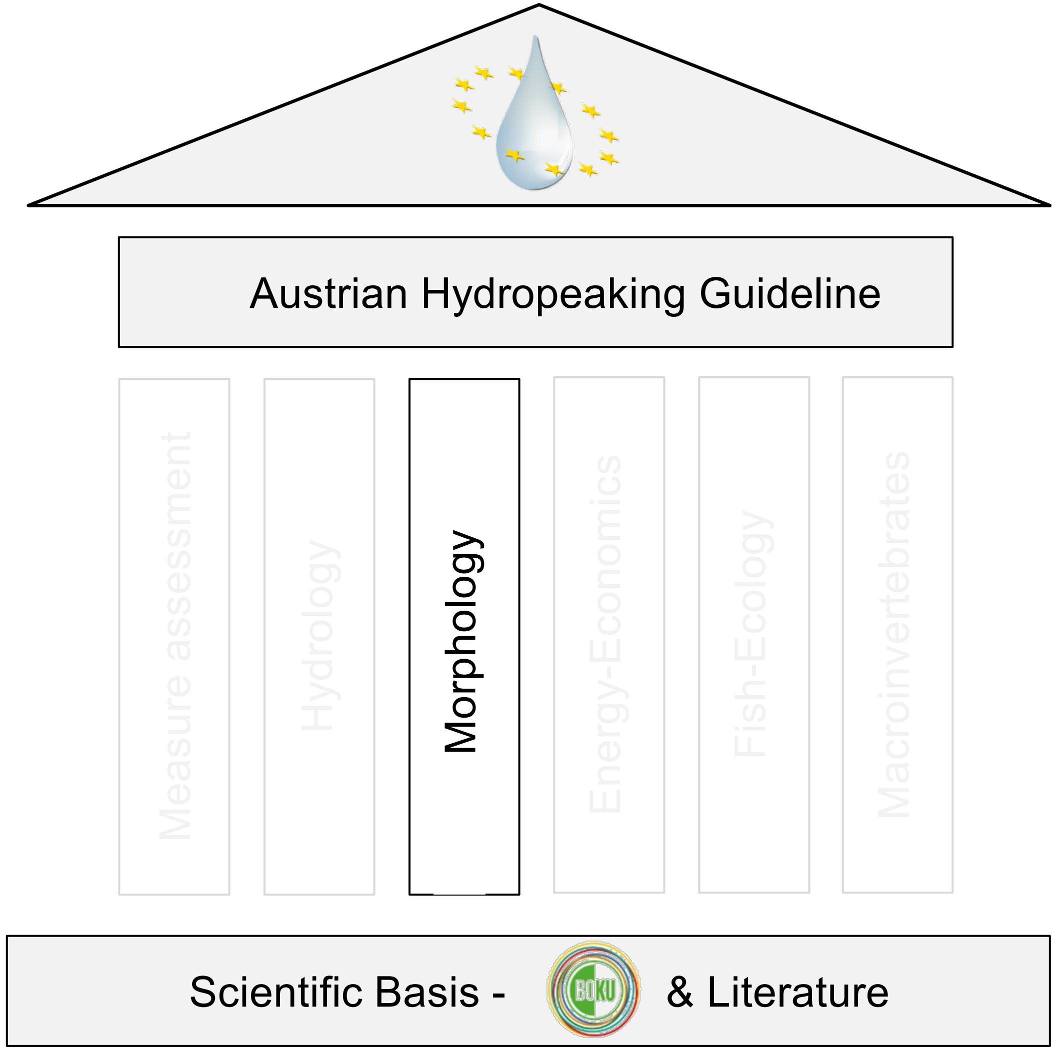
Lagrangian perspective



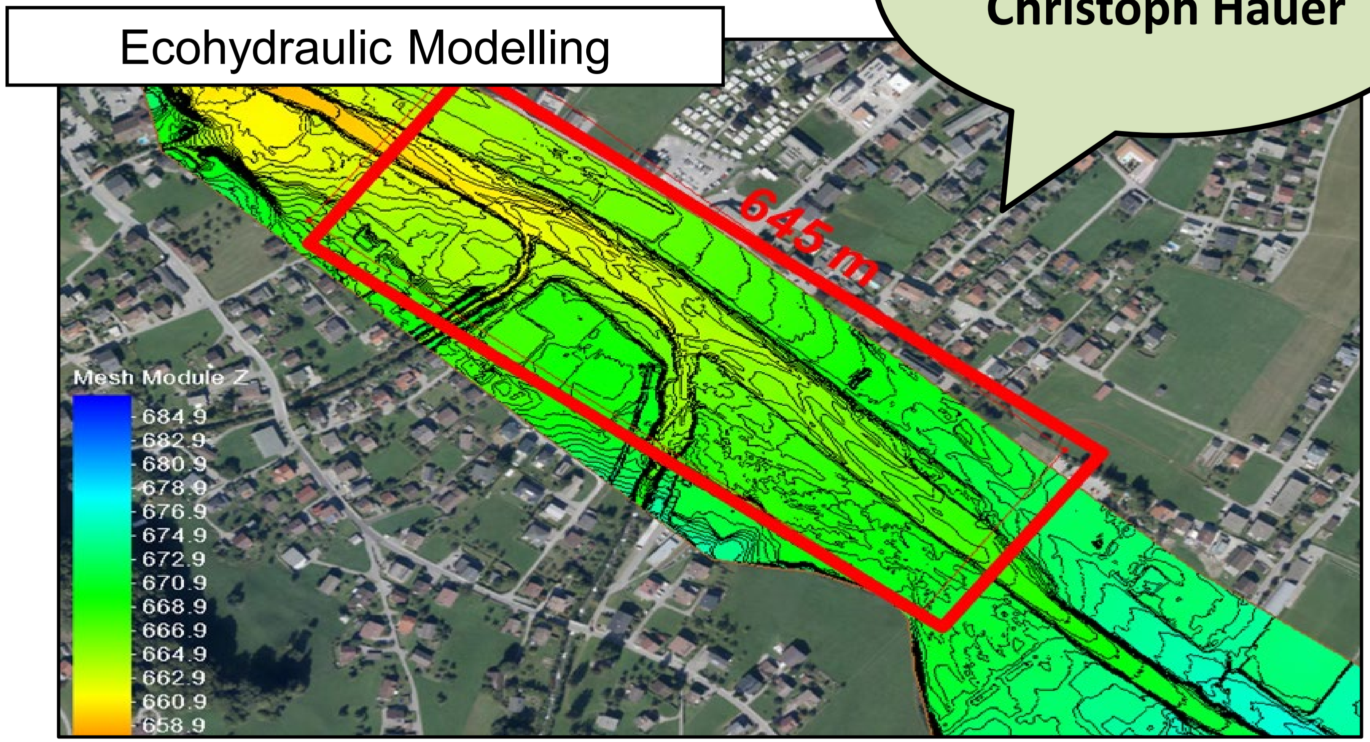
Large scale assessment of
(power plant-specific)
- Stranding risk
- Drift risk
- Habitat degradation risk

Greimel, F. (2022): Characterization of dub-daily flow fluctuations as a basis for sustainable hydropeaking management, Dissertation, University of Natural Resources and Life Sciences, Vienna.

Austrian Hydropeaking Guideline - Morphology



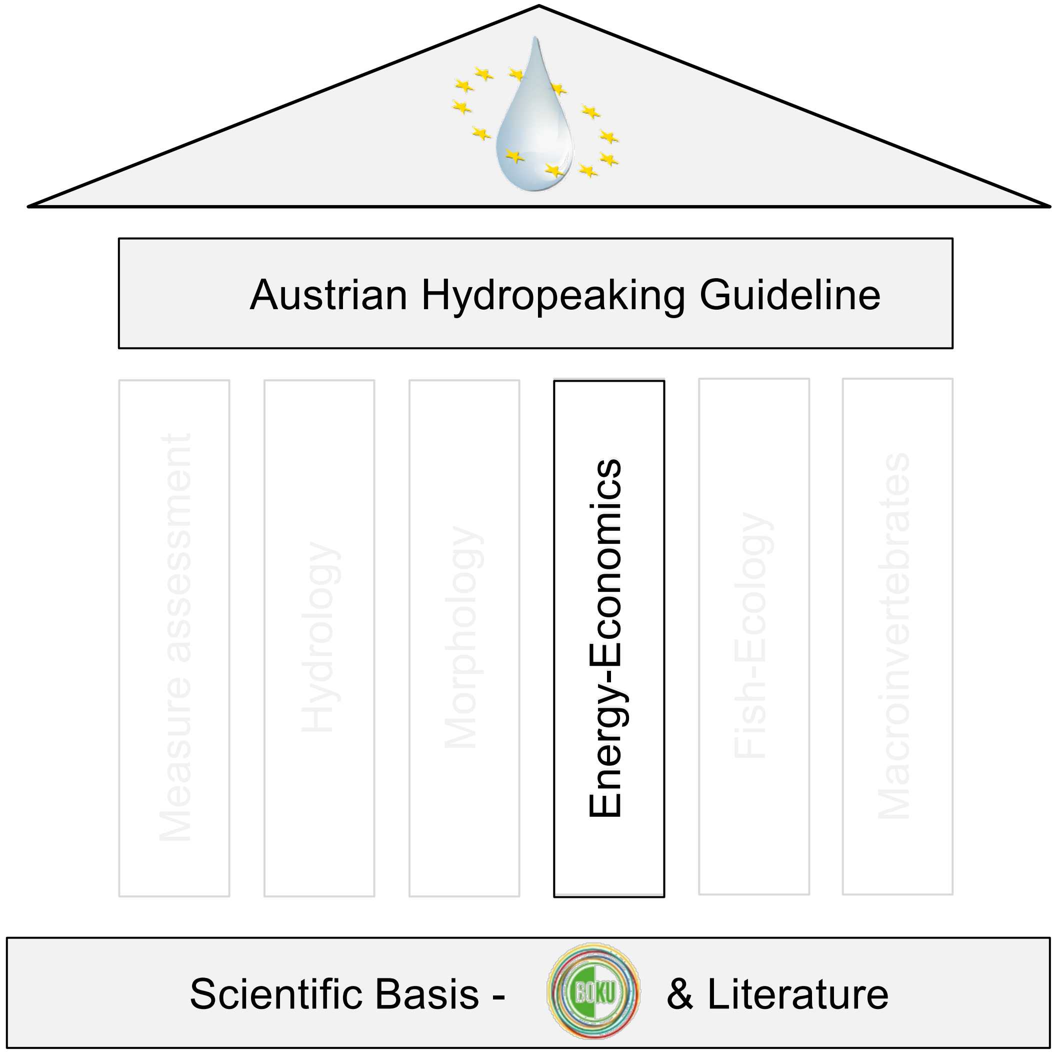
Talk of
Christoph Hauer



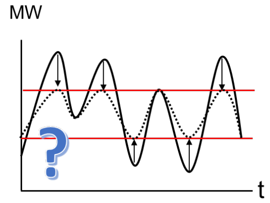
Case-based conceptualization and design of indirect/morphological mitigation measures.

e.g., Hauer, C., B. Schober, & H. Habersack, 2013. Impact analysis of river morphology and roughness variability on hydropeaking based on numerical modelling: River Morphological Impacts on Hydropeaking Processes. Hydrological Processes 27: 2209-2224.

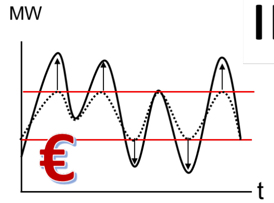
Austrian Hydropeaking Guideline – Energy-Economics



i
CO_2
Targets for climate protection

ii


Security of supply – flexible generation capacity

iii


Additional costs in the supply system

iv

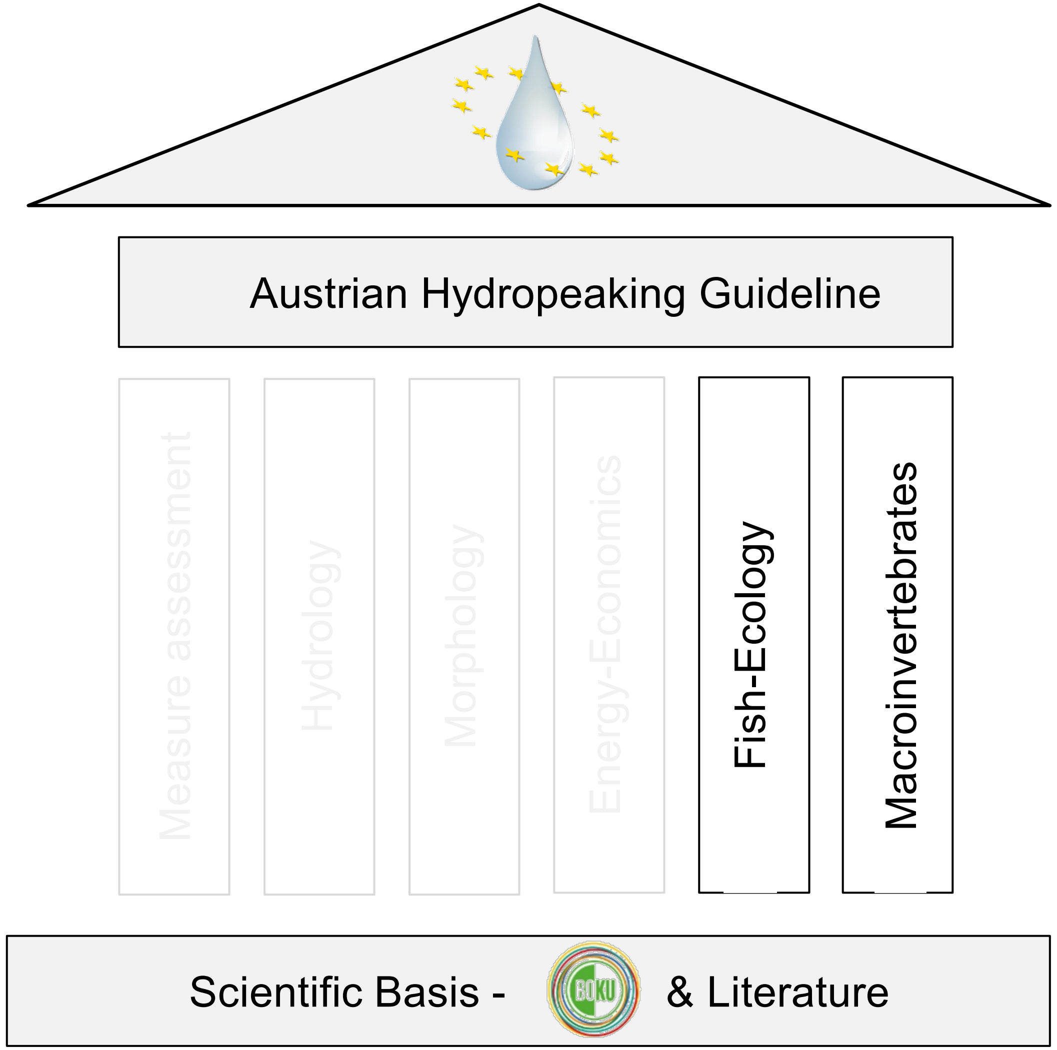

Investment costs

v
€ ⇨ €
Reduction in earnings

Standardised measure-specific assessment by hydropower plant operators and market experts

Neubarth J., 2021: Technischer Bericht III – Erweiterte energiewirtschaftliche Bewertung möglicher Maßnah-men zur Minderung von negativen schwall- und sunkbedingten ökologischen Auswirkungen. Ergänzung zu Endbericht: SuREmMa+ Entwicklung einer Methode zur ökologischen und energiewirtschaftlichen Bewertung von Maßnahmen zur Minderung von negativen schwall- und sunkbedingten ökologischen Auswirkungen. For-schungsbericht, oesterreichs energie, Wien, 26 Seiten.

Austrian Hydropeaking Guideline - Ecology

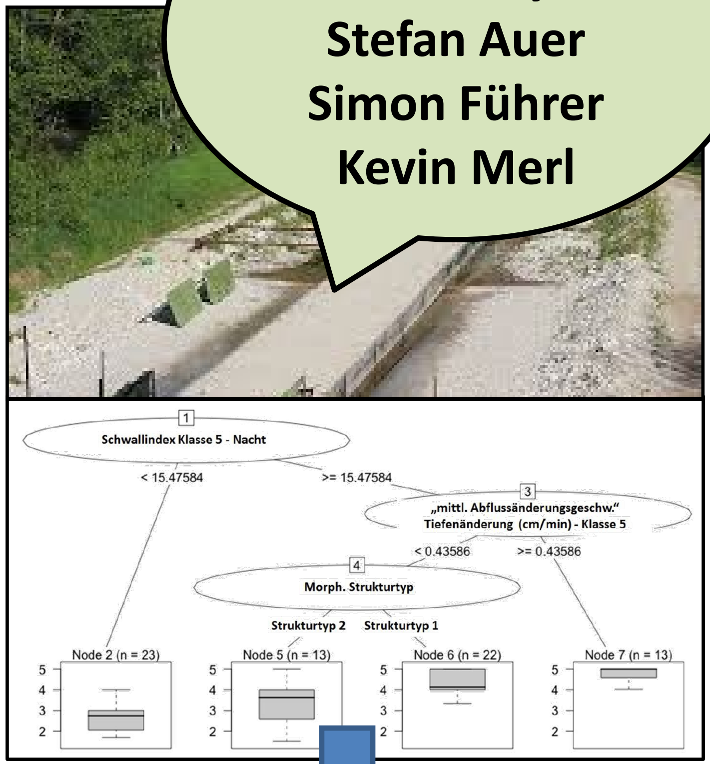


Standardized Sampling-Design

Pre- and Post-Monitoring

Experi

Talks of
Daniel Hayes
Stefan Auer
Simon Führer
Kevin Merl



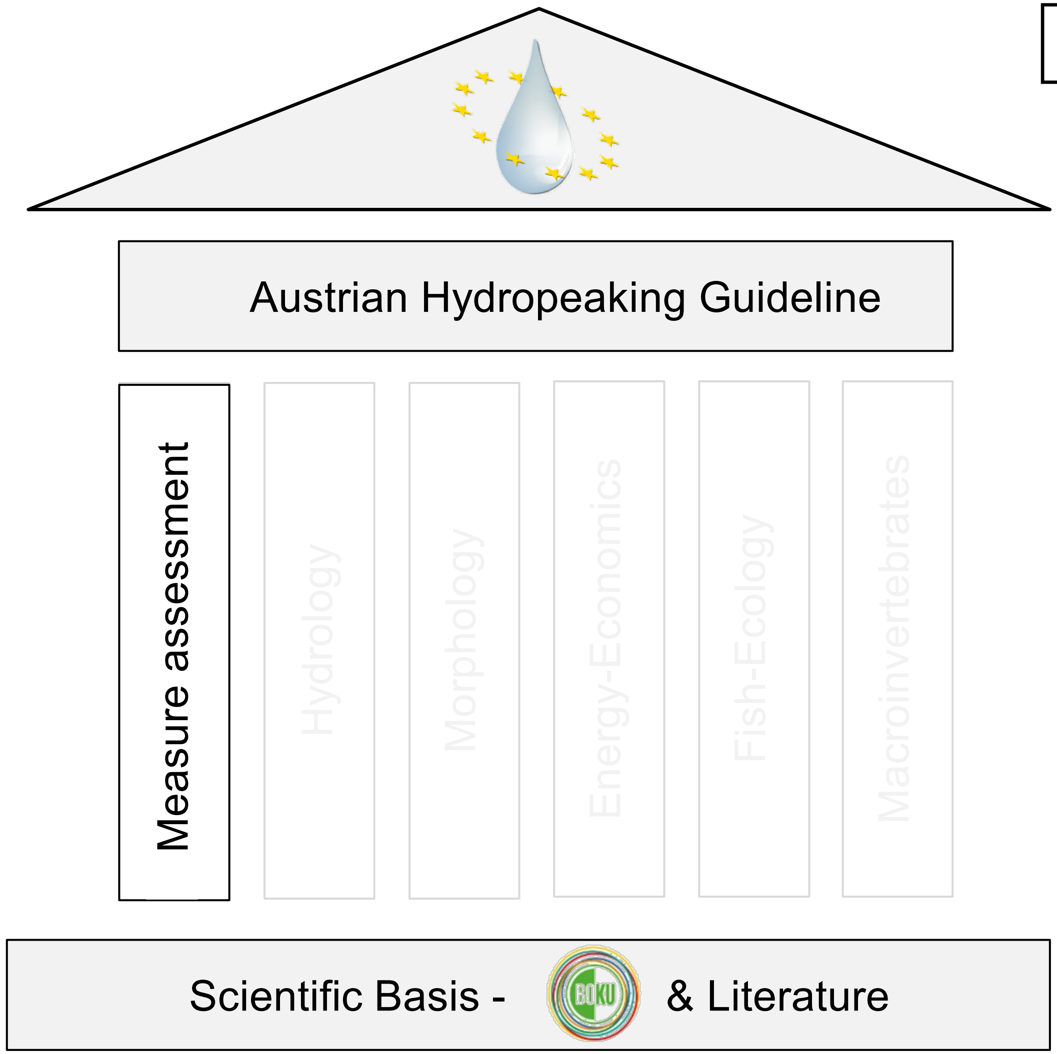
Basis for Impact-Assessment

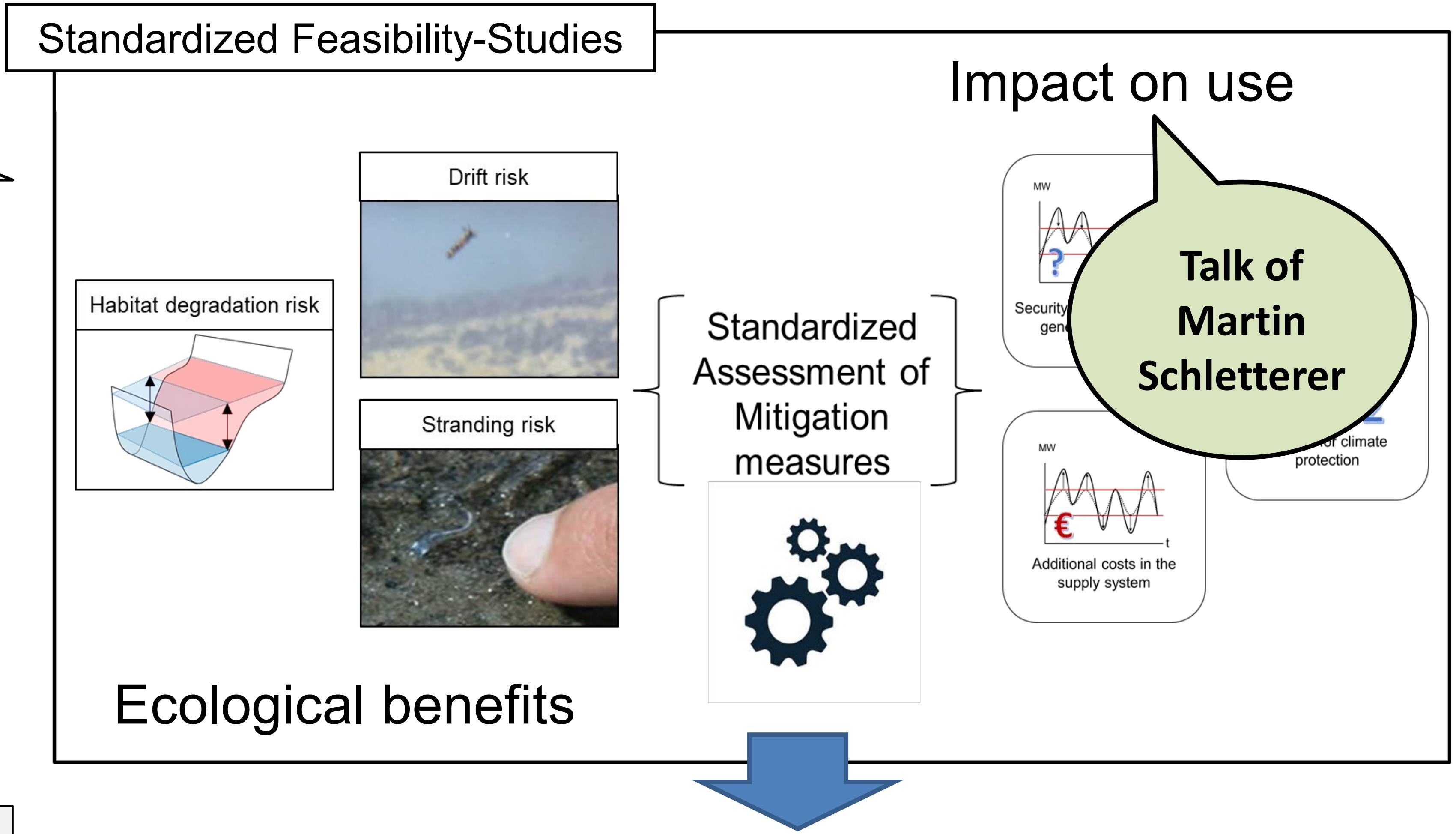
e.g.: Auer, S., Zeiringer B., Führer S., Tonolla D., & Schmutz S., 2017: Effects of river bank heterogeneity and time of day on drift and stranding of juvenile European grayling (Thymallus L.) caused by hydropeaking. Science of The Total Environment 575: 1515-1521.

Schülting, L., Feld C. K., Zeiringer B., Huđek H., & Graf W., 2019: Macroinvertebrate drift response to hydropeaking: An experimental approach to assess the effect of varying ramping velocities: Macroinvertebrate drift response to hydropeaking with varying ramping velocities. Ecohydrology 12: e2032.

Hayes, D., Lautsch E., Unfer G., Greimel F., Zeiringer B., Höller N., & Schmutz S., 2021: Response of European grayling, Thymallus , to multiple stressors in hydropeaking rivers. J Environ Mange. 292, 112737.

Austrian Hydropeaking Guideline – Identifying relevant mitigation measures

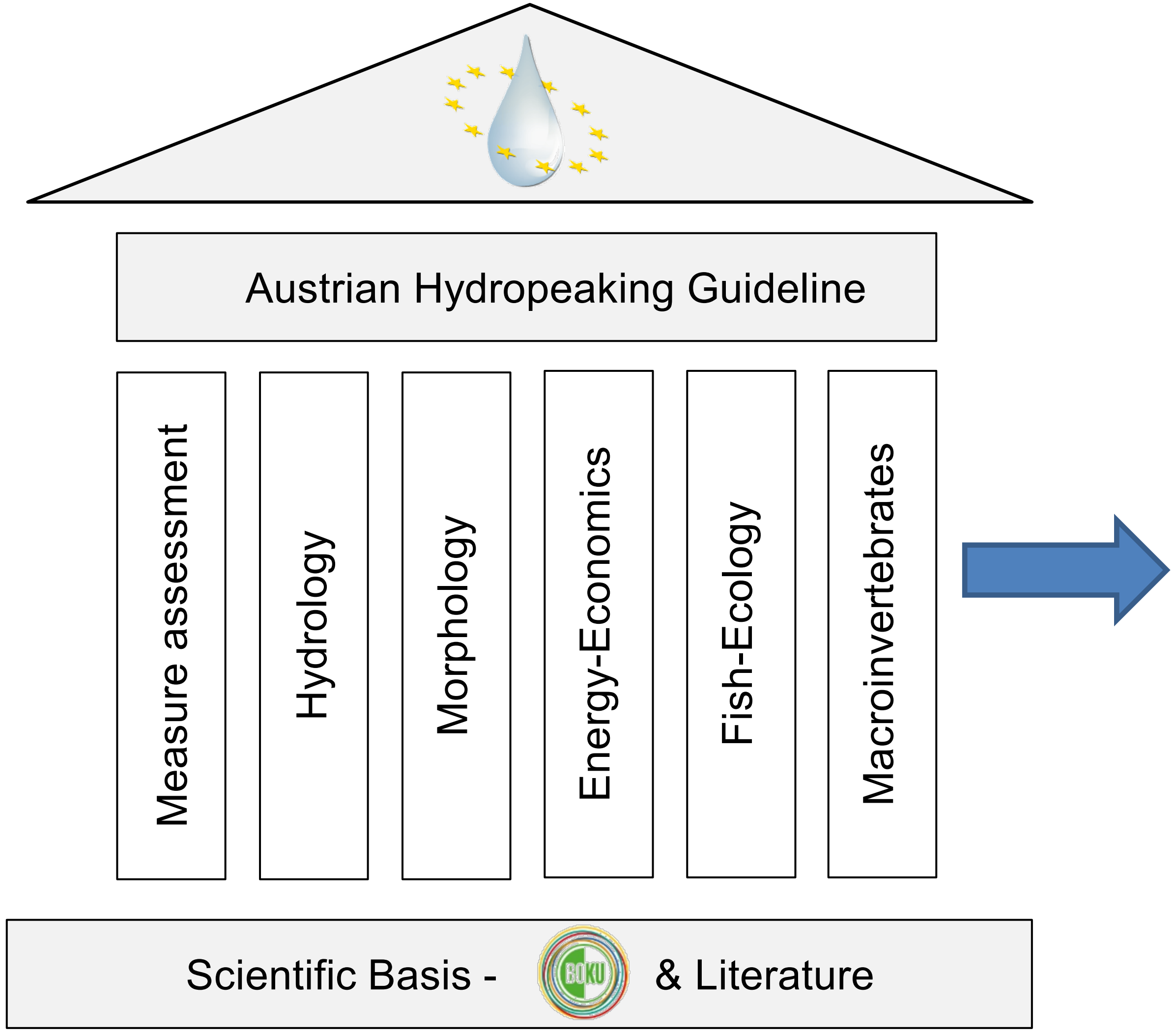




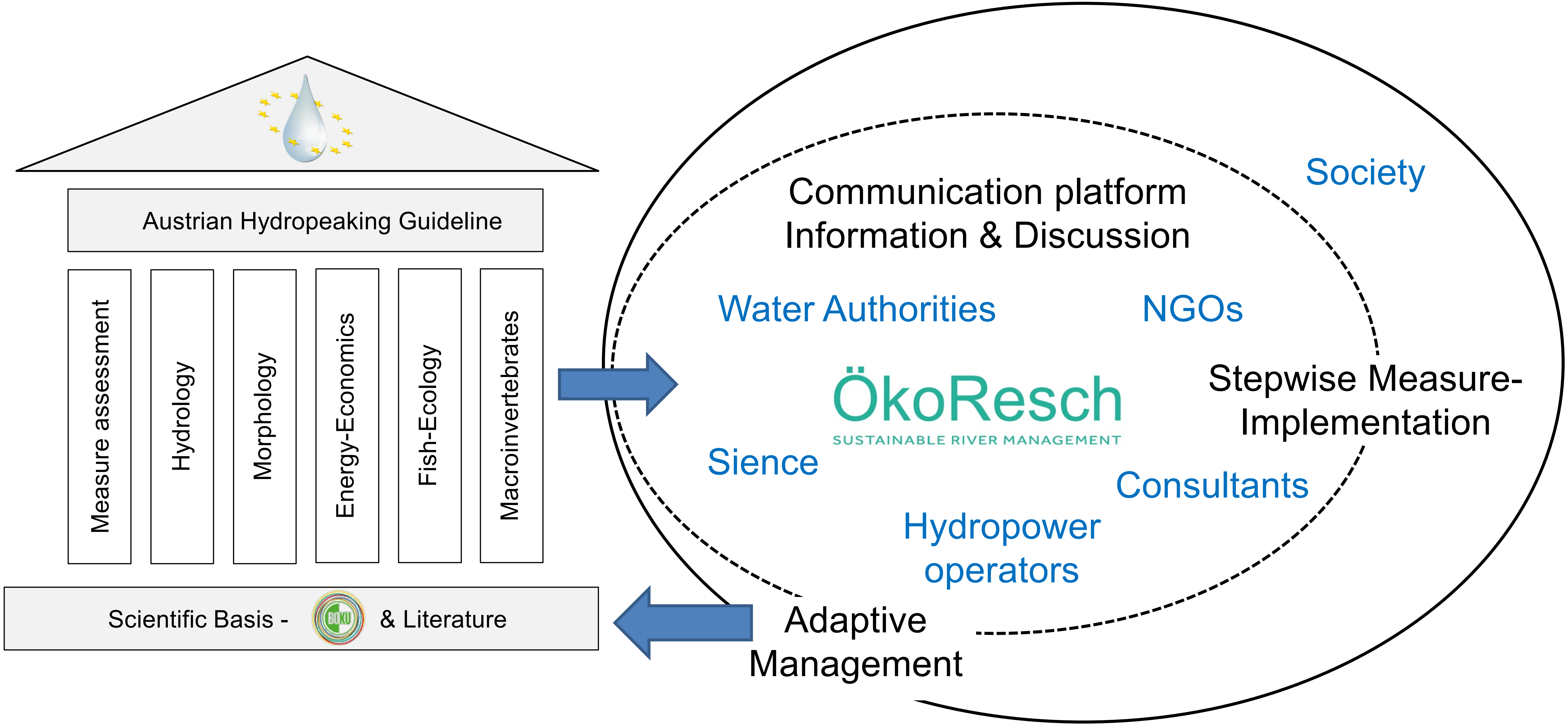
Basis for decision-making: „Good Ecological Potential“

Greimel, F., Neubarth J., Fuhrmann M., Zoltan L., Zeiringer B., Schülting L., Führer S., Auer S., Leitner P., Dossi F., Holzapfel P., Pfleger M., Leobner I., Sumper R., Pazmandy J., Graf W., Hauer C. & Schmutz S., 2021: SuREmMa+: Entwicklung einer Methode zur ökologischen und energiewirtschaftlichen Bewertung von Maßnahmen zur Minderung von negativen schwall- und sunkbedingten ökologischen Auswirkungen. For-schungsbericht, BMLRT, Wien, 158 Seiten.

Austrian Hydropeaking Guideline – ÖkoResch project (2020-2026)



Austrian Hydropeaking Guideline – ÖkoResch project (2020-2026)



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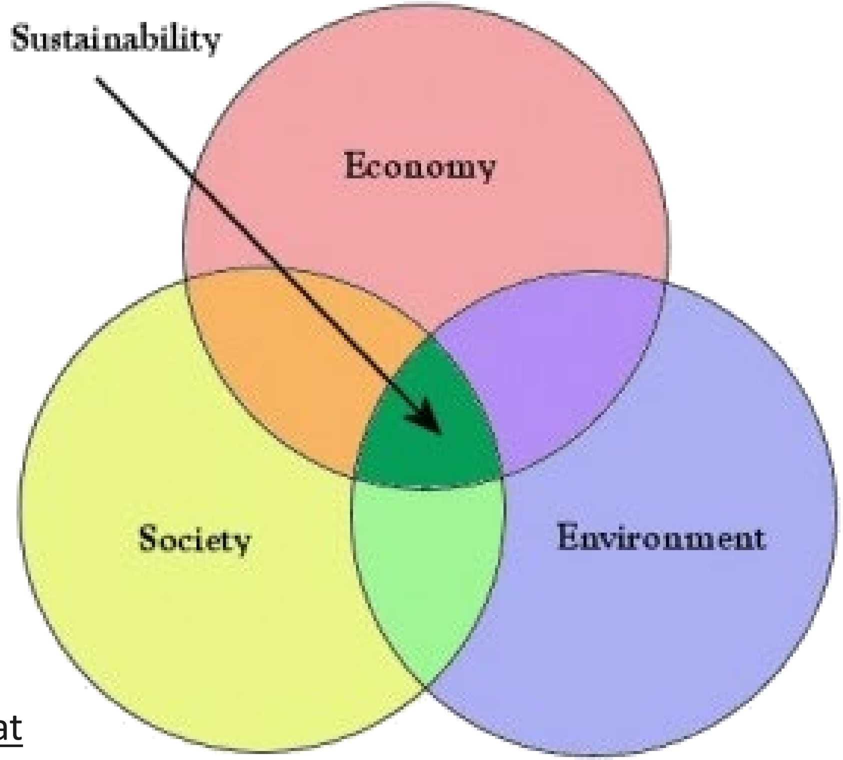

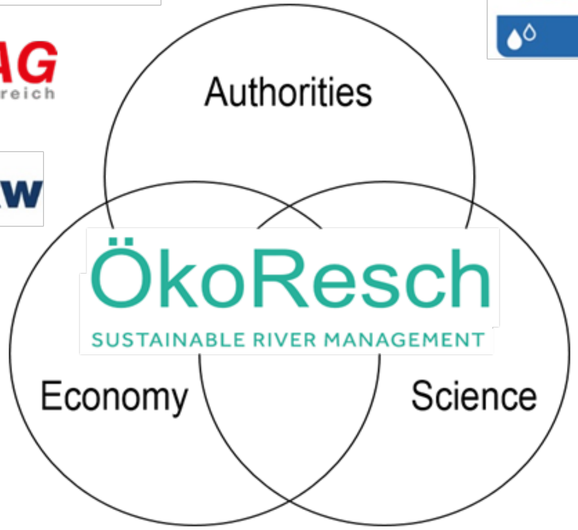

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