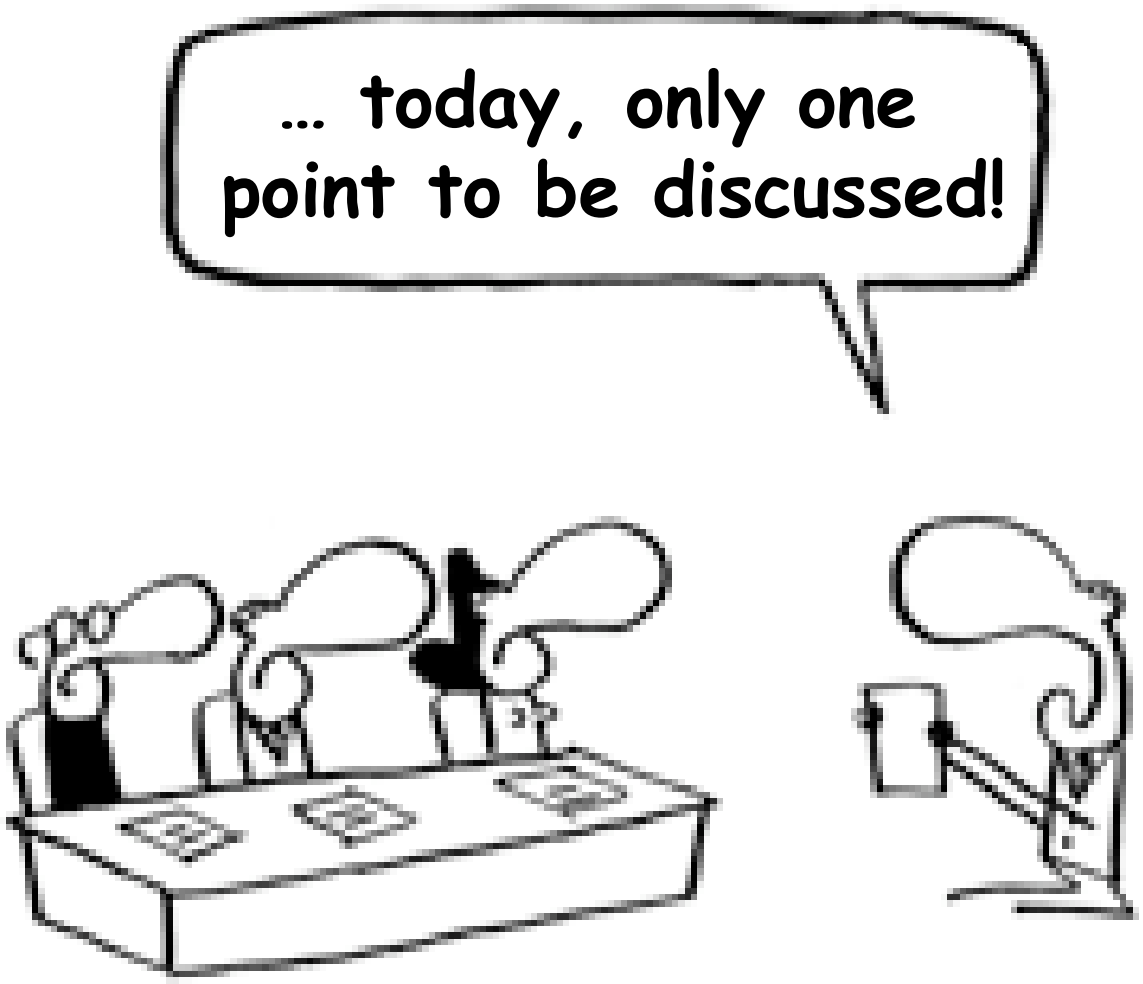

point to be discussed

-SAVE THE PLANET

MIX & REMIX

35 LCA forum Zurich
Water in LCA
June 5, 2008

Characterization factors for damage to aquatic biodiversity caused by water use

especially from dams used for hydropower

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Problem statement

- LCA tend to systematically show hydropower more environmentally friendly than other alternatives to produce electricity

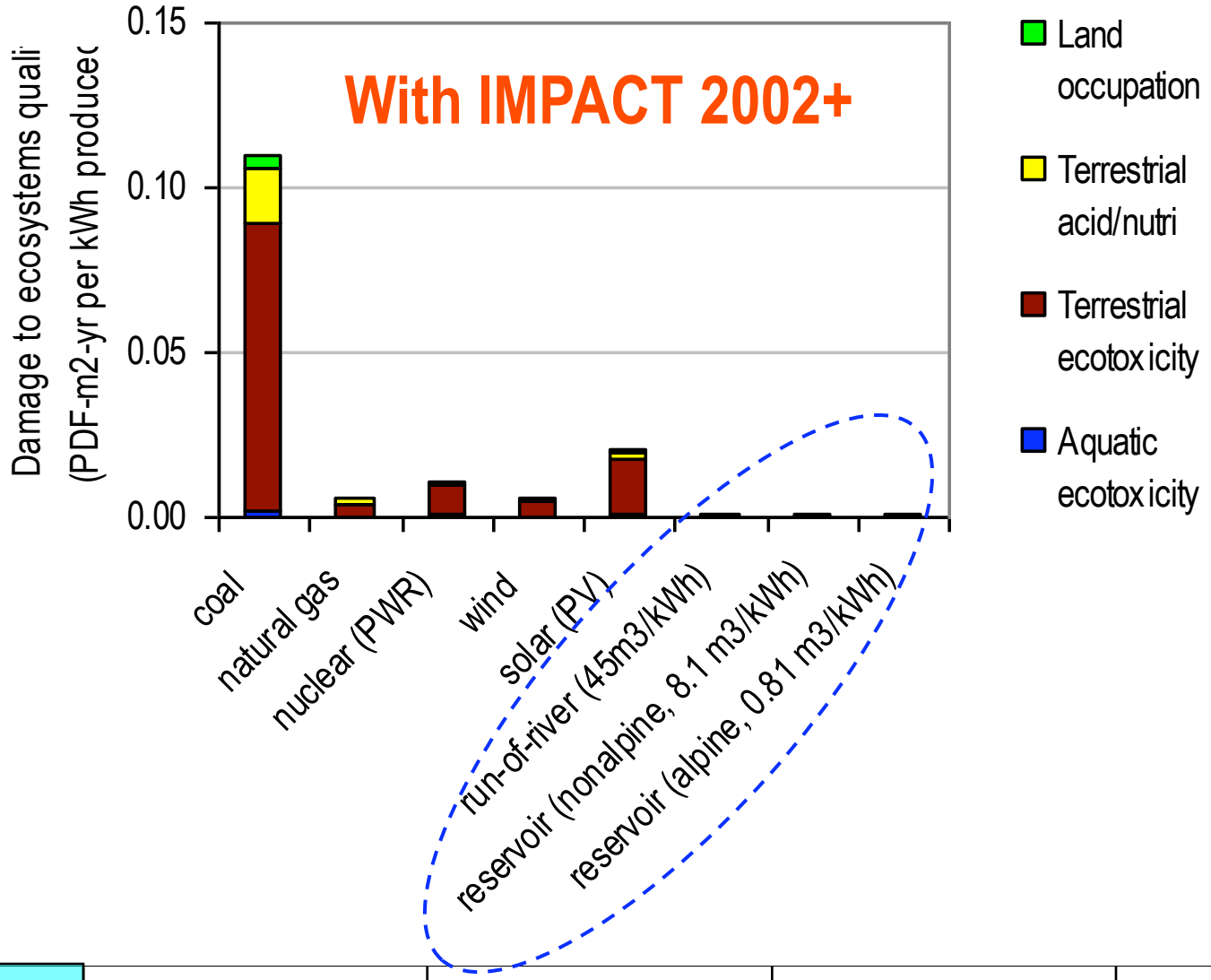
- Can be intuitive for CO_2,
  - Though dams in tropical regions can emit high amount of CH_4

- Using traditional LCIA methodologies, even

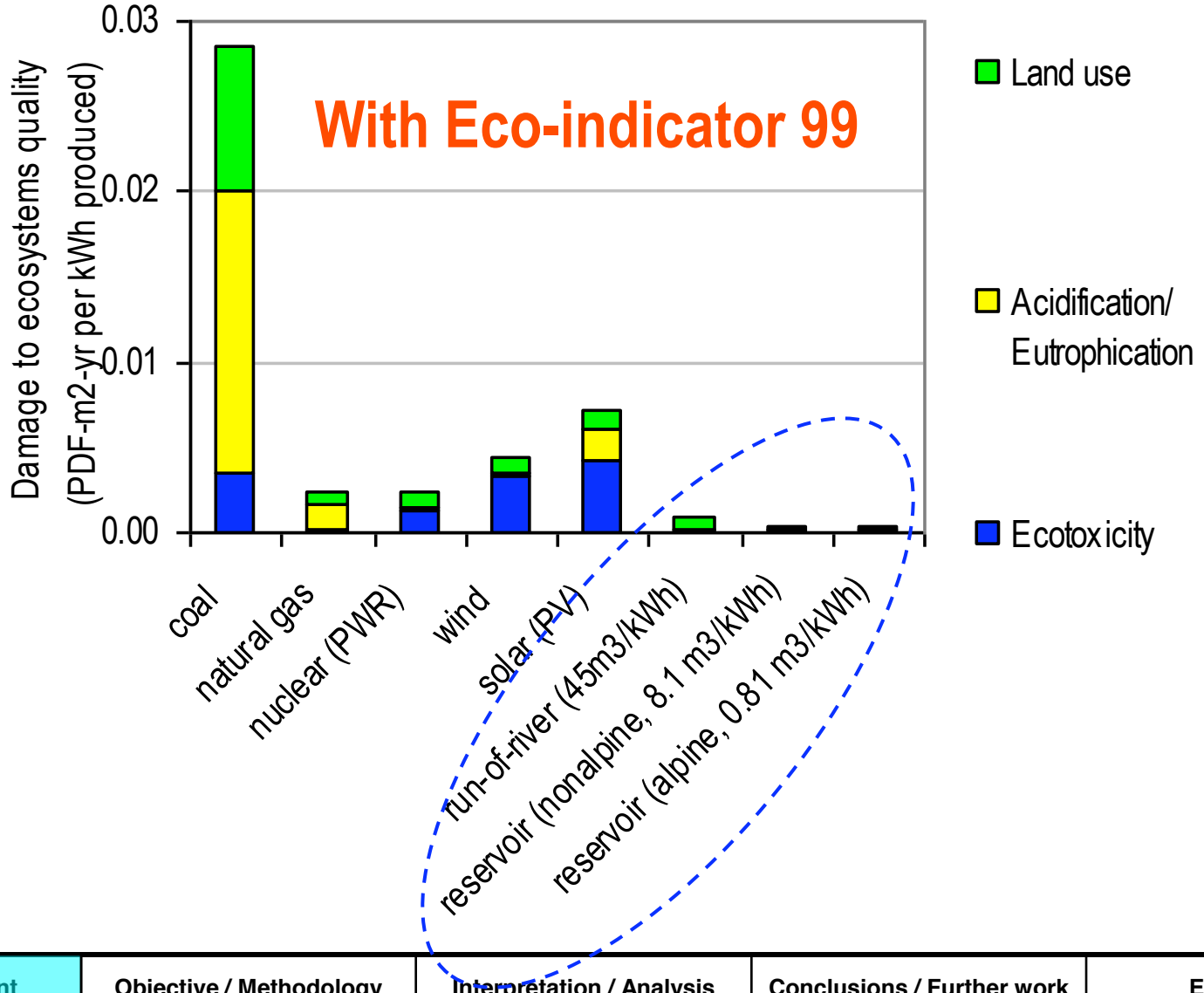
  damage to ecosystems quality

  appears lower for dams than for fossil fuel based power plants

Hydropower has less damage to ecosystems quality?

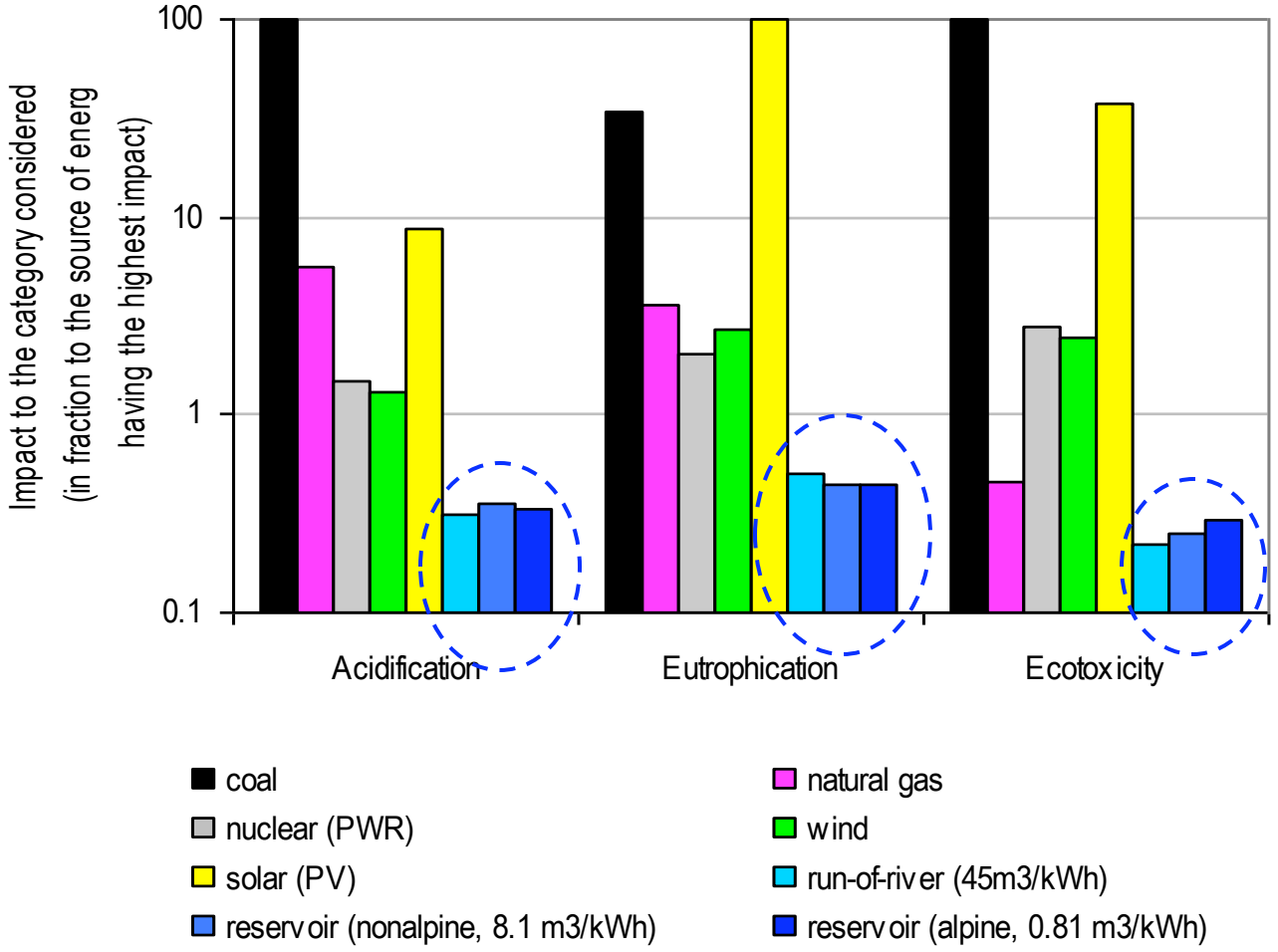


Hydropower has less damage to ecosystems quality?



Hydropower has less damage to ecosystems quality?

With TRACI (midpoint)



Problem & Objective

- **No impact category to account for**

  aquatic biodiversity loss

  due to a change in the ecosystems caused by dams

  → ***No impact category → no impact…. !?***

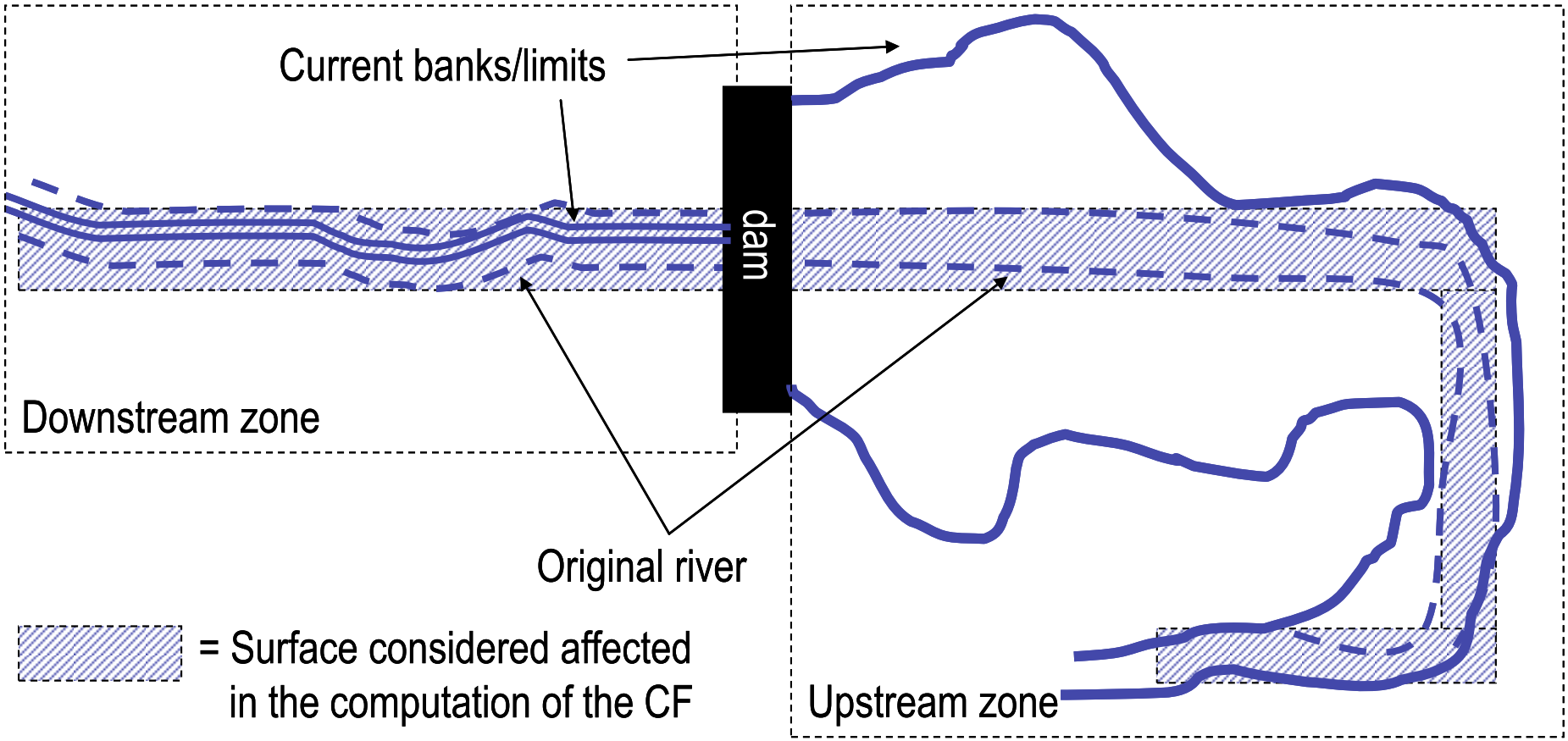
- **Our goal:**
  - **Try to capture this damage in a comprehensive and usable way with current LCA approach**

- **Empirical approach, using observation of**

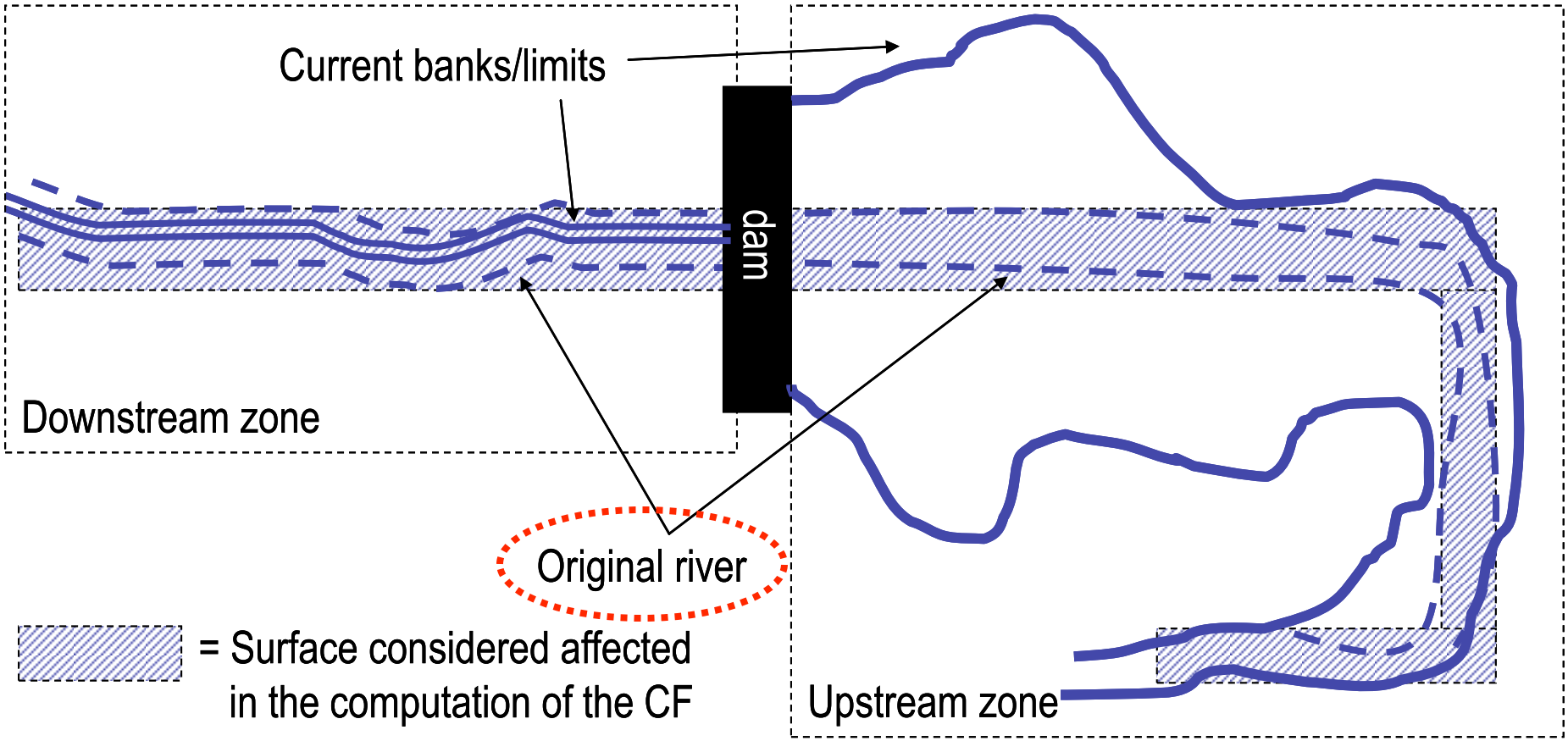
  reduction in biodiversity

  in the river between before and after the construction of dams

The model


Current banks/limits
dam
Downstream zone
Original river
= Surface considered affected
in the computation of the CF
Upstream zone

The model



Our goal: capture the damage on the original system

The characterization factor (CF)

*Impact score = emission or use of a resource * CF*

Fraction of species that disappears

Surface affected

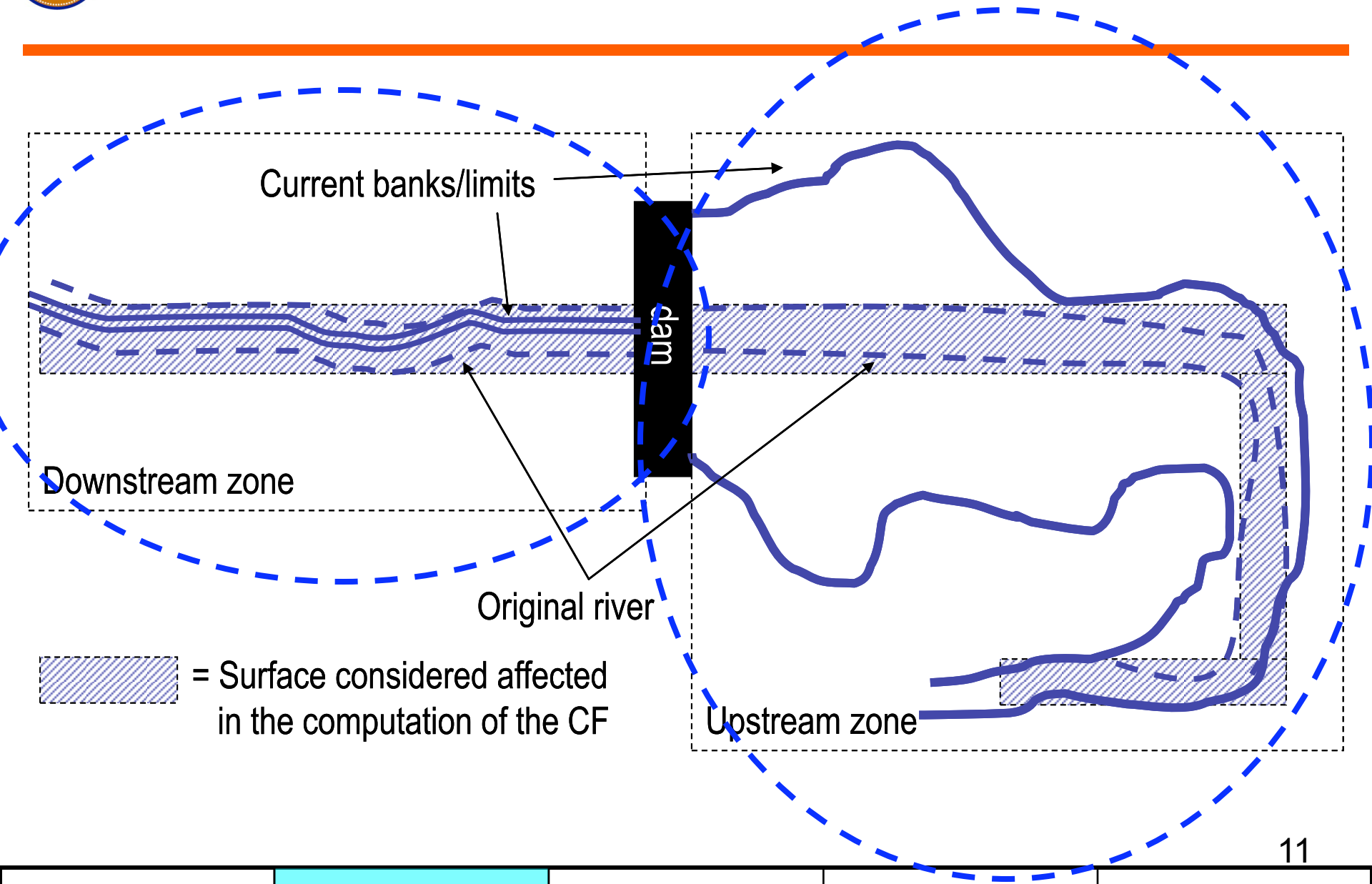
$$CF = \frac{PDF * S}{Q_{water\_or\_electricity}}$$

[PDF*m^2*yr / m^3 or kWh]

Flow "under" the dam or electricity produced, per year

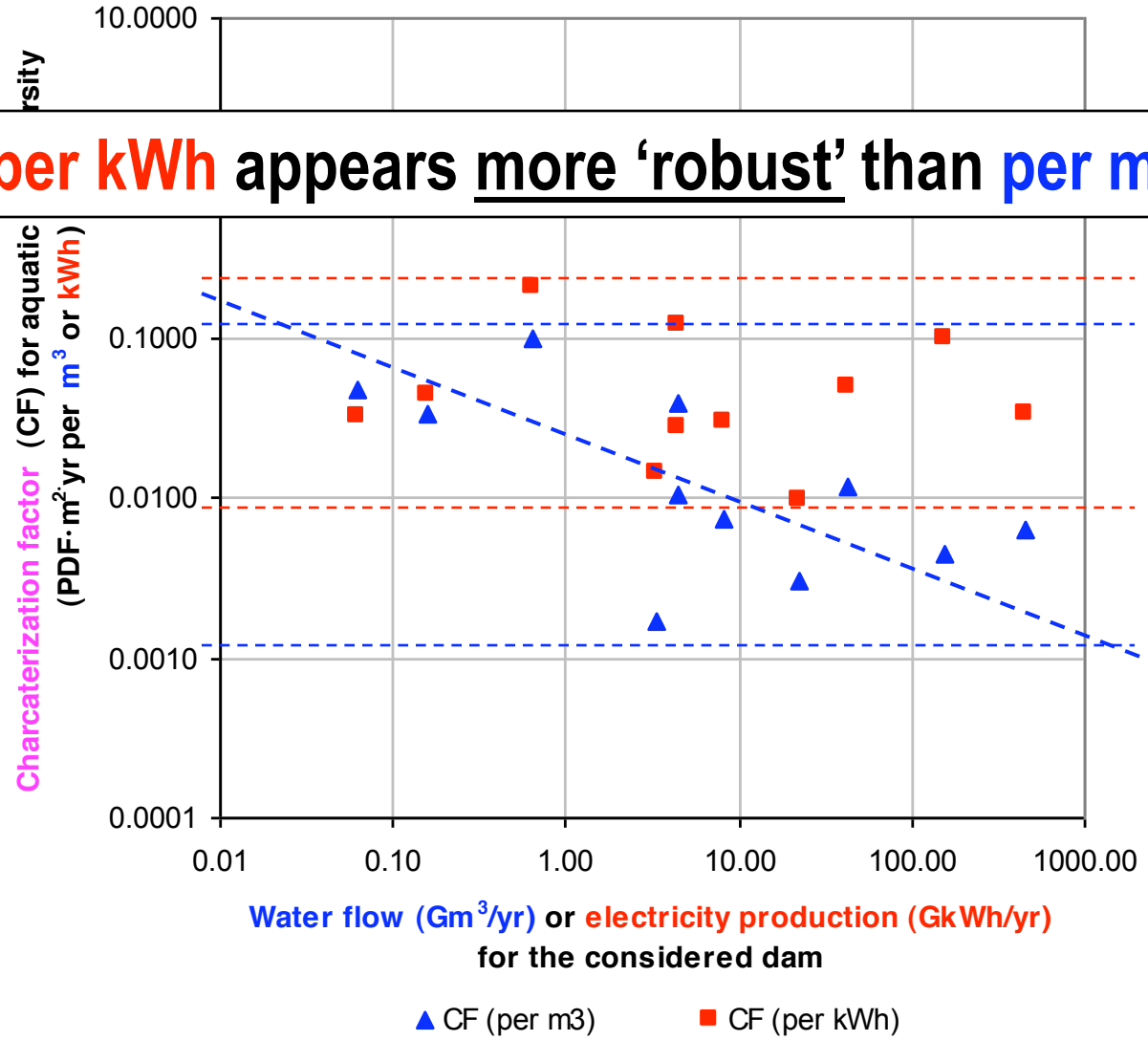
$$CF_{total} = \sum_i \underbrace{CF_{section\_i}}_{\text{per sub-section}} = \frac{1}{Q_{total}} \sum_i (PDF_{section\_i} * S_{section\_i})$$

2 sub-sections



CF independent of the size!

➔ per kWh appears more 'robust' than per m^3 of water



reduction statistically significant?

➔ one can generate a unique CF (per m3 or per kWh) whatever the size of the dam the power is from

ecointesys life cycle systems

Per m^3 of water

0.01 PDF·m^2·yr

(0.002 – 0.1) (x50)

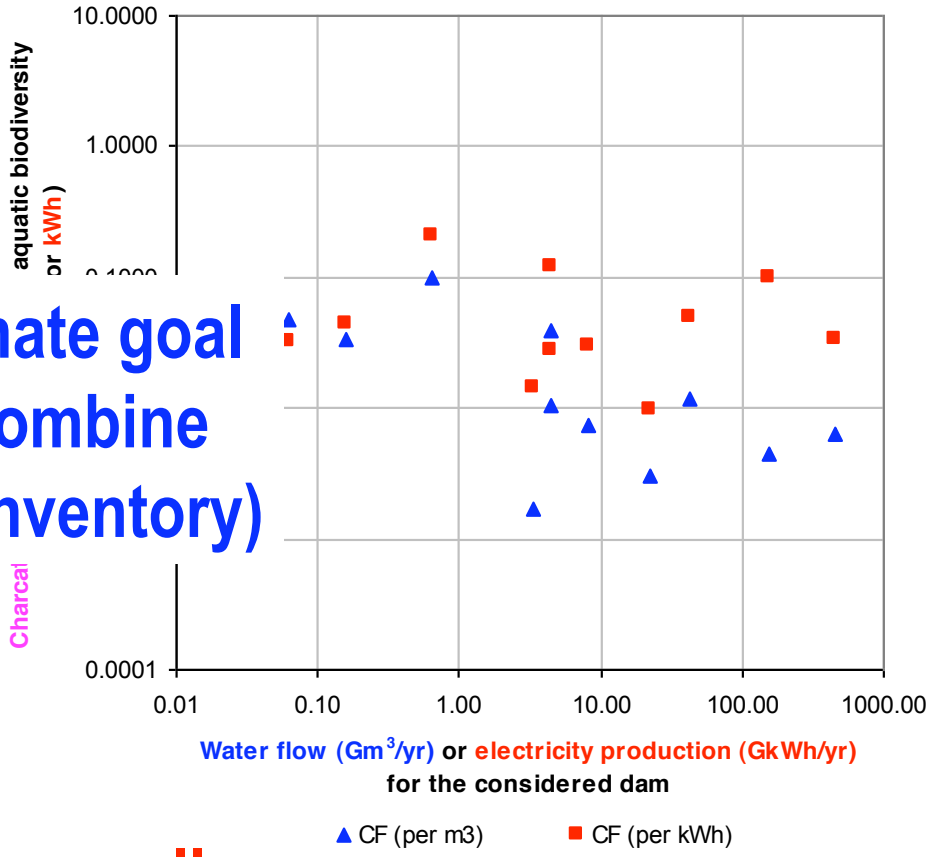
- ultimate goal (to combine with inventory)

Per kWh produced

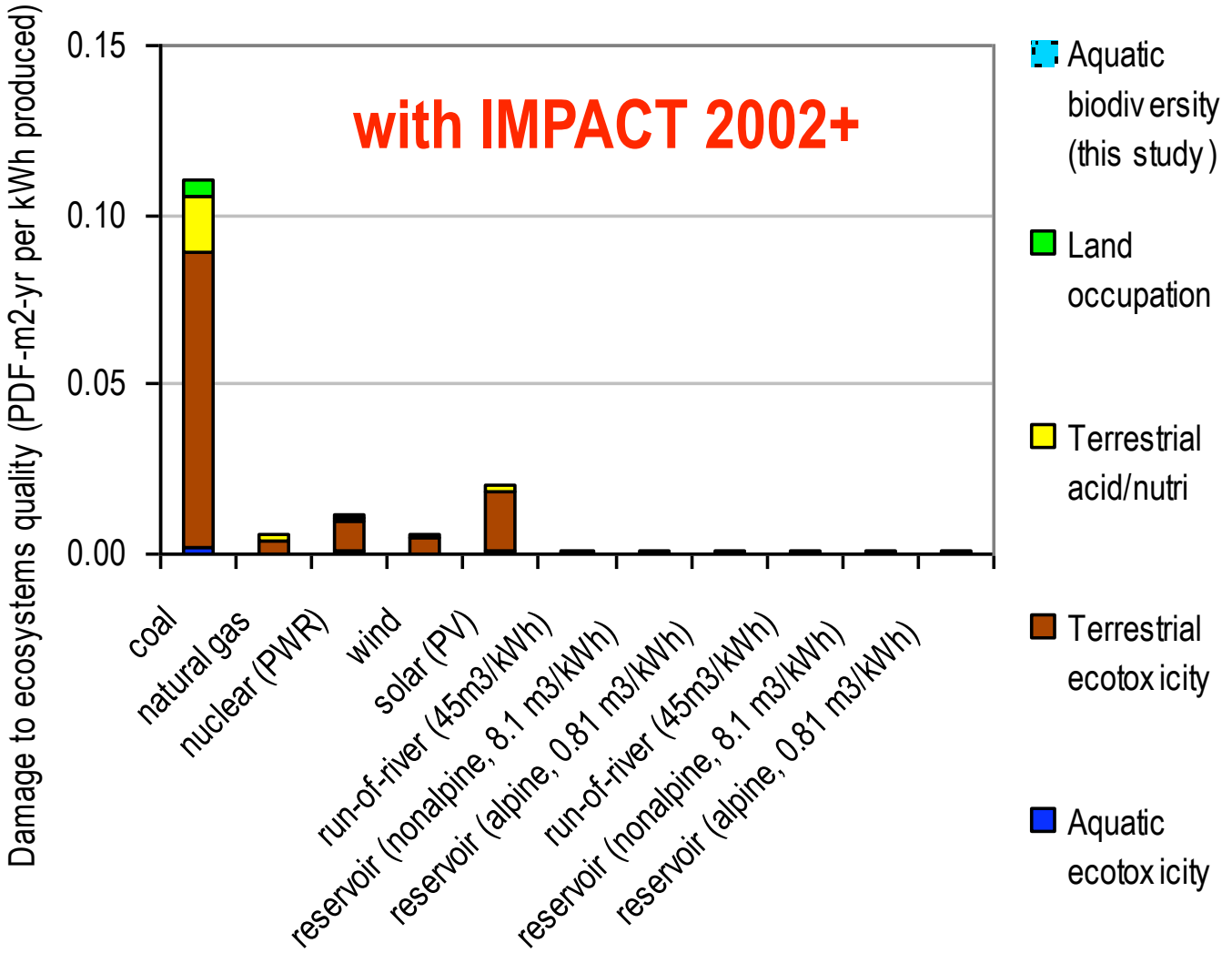
0.04 PDF·m^2·yr

(0.01 – 0.2) (x20)

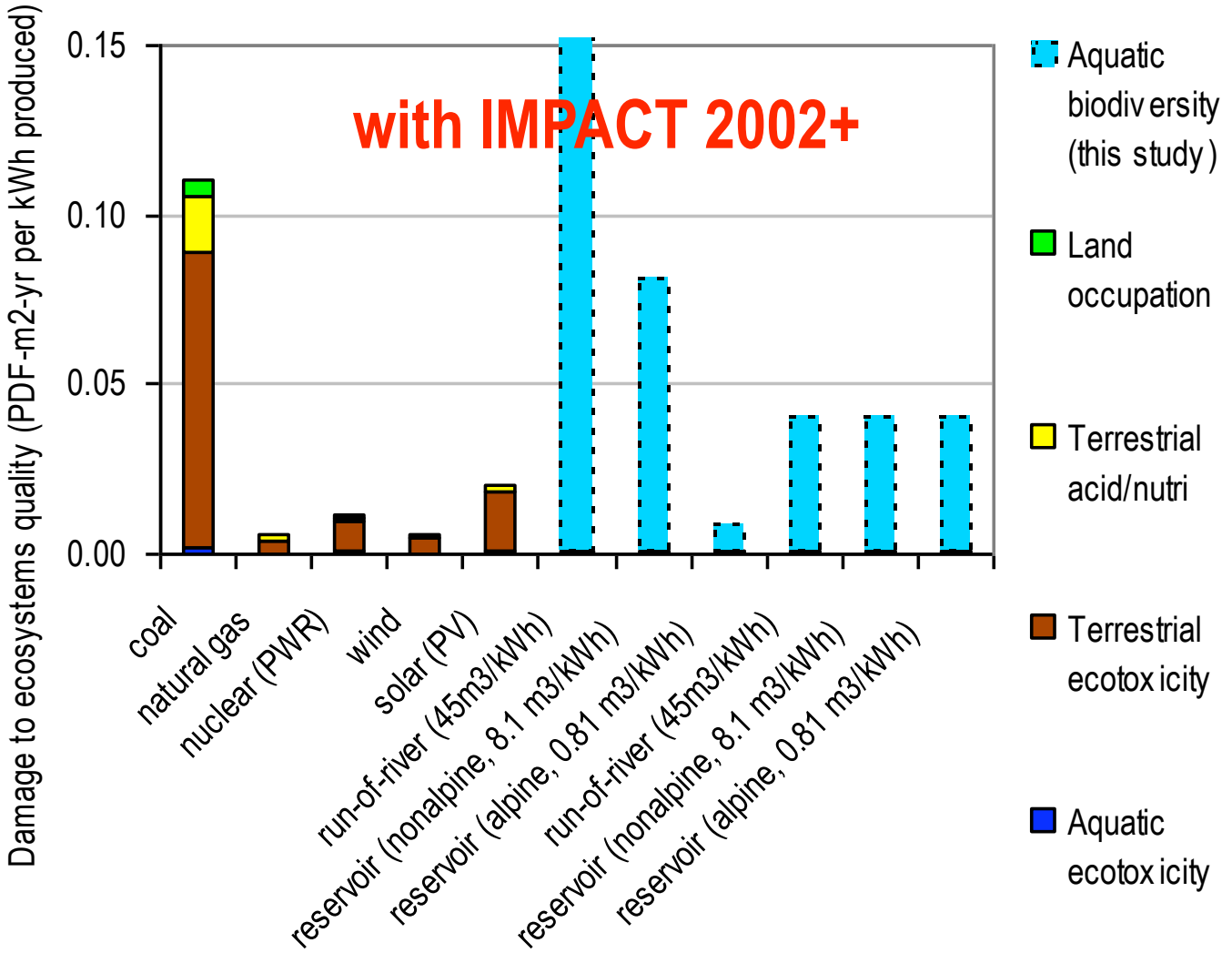
- range smaller
- more robust



Back to original results



Aquatic biodiversity appears not negligible



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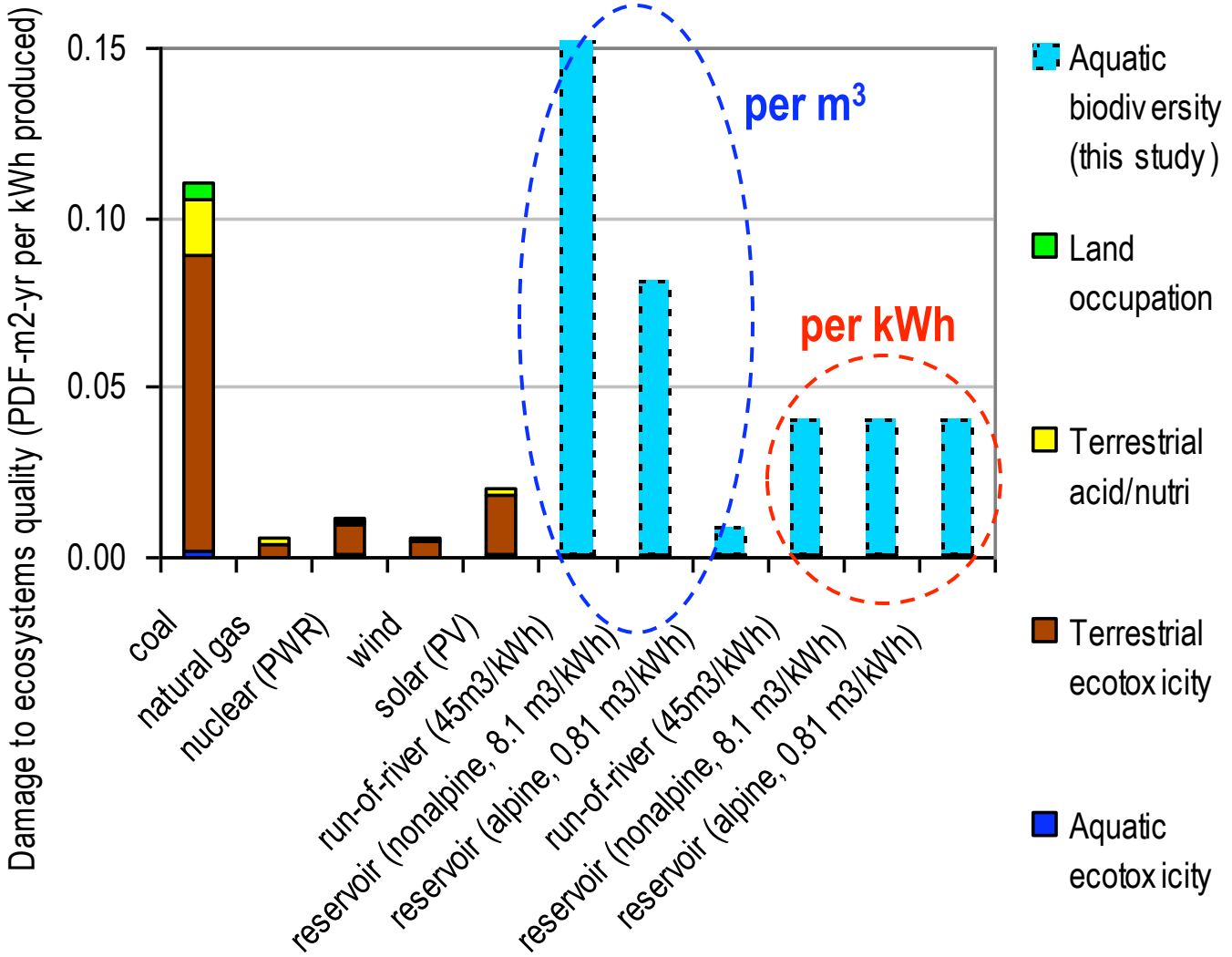
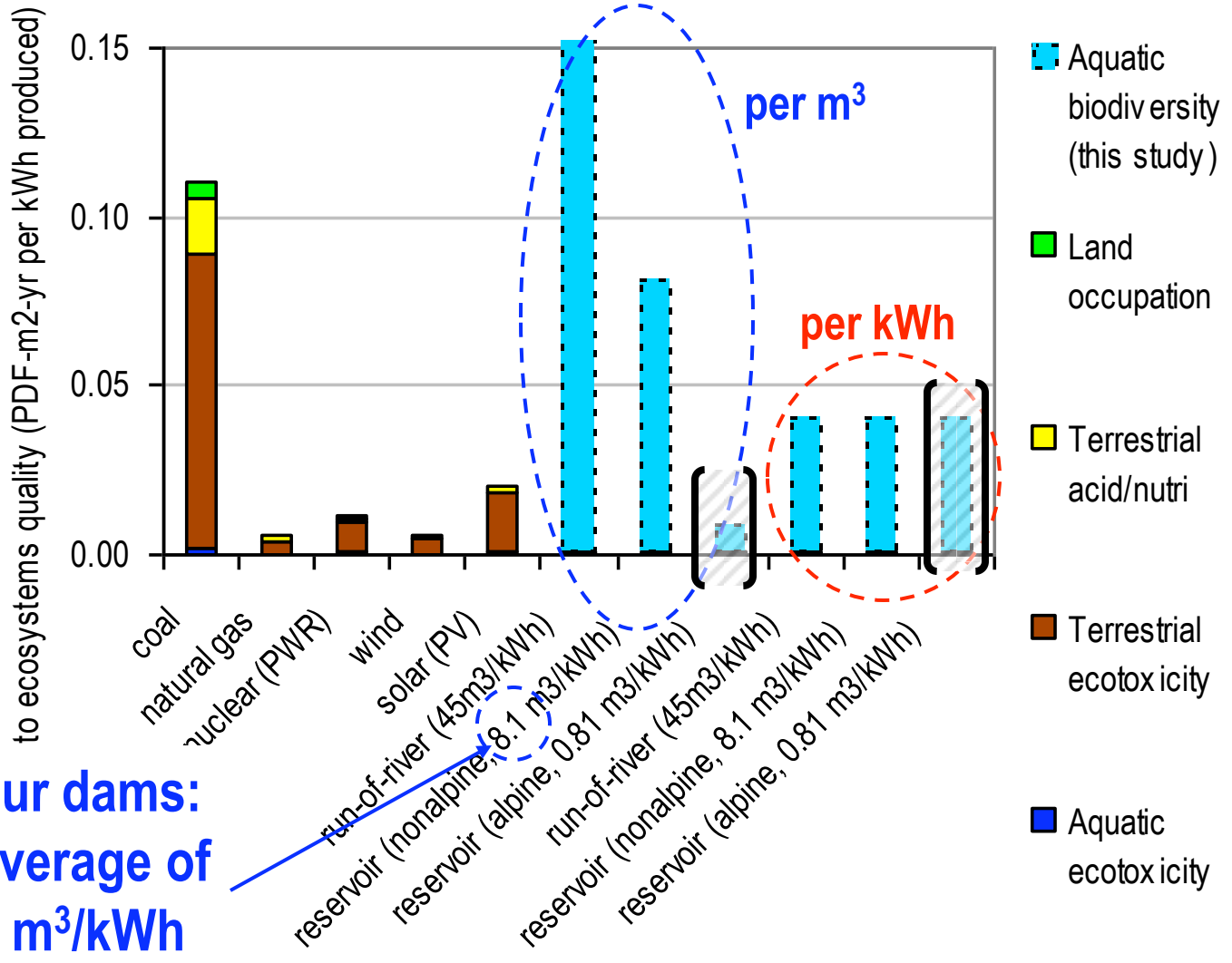
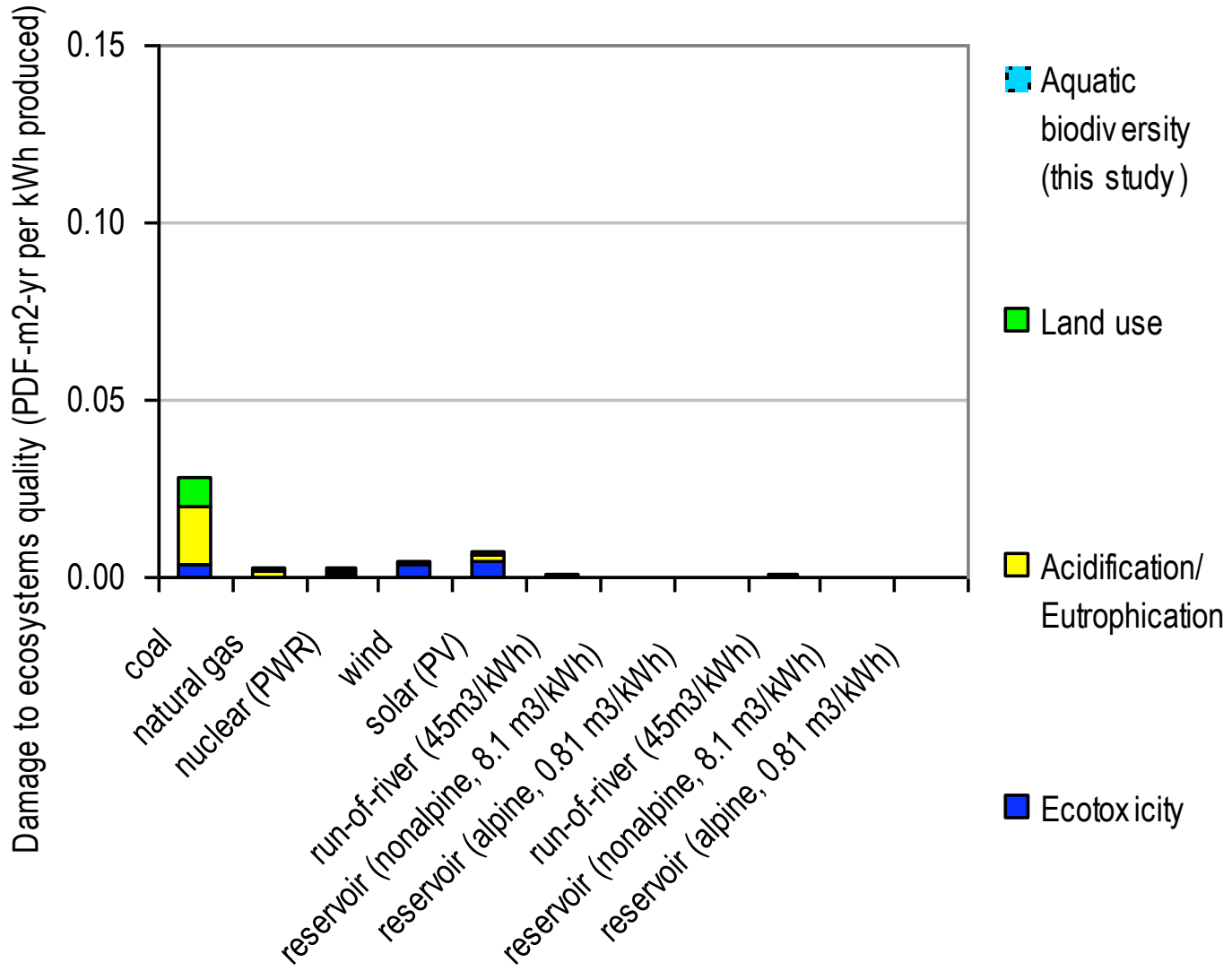


Aquatic biodiversity appears not negligible

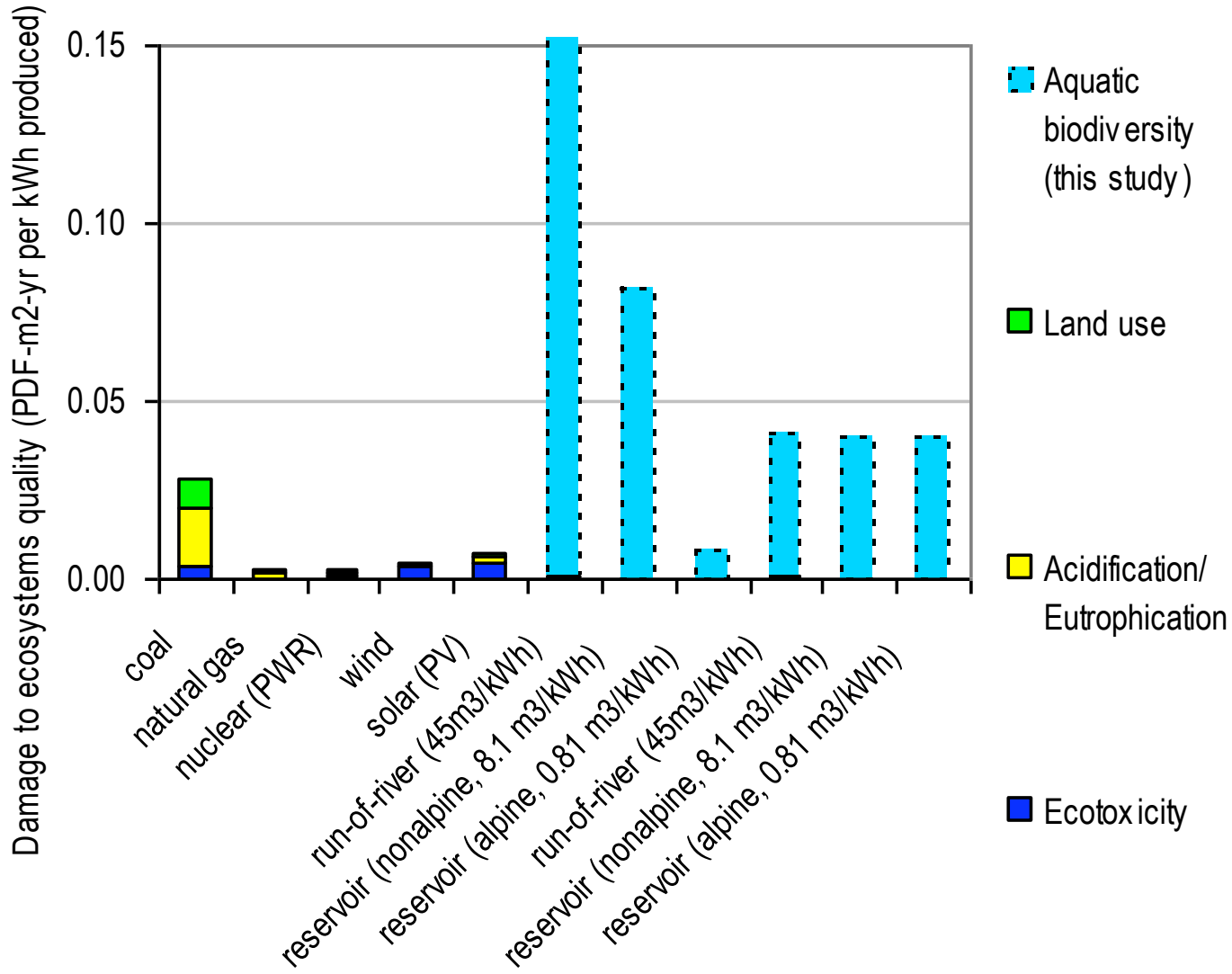


our dams: average of 3 m³/kWh

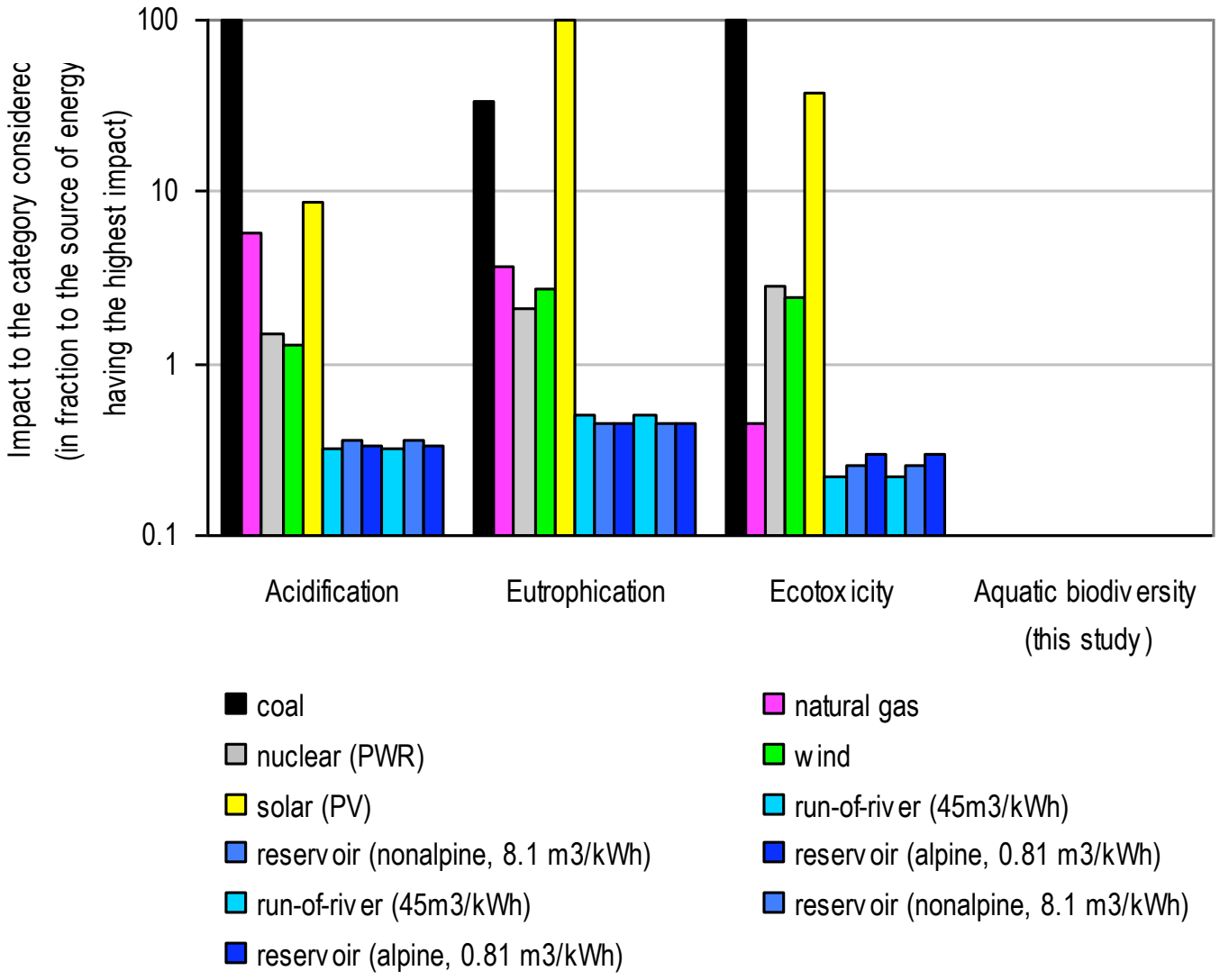
Same observations with Eco-indicator 99



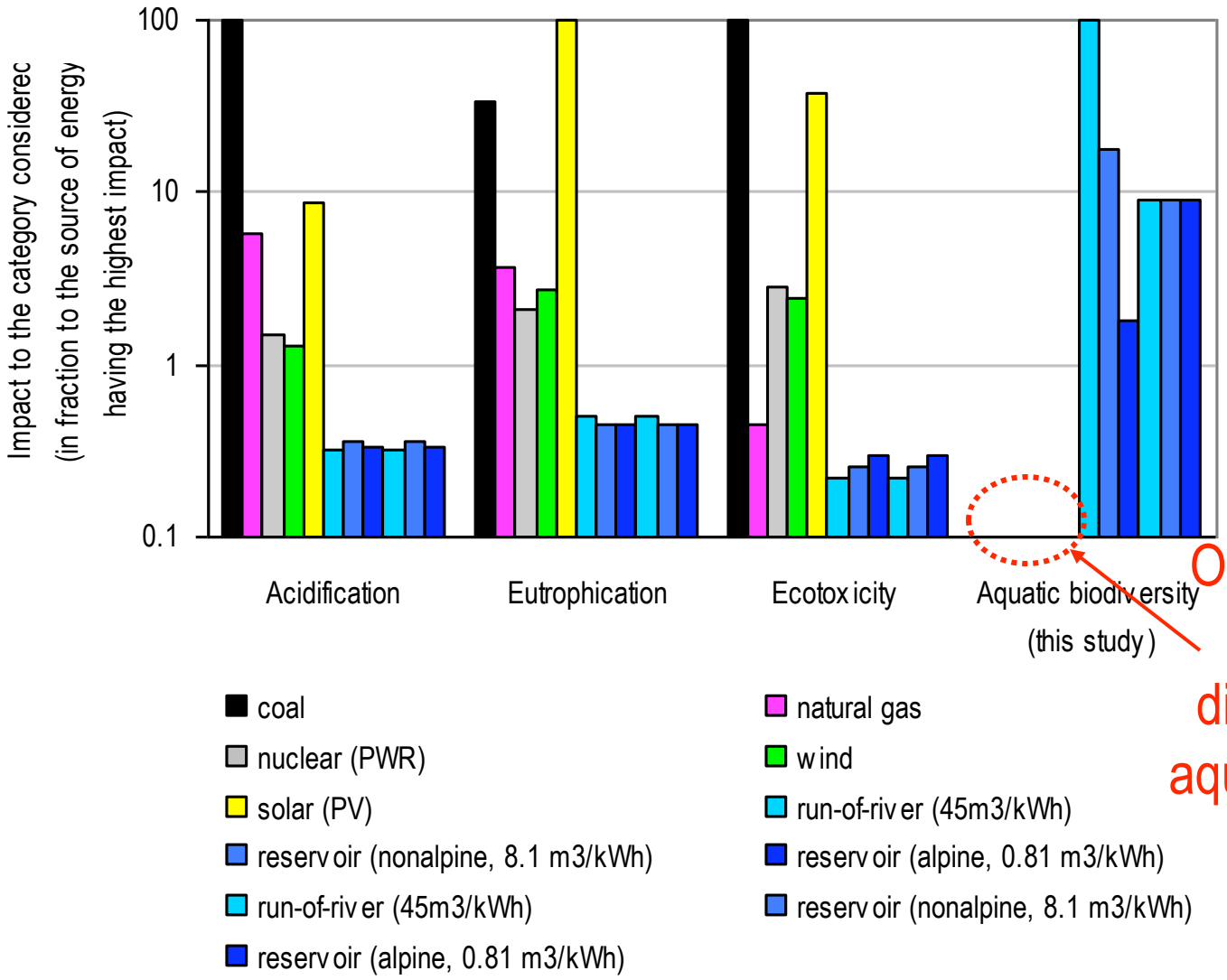
Same observations with Eco-indicator 99



With TRACI (midpoint LCIA)



More complicated with midpoint LCIA



Other processes do not have direct impact on aquatic biodiversity

Conclusions

- **Framework suggested to account for damage to aquatic biodiversity from water use**
  - **focus on hydropower**

- **When expressed per kWh produced, damage to aquatic biodiversity appears independent from the size of the dam**
  - **Less clear when expressed per m^3 of water use**
  - **Further research needed**

- **CF, per kWh produced, directly usable with current LCA approach, to capture the magnitude of the damage to aquatic biodiversity associated with hydropower**

Further work

- Need for a special analysis of alpine dams
- Need to understand better the relation between amount of water use and impact
- Need to evaluate benefits from increase in aquatic ecosystem (reservoir) vs decrease in terrestrial ecosystem (loss of some land and original banks)
- Framework suggested valid for other type of water use
  - Irrigation dams (→ per m^3 water used or retained?)
  - Flooding control dams (→ per m^3 retained?)
  - Rivers' correction (→ per m^2 of river corrected?)

Thank you for your interest!

➔ *Let's strive towards a better capture of the different issues associated with water use!*

Questions ?

Thanks to Manuele Margni for his precious feedbacks

Maendly and Humbert (2008)
"Characterization factors for damage to aquatic biodiversity caused by water use"
in process


... AUJOURD'HUI, UN SEUL POINT À L'ORDRE DU JOUR !
ORDRE DU JOUR
- SAUVER LA PLANÈTE
MIX & REMIX