



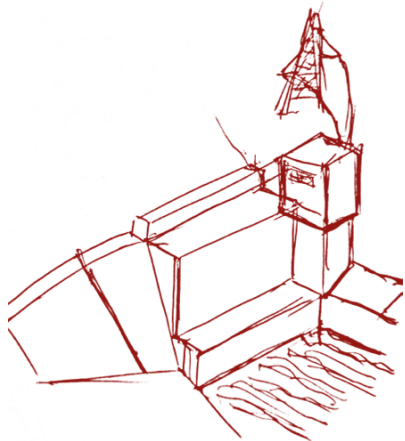
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A framework to identify cost-effective mitigation measures using Influence Diagrams

Ana Adeva-Bustos (SINTEF), Manon Dewitte (CNRS-Université de Poitiers), Laurent David (CNRS-Université de Poitiers), Atle Harby (SINTEF), Mauro Carolli (SINTEF) et. al...

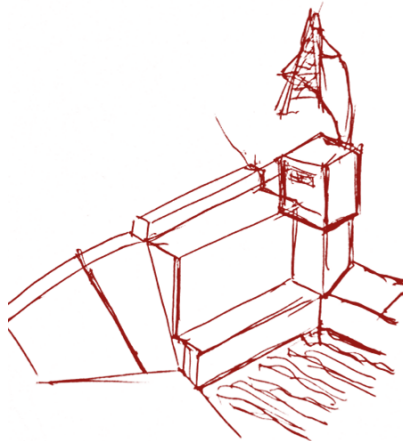


Complexity in environmental decision-making





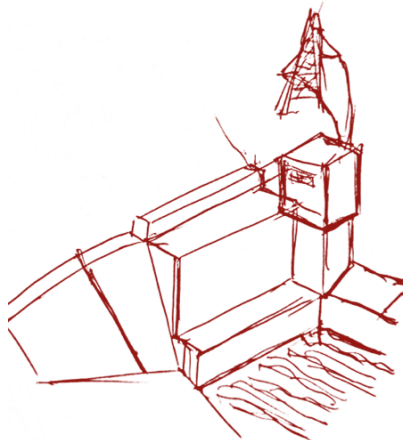
Complexity in environmental decision-making



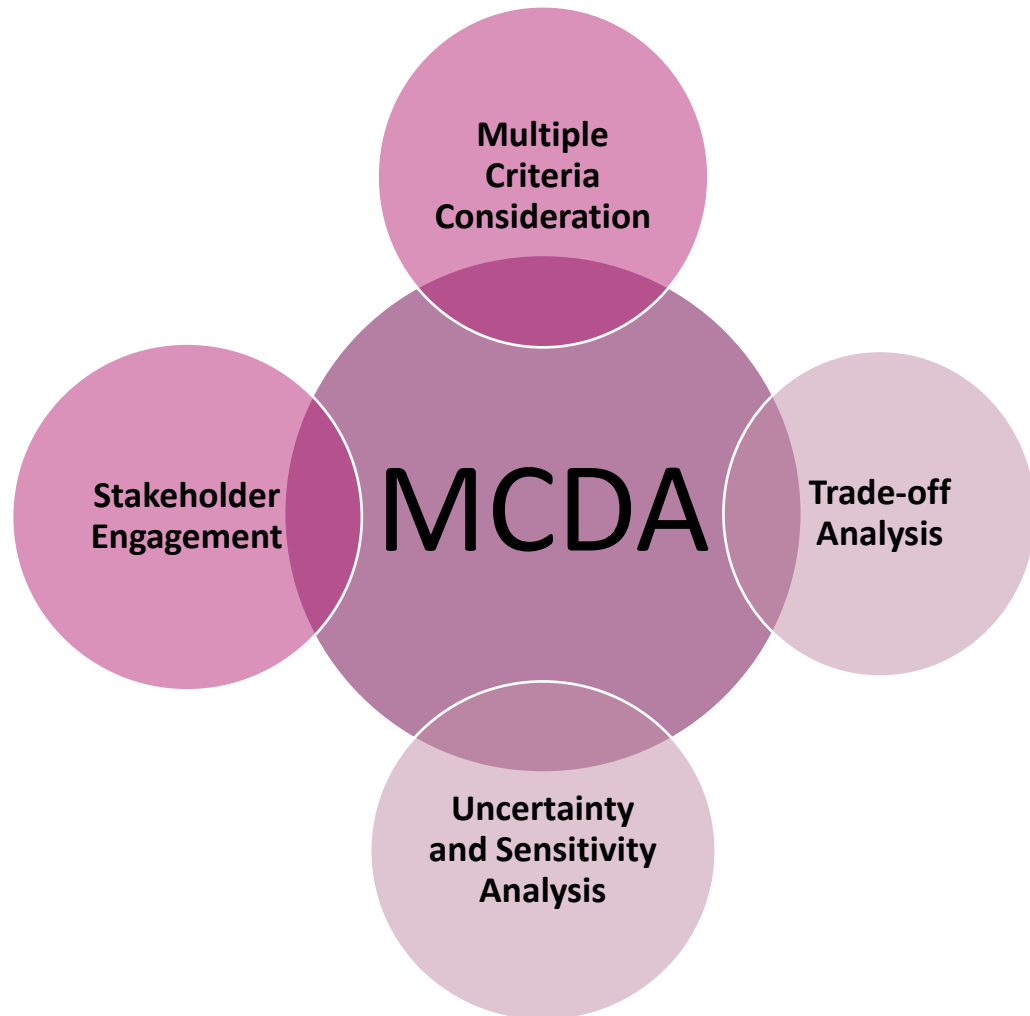
Complexity in environmental decision-making



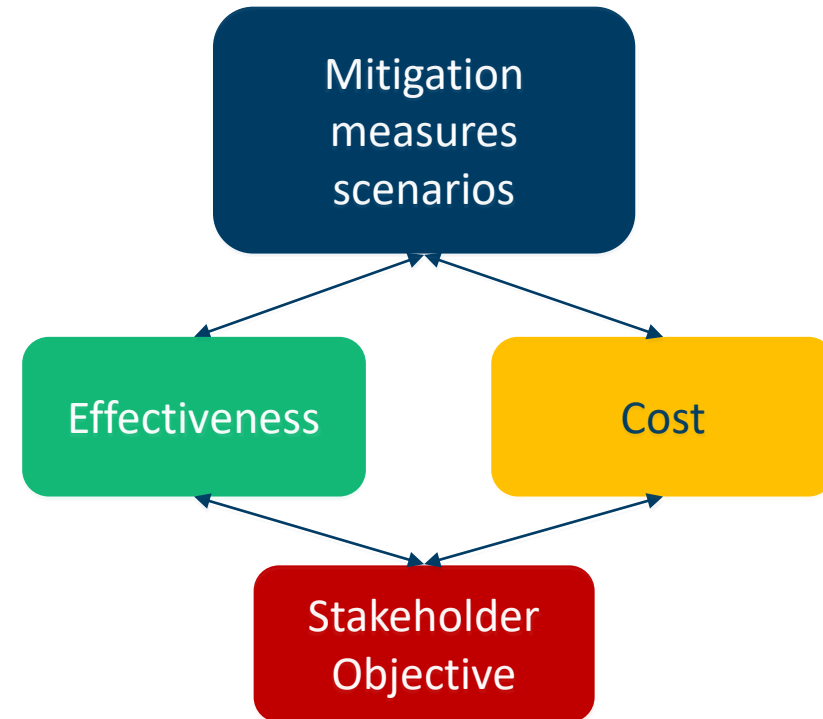
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Methods to deal with

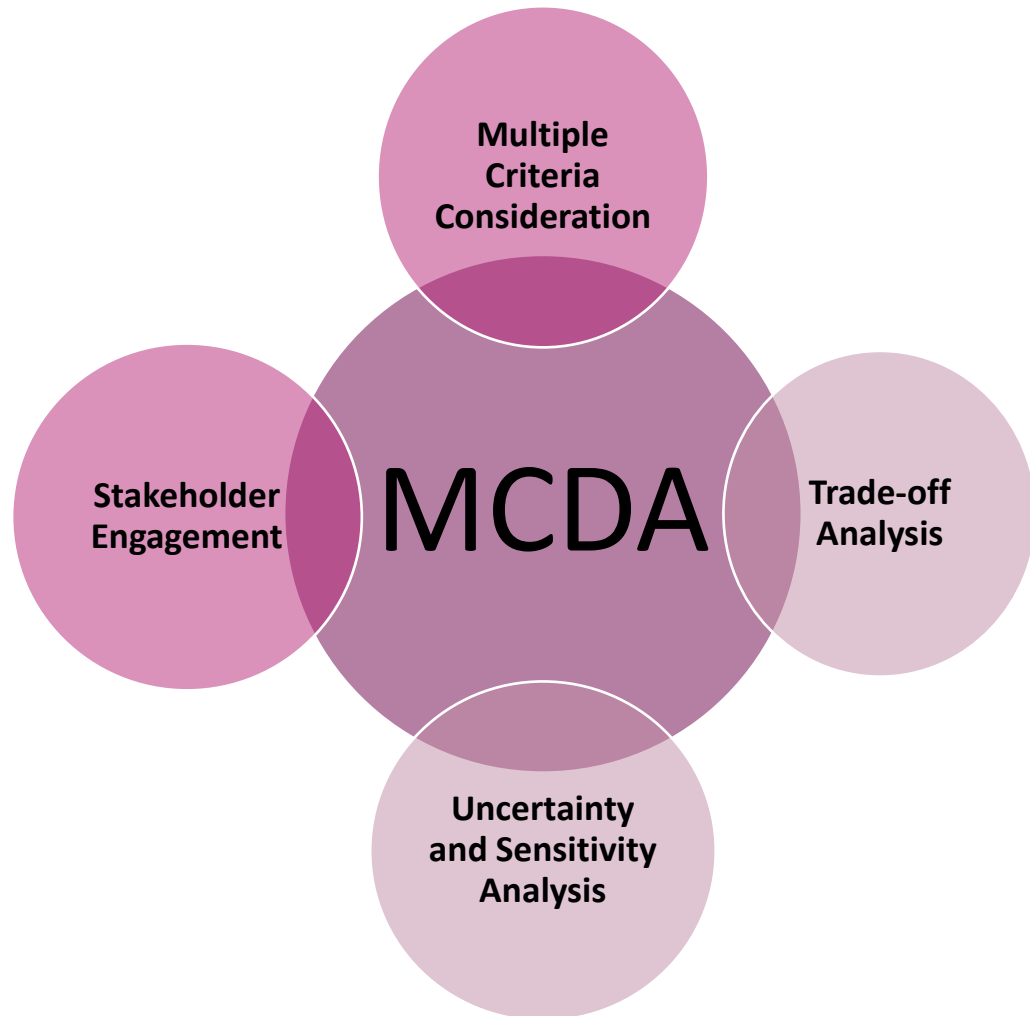


Influence Diagrams

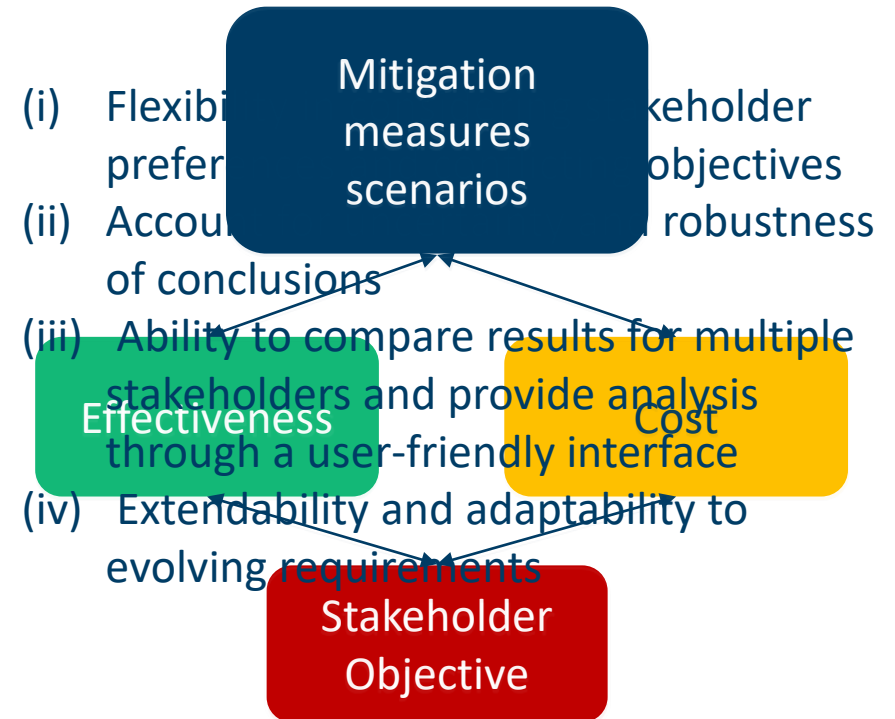


Barton. *et al* 2019

Methods to deal with



Influence Diagrams



Barton. *et al* 2019



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Influence Diagram Decision Support Tool



Finding the right fish-friendly mitigation measures

A tool for selecting cost-effective fish-friendly mitigation measures for existing and new hydropower schemes





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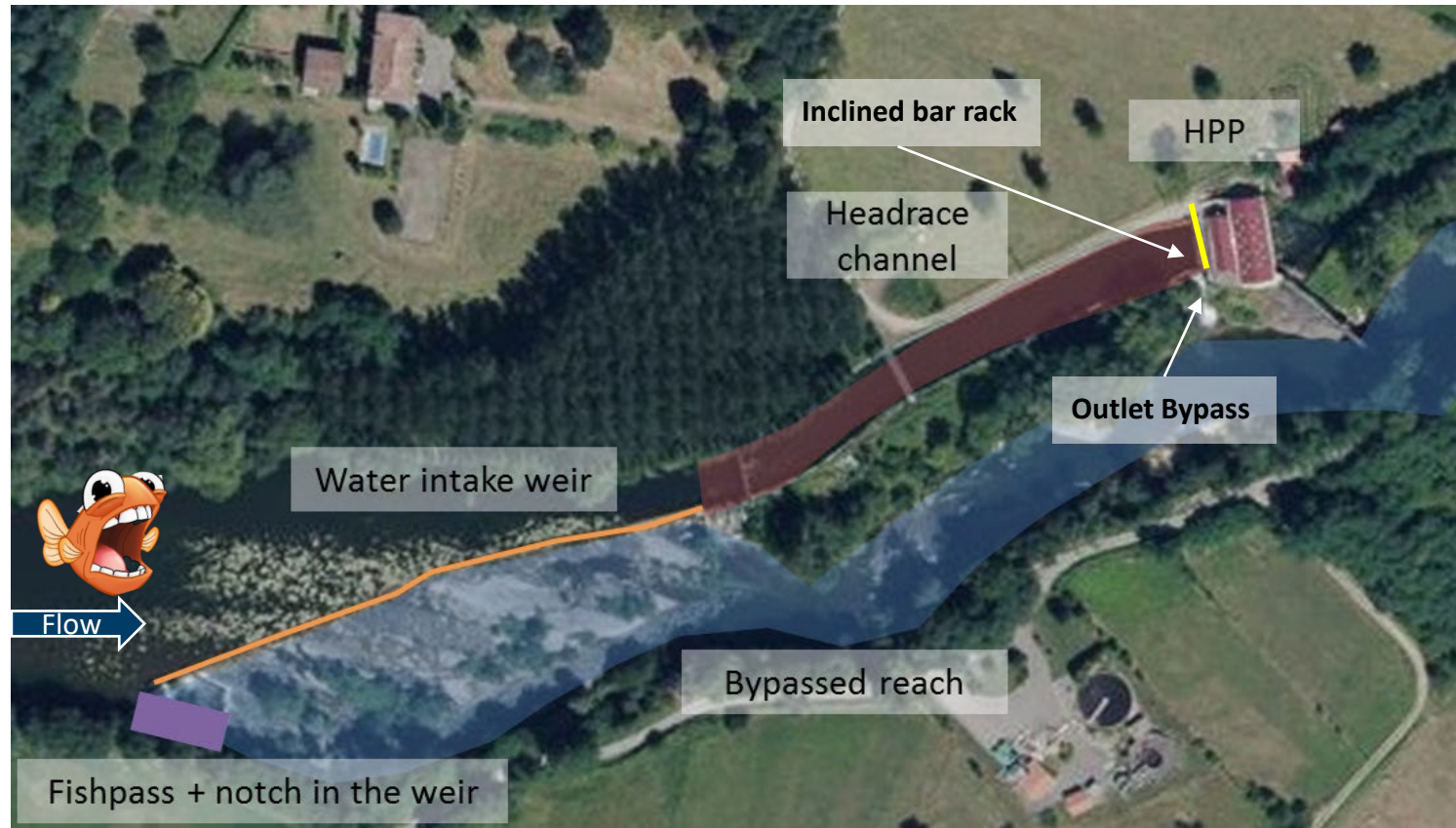
Las Rives



European Eel



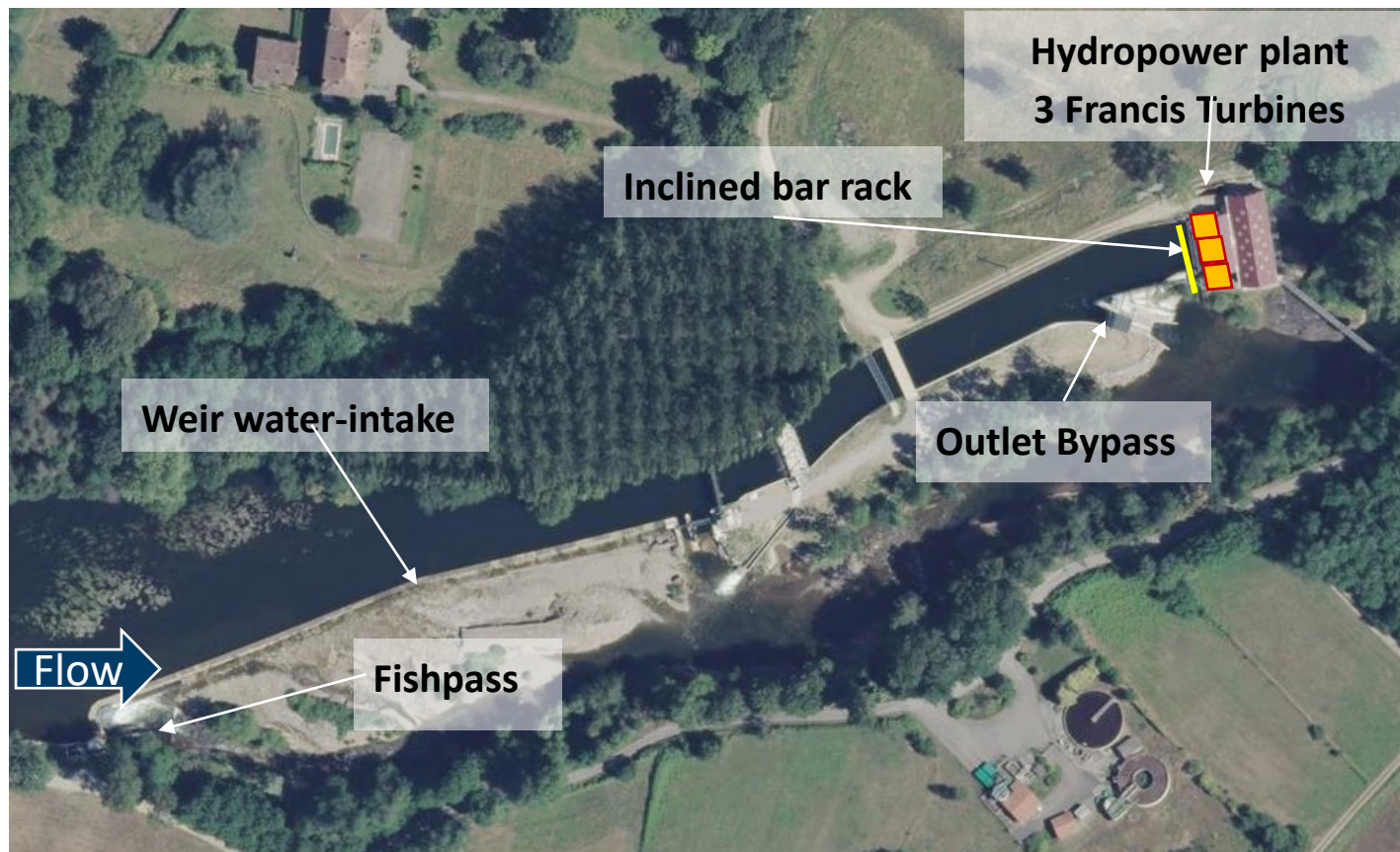
Salmon





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Las Rives: Scenario Former





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Las Rives: Scenario D



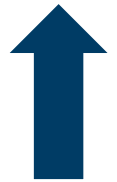
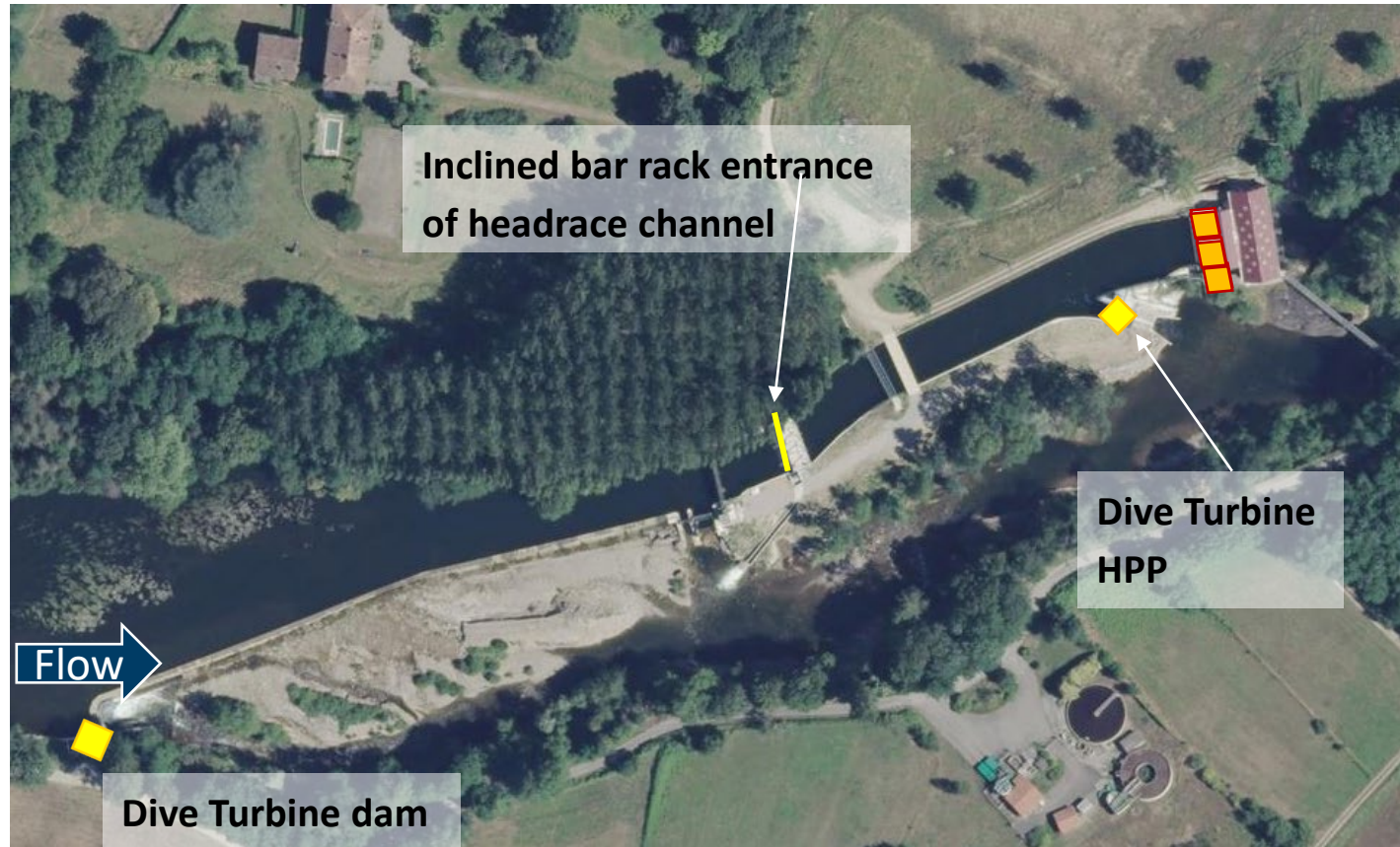
Energy

Attraction flow at the dam



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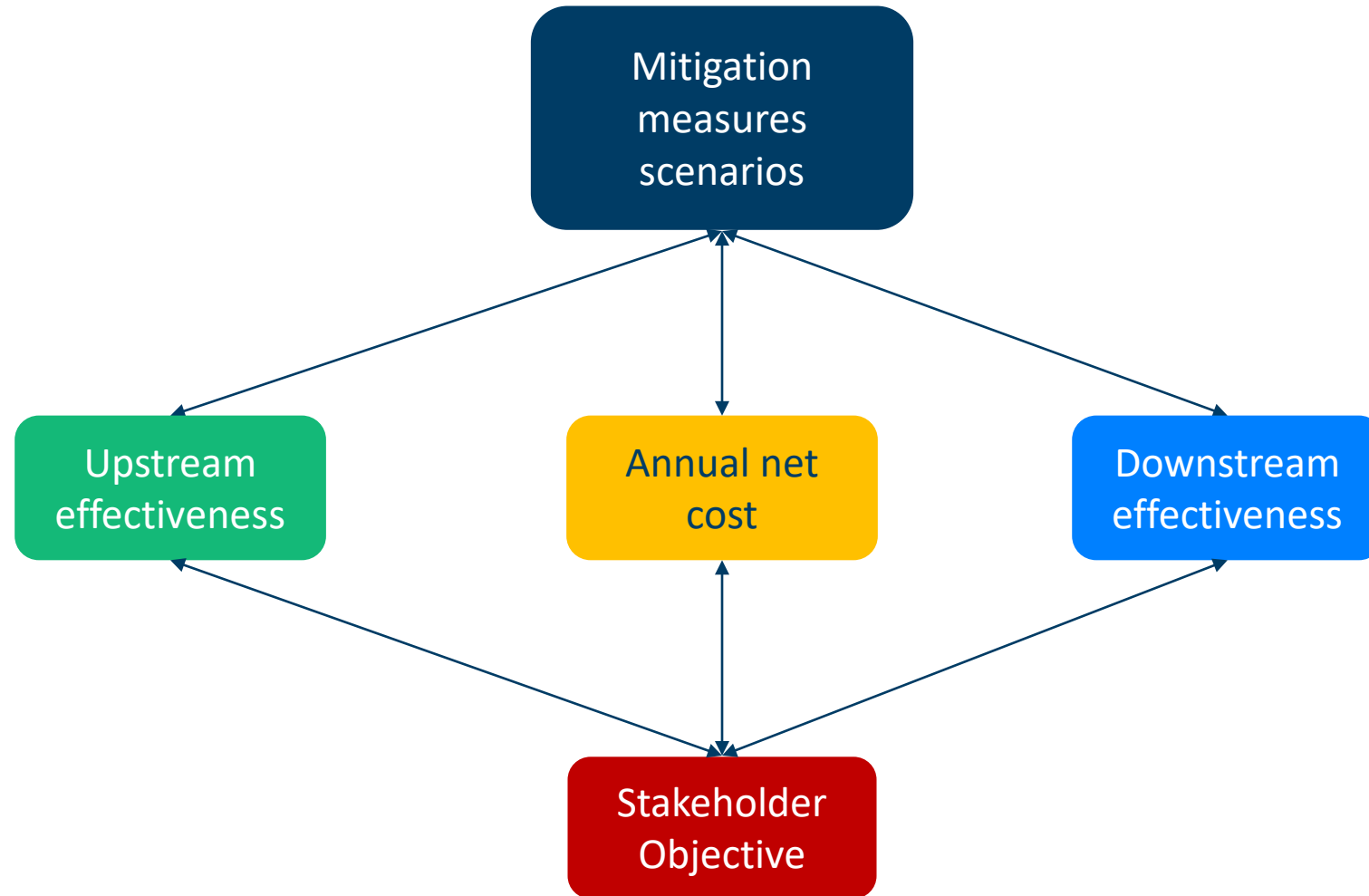
Las Rives: Scenario F



Energy

Attraction flow both at the entrance and at the dam

Influence Diagram





Indicators



Indicators FISH PASS

Attraction

- Relative flow of attraction
- Location of fish entrance

Entrance

- Difference in water level at the entrance
- Water depth at the entrance
- Width of the entrance
- Water depth before the entrance
- Orientation of the entrance respect to the river
- Typology of the entrance

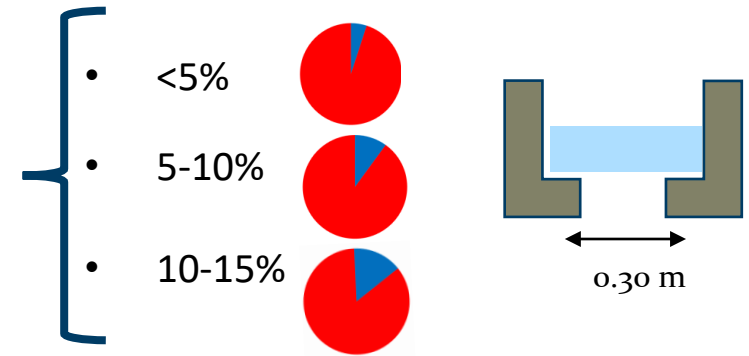
Passage

- Difference in water level between pools
- Volumetric power dissipation
- Mean water depth of the pool
- Dissipated power
- Water depth between pools
- Width notches pools
- Typology of connection between pools

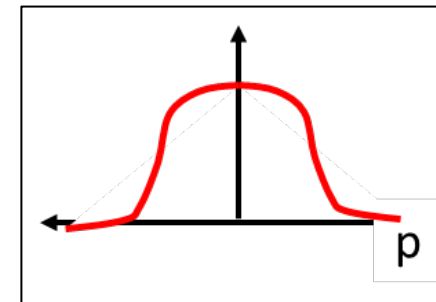
Exit

- Difference in water level at the exit
- Water depth at the exit
- Width of the exit
- Water depth after the exit
- Orientation of the exit respect to the river
- Typology of the exit

Indicator values



Probability

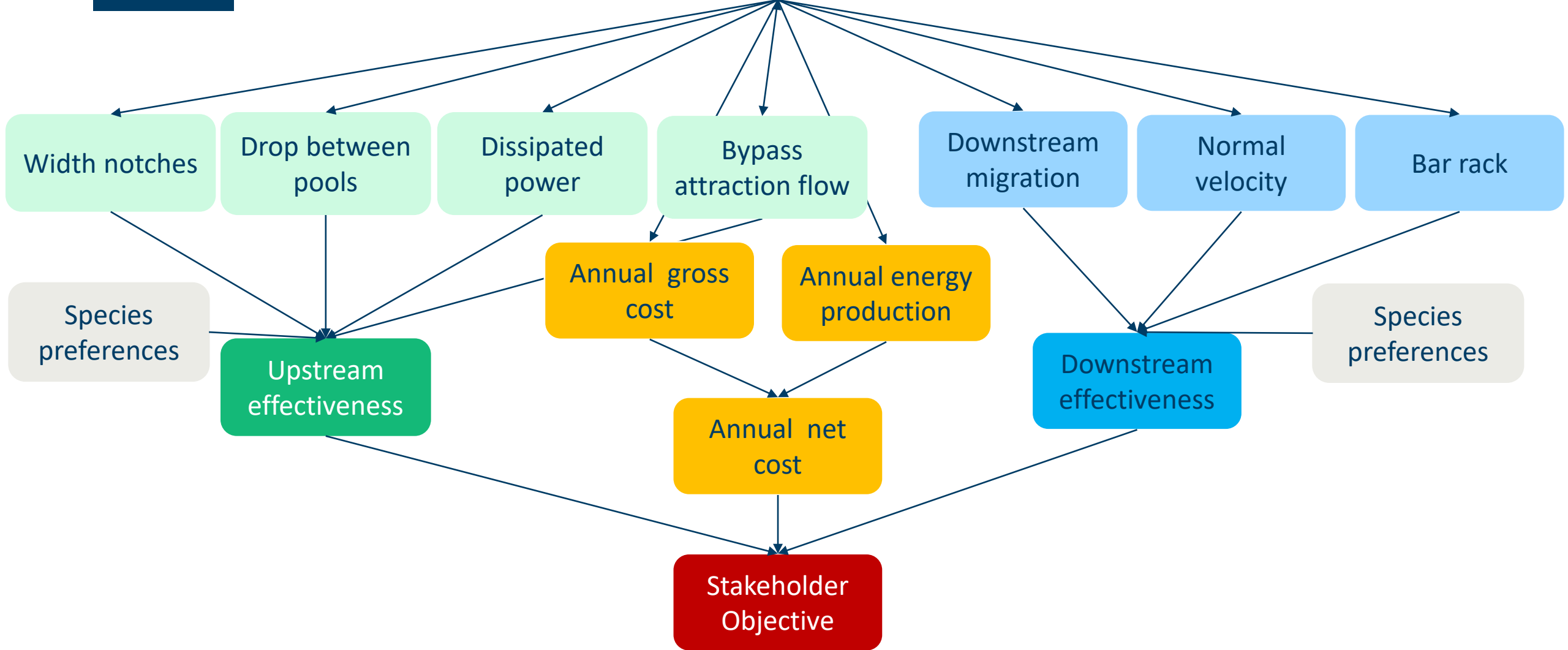


Efficiency





Mitigation measures Scenarios





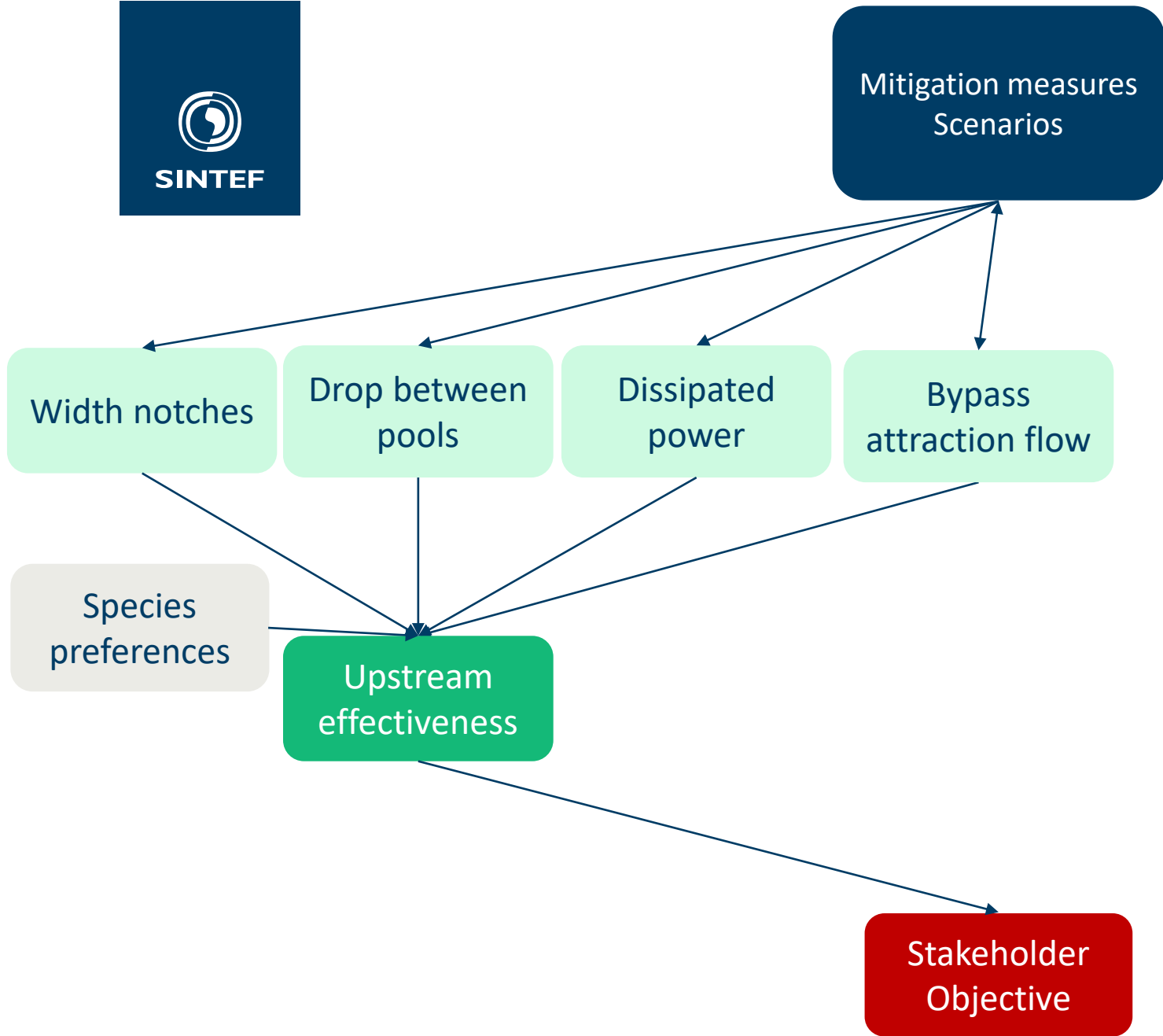
Mitigation measures
Scenarios

Width notches Drop between pools Dissipated power Bypass attraction flow

Species preferences

Upstream effectiveness

Stakeholder Objective





Mitigation measures
Scenarios

Width notches

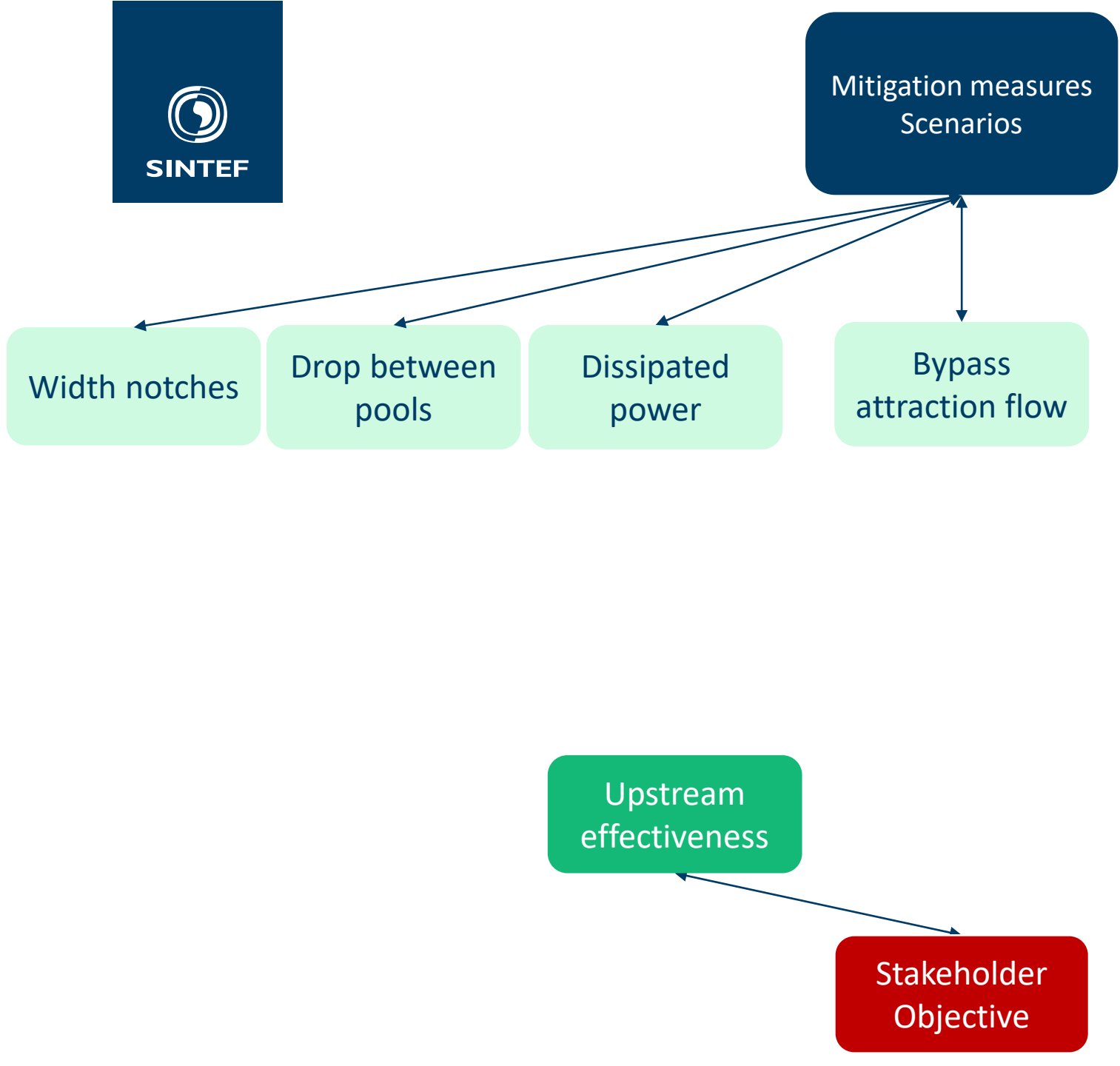
Drop between
pools

Dissipated
power

Bypass
attraction flow

Upstream
effectiveness

Stakeholder
Objective





Mitigation measures
Scenarios

Width notches

Drop between
pools

Dissipated
power

Bypass
attraction flow

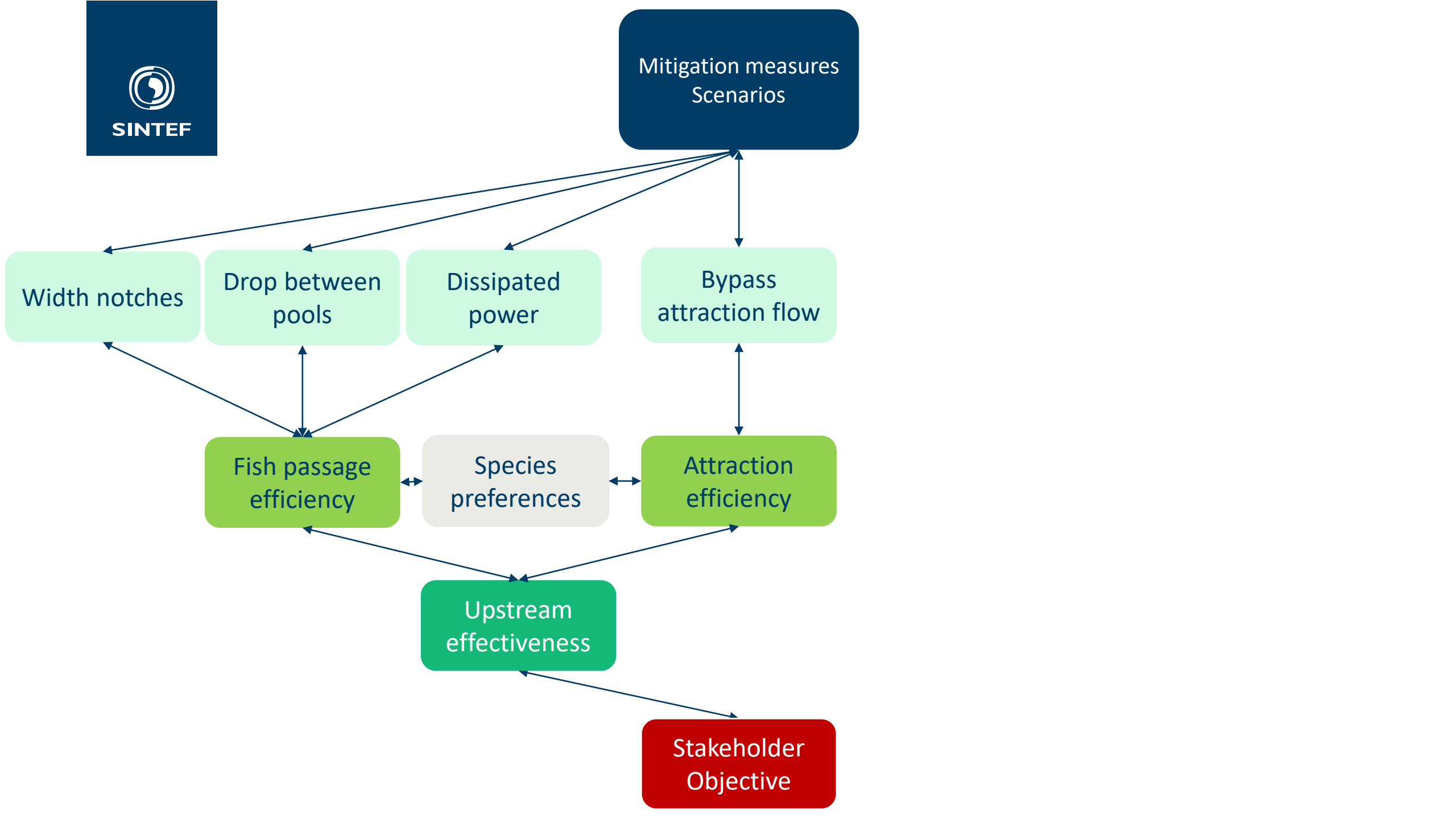
Fish passage
efficiency

Species
preferences

Attraction
efficiency

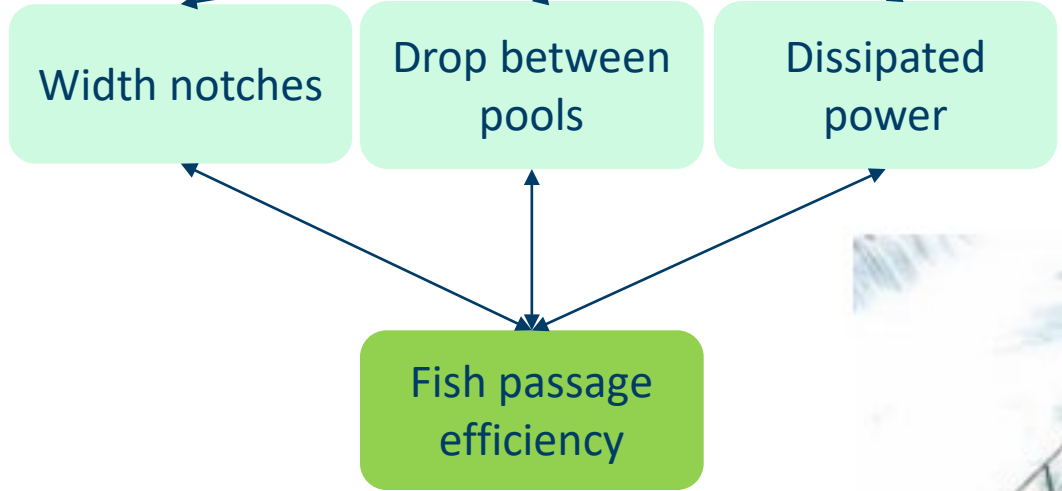
Upstream
effectiveness

Stakeholder
Objective

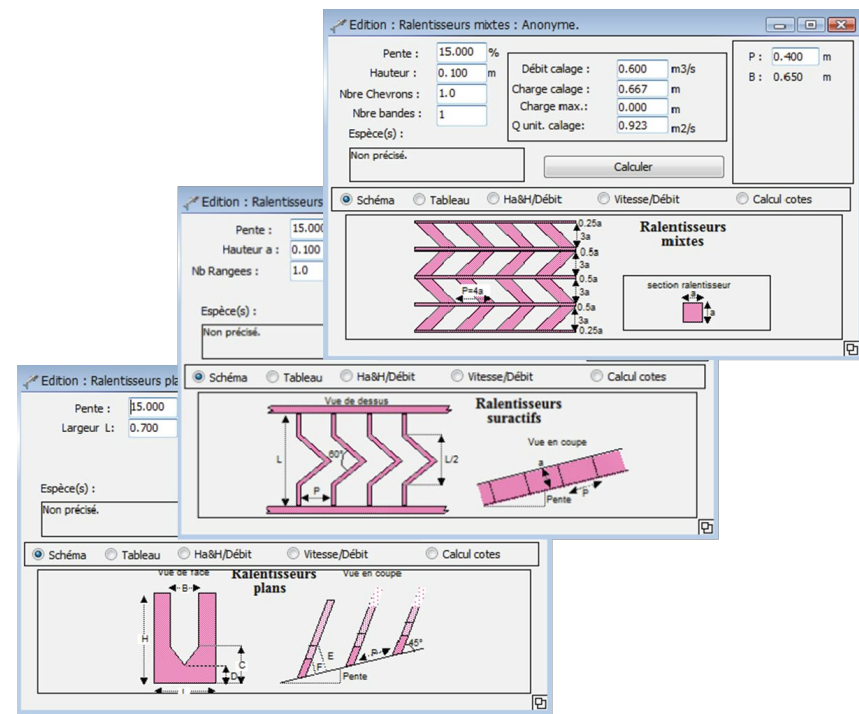




Mitigation measures
Scenarios



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Cassiopée Model



Indicators



European Eel



Fishfriendly Innovative Technologies for Hydropower



Funded by the Horizon 2020 Framework Programme of the European Union

Assumed:
 $\geq 0.15-0.20\text{m}$
 Cut off $<0.15 \rightarrow$ no effective at all

Preferable:
 $0.20-0.25\text{ m}$
 Cut off $>0.35 \rightarrow$ no effective at all if other species are considered

Preferable:
 $130-150\text{ W/m}^3$
 Cut off $<70 \rightarrow$ not effective at all

Width notches/ slots (m)			
0.0	0.0	0.15-0.19 m	
0.0	0.0	0.20-0.25 m	
0.0	0.0	0.30-0.40 m	
100.0	3.5	0.45-0.50 m	

Drop between pools (m)			
0.0	0.0	0.15-0.19 m	
100.0	3.5	0.20-0.25 m	
0.0	0.0	0.30-0.35 m	

Dissipated Power (W/m3)			
0.0	0.0	70-100 W/m3	
0.0	0.0	100-130 W/m3	
0.0	0.0	130-150 W/m3	
100.0	3.5	200-220 W/m3	

Width notches/ slots (m)

Drop between pools (m)

Dissipated Power (W/m3)

Task 2.1.4 Solution, Methods, Tools and Devices (SMTD) for fish migration issue

Project Acronym	FiThydro
Project ID	727830
Work package	2
Coordinator	Laurent David (CNRS)
Author	Manon Dewitte (CNRS)
Contributor	Please refer first page of each part
Reviewer	Please refer first page of each part
Dissemination Level	
Delivery Date	31/10/2018
Actual Delivery Date	
Version	1



Indicators



Preferable:
 $\geq 0.30-0.40$ m
 Cut off $<0.3 \rightarrow$ no effective at all



Preferable:
 $0.30-0.35$ m
 Cut off $>0.35 \rightarrow$ no effective at all if other species are considered



Preferable:
 $200-220$ W/m³
 Cut off $<70 \rightarrow$ not effective at all



Salmon



Fishfriendly Innovative Technologies for Hydropower

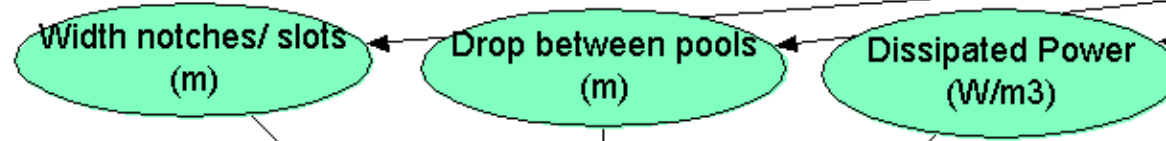


Funded by the Horizon 2020 Framework Programme of the European Union

Width notches/ slots (m)			
0.0	0.0	0.15-0.19 m	
0.0	0.0	0.20-0.25 m	
0.0	0.0	0.30-0.40 m	
100.0	3.5	0.45-0.50 m	

Drop between pools (m)			
0.0	0.0	0.15-0.19 m	
100.0	3.5	0.20-0.25 m	
0.0	0.0	0.30-0.35 m	

Dissipated Power (W/m3)			
0.0	0.0	70-100 W/m3	
0.0	0.0	100-130 W/m3	
0.0	0.0	130-150 W/m3	
100.0	3.5	200-220 W/m3	



Task 2.1.4 Solution, Methods, Tools and Devices (SMTD) for fish migration issue

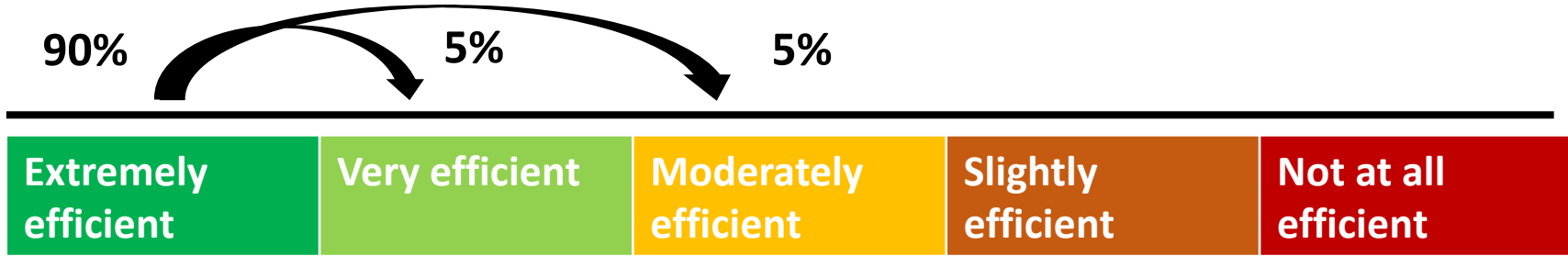
Project Acronym	FiHydro
Project ID	727830
Work package	2
Coordinator	Laurent David (CNRS)
Author	Manon Dewitte (CNRS)
Contributor	Please refer first page of each part
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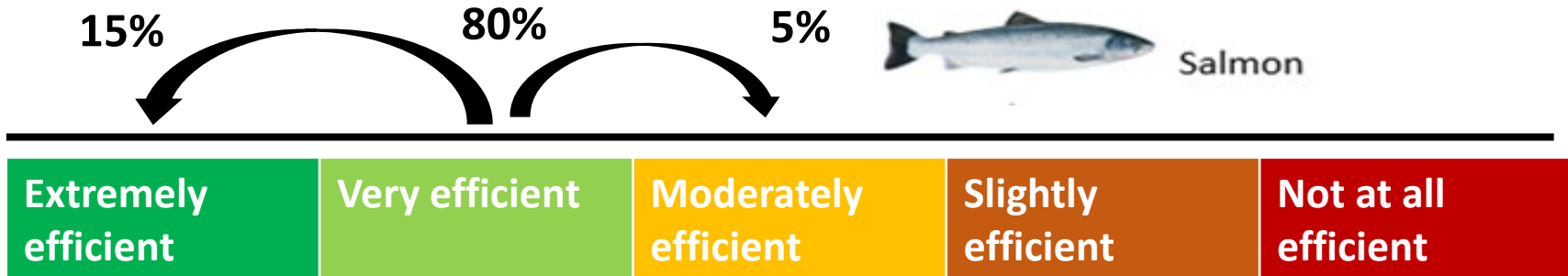
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Efficiency- one out all out/...

3 indicators inside the preference values



2 indicators outside preference value (within acceptable range)



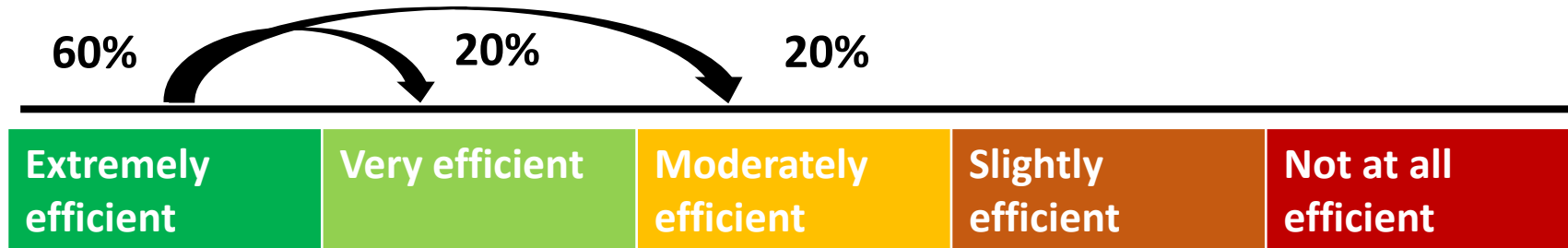
1 indicator outside preference value (>50%)



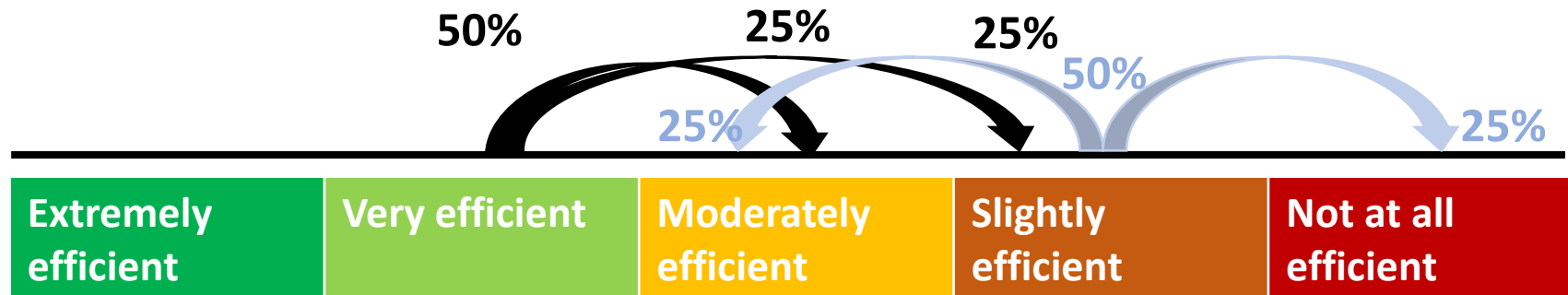


Efficiency- weighted unequally

1 indicators outside the preference values (within acceptable range) (ranked as lowest)



2 indicators outside the preference values (within acceptable range) (ranked as lowest) (ranked as highest)





Mitigation measures
Scenarios

Width notches

Drop between
pools

Dissipated
power

Bypass
attraction flow

Species
preferences

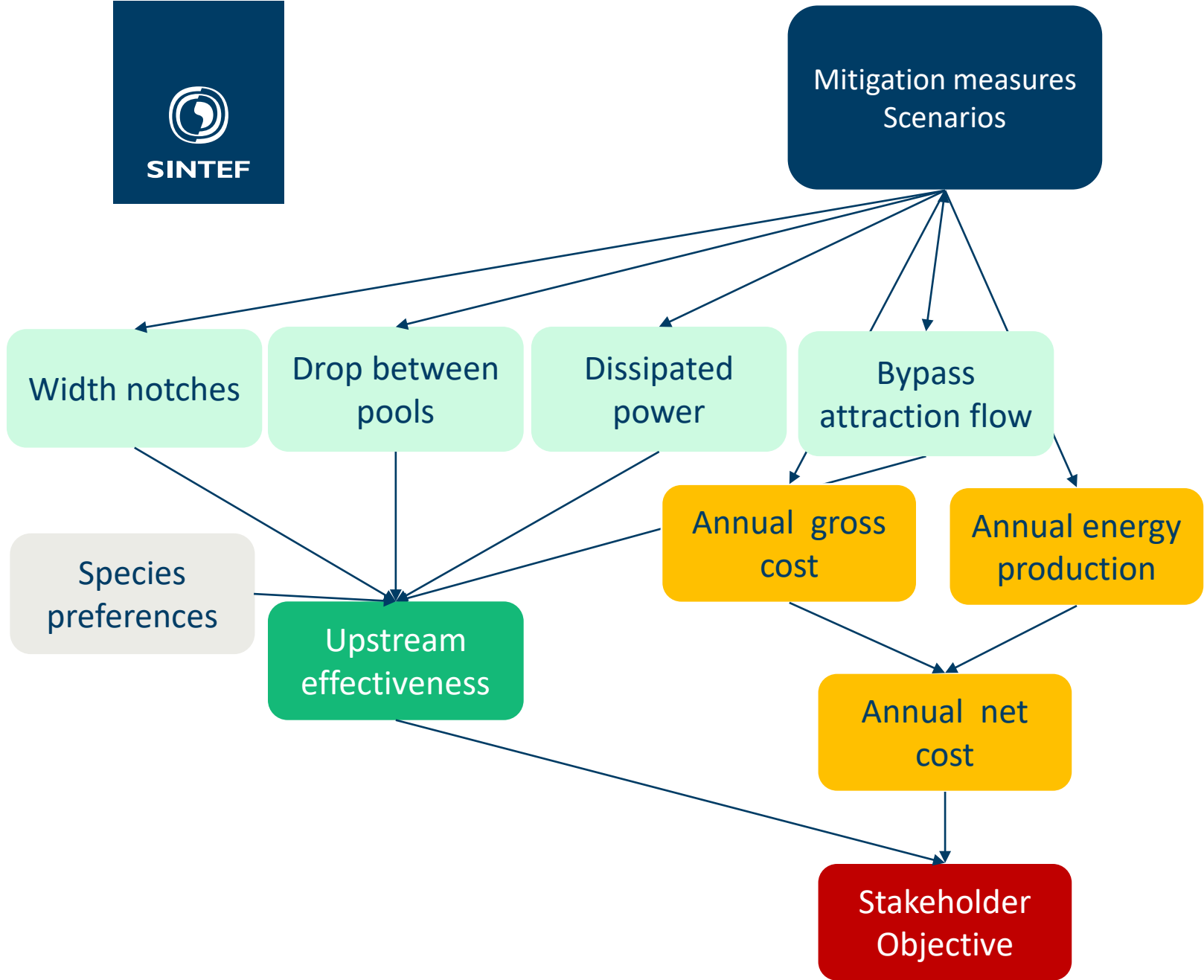
Upstream
effectiveness

Annual gross
cost

Annual energy
production

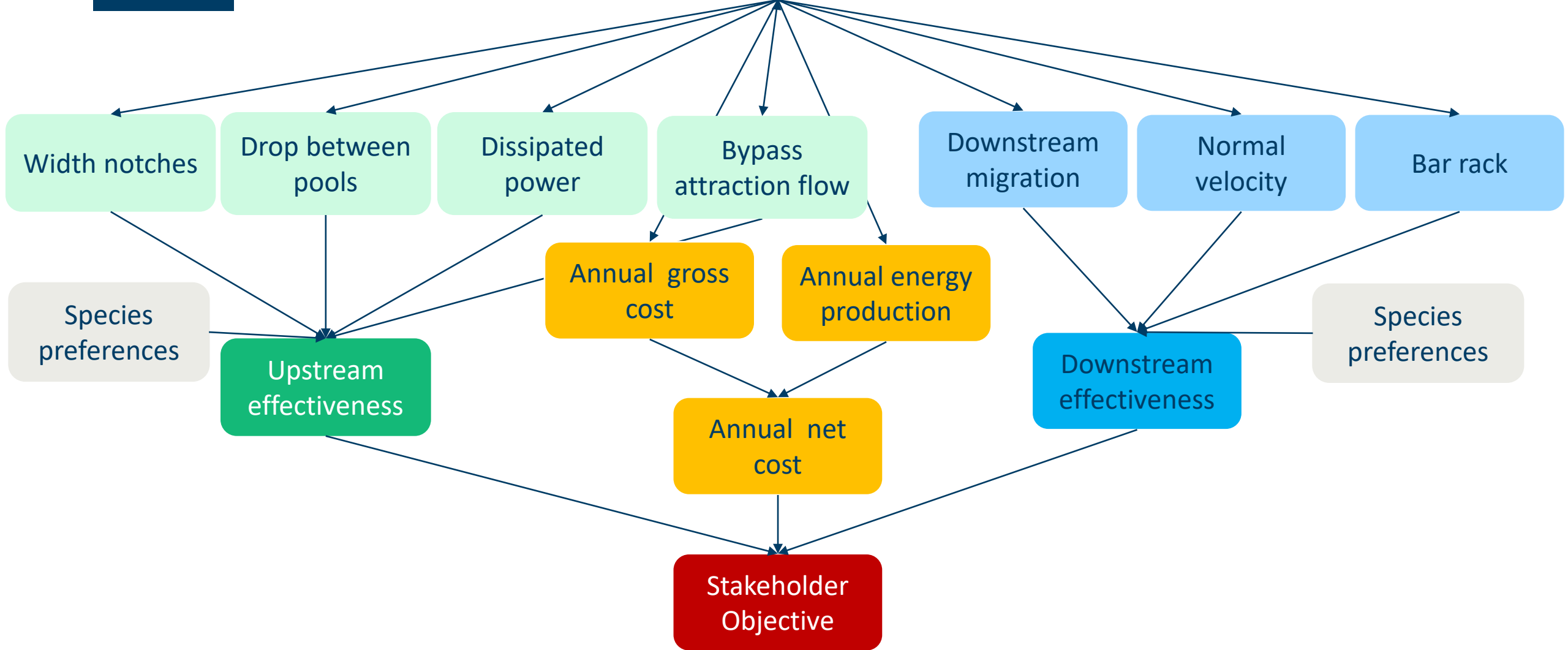
Annual net
cost

Stakeholder
Objective

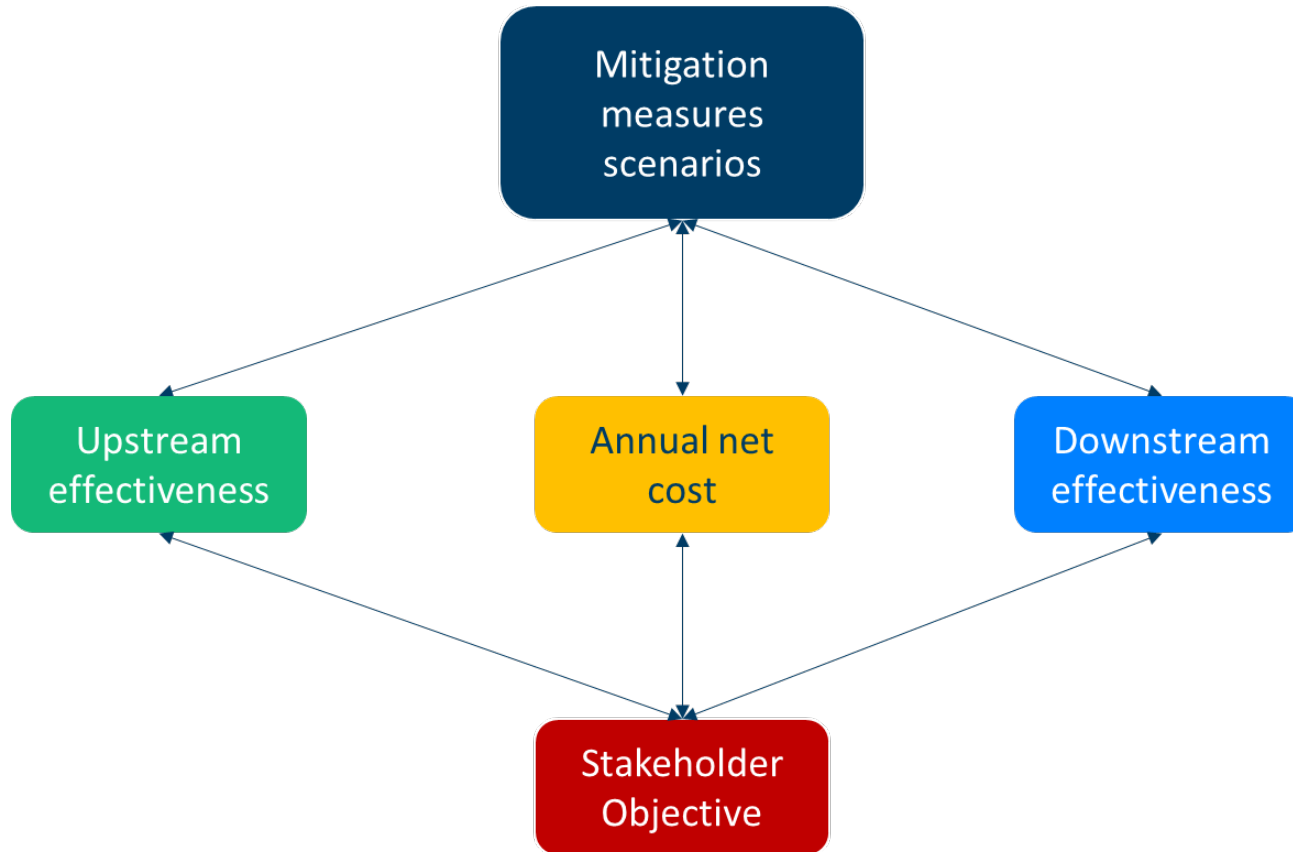




Mitigation measures Scenarios



Objective function



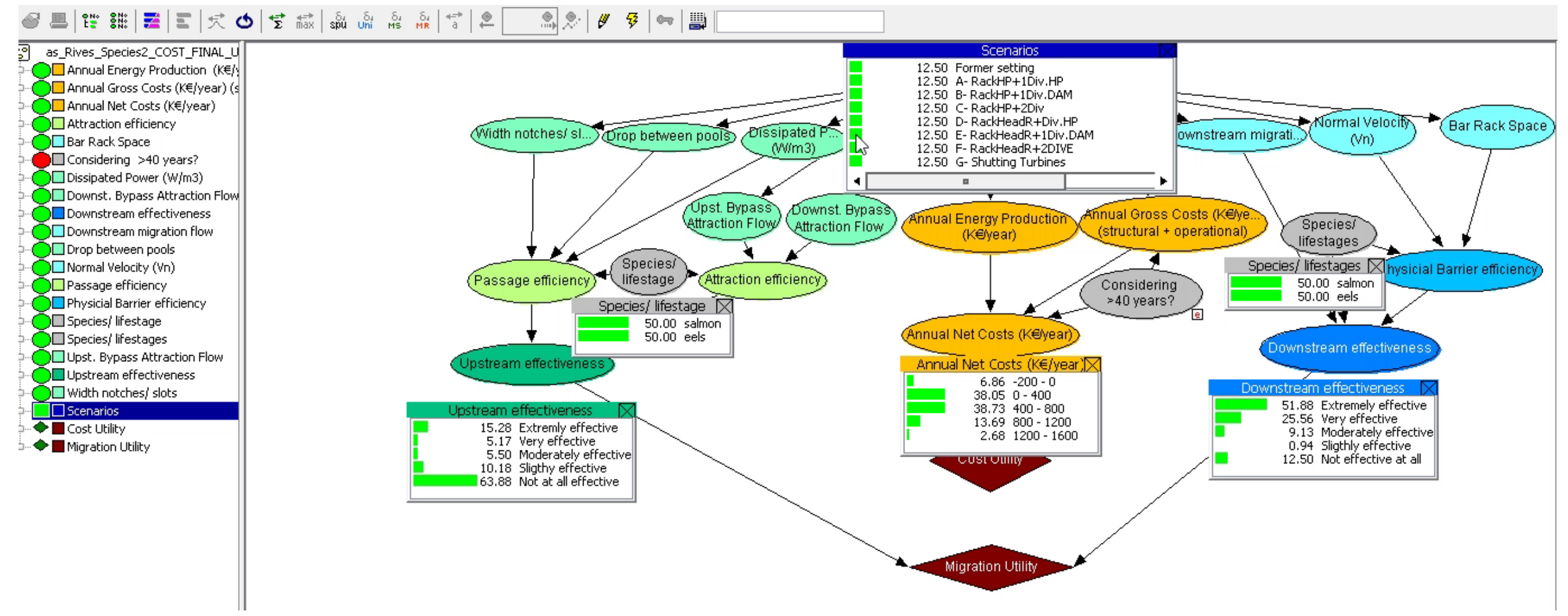
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Interest-Weighting:

- Least cost
- Highest efficiency (80%...)
- Upstream cost-effective
- Downstream cost-effective
- Combined cost-effective



ID: Las Rives





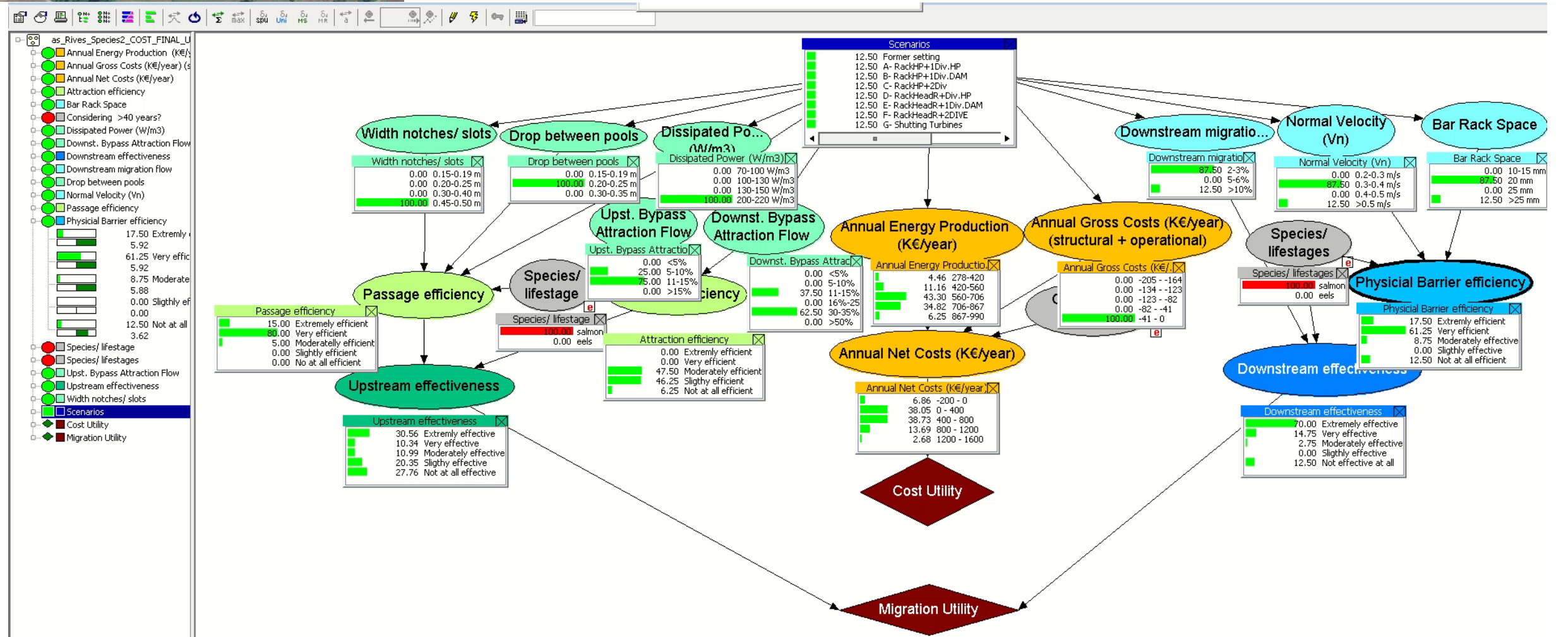
ID: Las Rives



Salmon



European Eel





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Summary Influence Diagrams



Influences Diagrams are **valuable**' tools for conducting **cost-effectiveness analyses** where **several criteria and interests** must be considered



The method allows users and decision-makers to **visually represent and understand various interests and goals**, which may lead to different prioritization of potential mitigation measures



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Thank you for your attention!
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