Cost-effectivenes of physical measures versus spill of water past the Laudal Hydropower plant.

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2. Objectives
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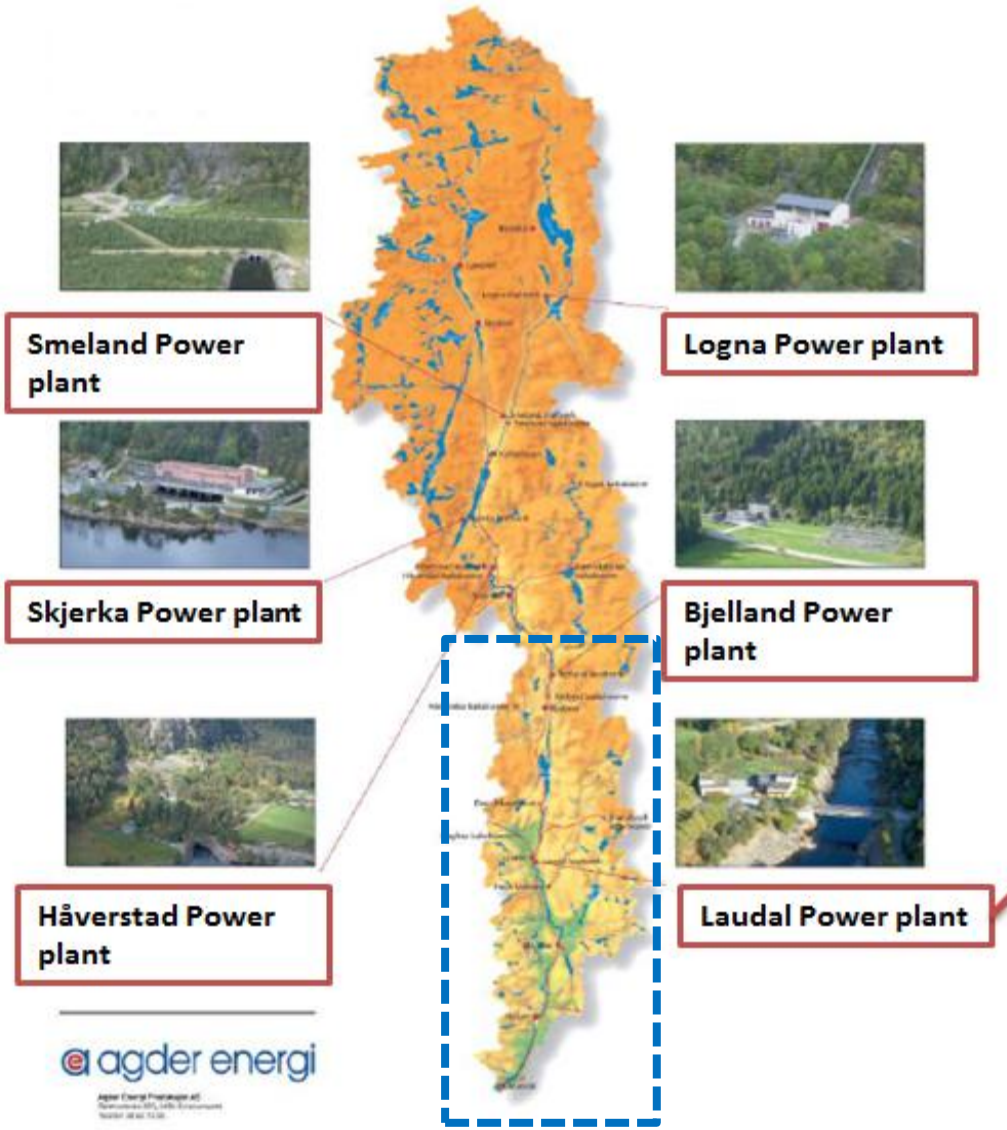
1. Introduction



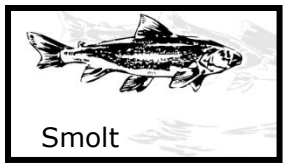
Laudal HPP
1977: License
1981: In operation

Anadromous reach: 47 km

1. Introduction

Present:
-1.5 m^3s^{-1} in winter
-3 m^3s^{-1} in summer

NVE suggestion:
-6 m^3s^{-1} in winter
-Spill during smolt migration
- 8-25 m^3s^{-1} summer



Brief notes

- 5 years trial period (2013-2017)
- Purpose: Improve salmon migration, production and recreational fishing

IB Salmon

Smolt production

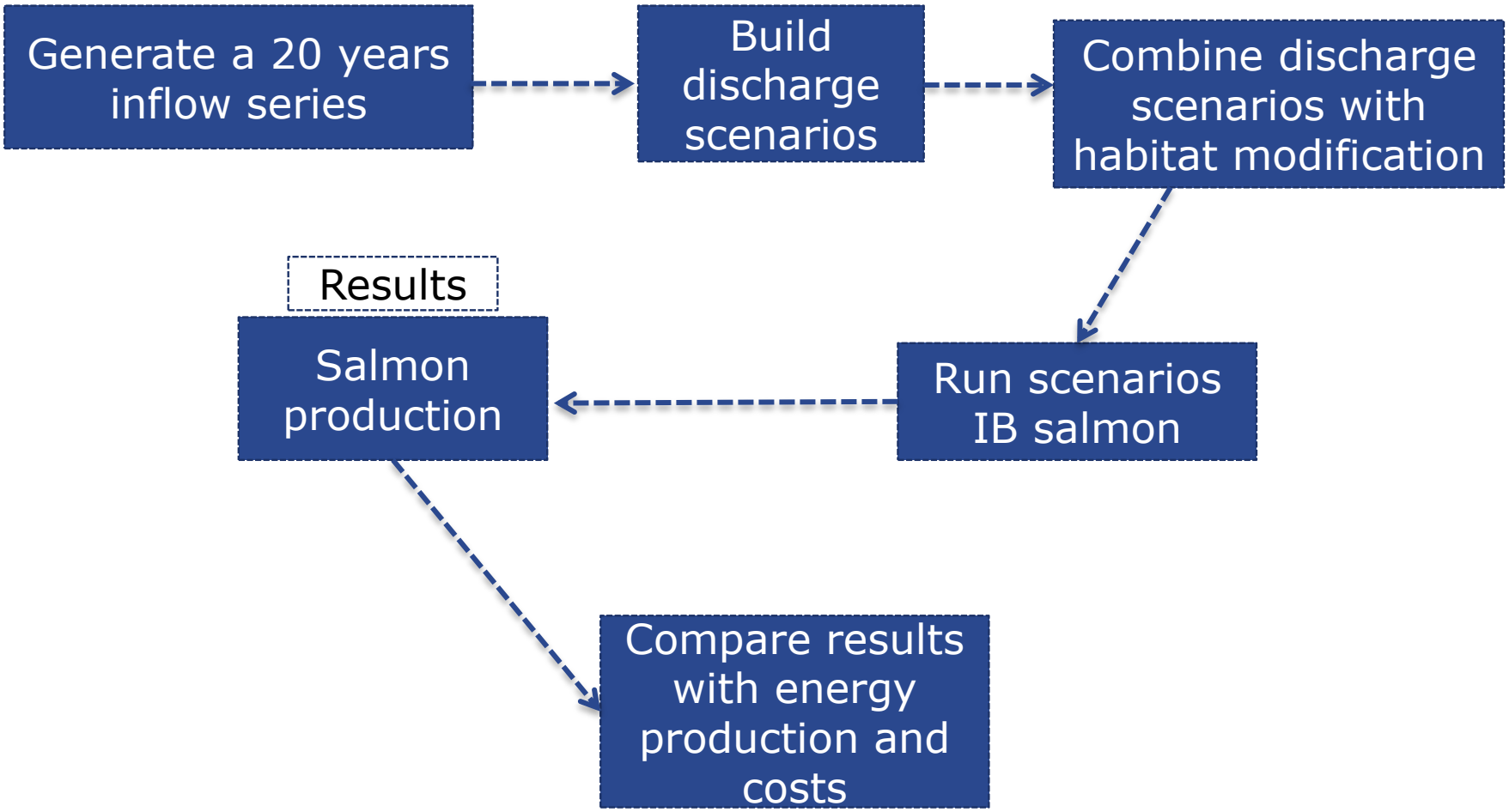
2. Objectives:

- The main objective of this study is to evaluate the ”**Cost-effectiveness of physical measures versus spill of water past the Laudal Hydropower plant”**

- Demonstrate and evaluate a methodology which can be used in other projects/rivers as a tool to predict trade-offs between changed discharge regimes, habitat modification, and power generation.

- Also to evaluate principles of off-setting versus mitigation measures.

3. Methodology



3. Methodology

Scenarios without/with habitat modification

Scenarios	Winter discharge (m^3s^{-1})	Spill in the spring (smolt migration period)	Summer discharge (m^3s^{-1})	Habitat modification (H+)
A:Present	1.5	No extra water	3	H+No extra water
B: Intermediate 1	4	No extra water 25% of inflow 50% of inflow	6-14	H+No extra water H+50%
C: Intermediate 2	6	No extra water 25% of inflow 50% of inflow	8-14	H+No extra water H+50%
D:NVEs Regime	6	No extra water 25% of inflow 50% of inflow	8-25	H+No extra water H+50%

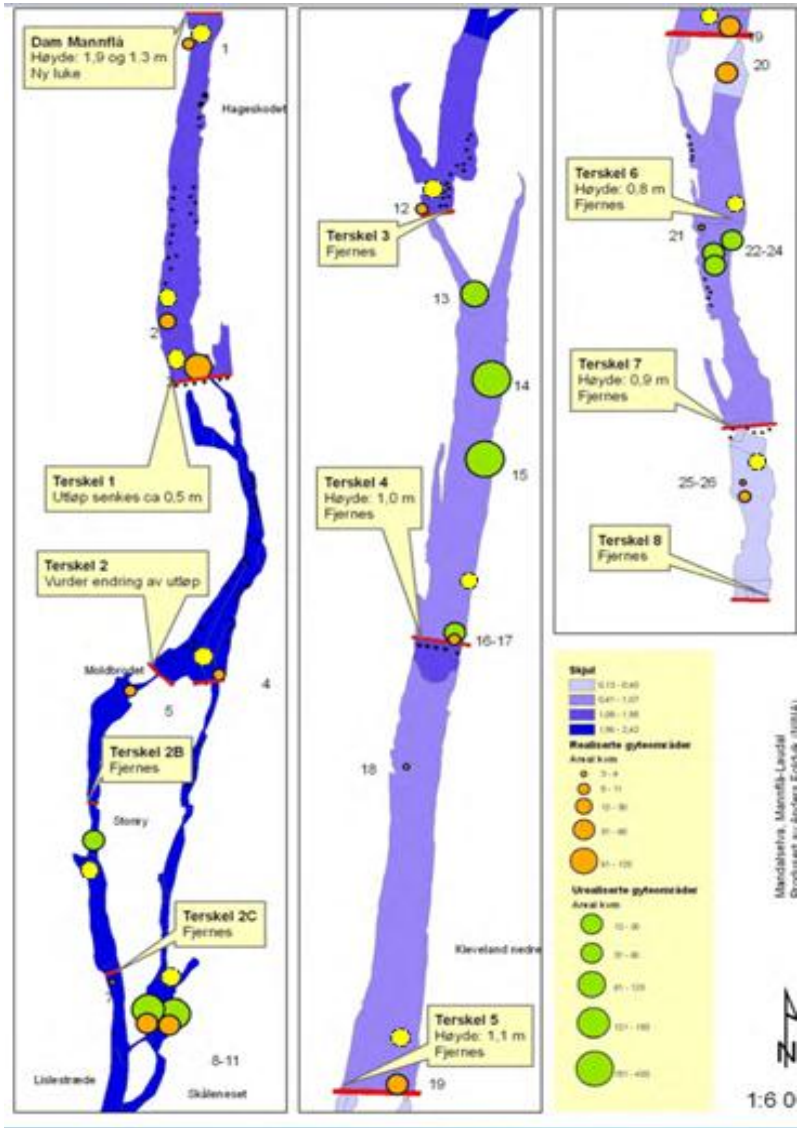
3. Methodology

Habitat modification

Maximize habitat improvement:

Removal of weirs **+** increase of spawning habitat areas

3. Methodology
Habitat modification



(Thorstad & Forseth, 2009)

4. IB salmon Results

Spring (smolt migration period):

D: NVEs regime

W:6
S:8-25
(m^3/s)

C: Intermediate 2

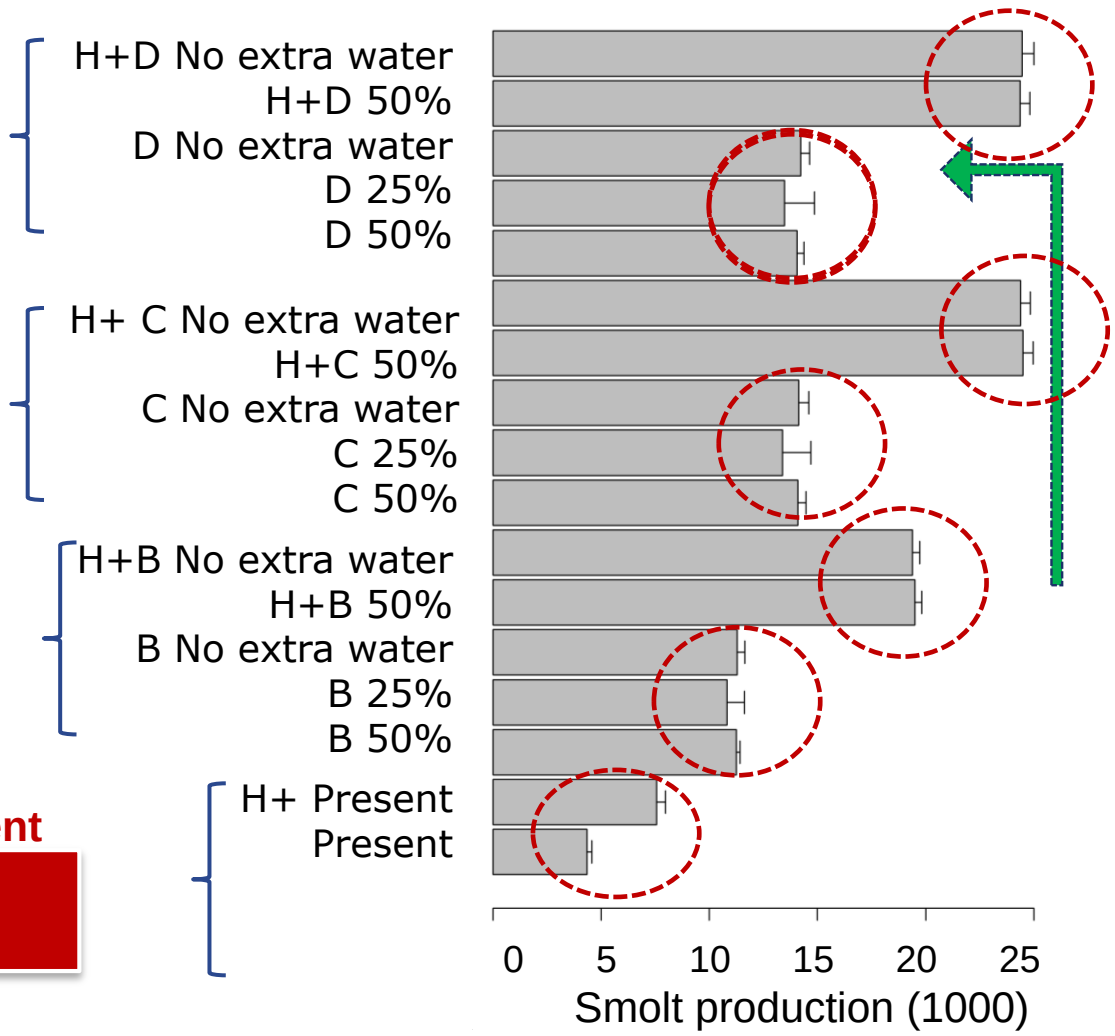
W:6
S:8-14
(m^3/s)

B: Intermediate 1

W:4
S:6-14
(m^3/s)

A: Present

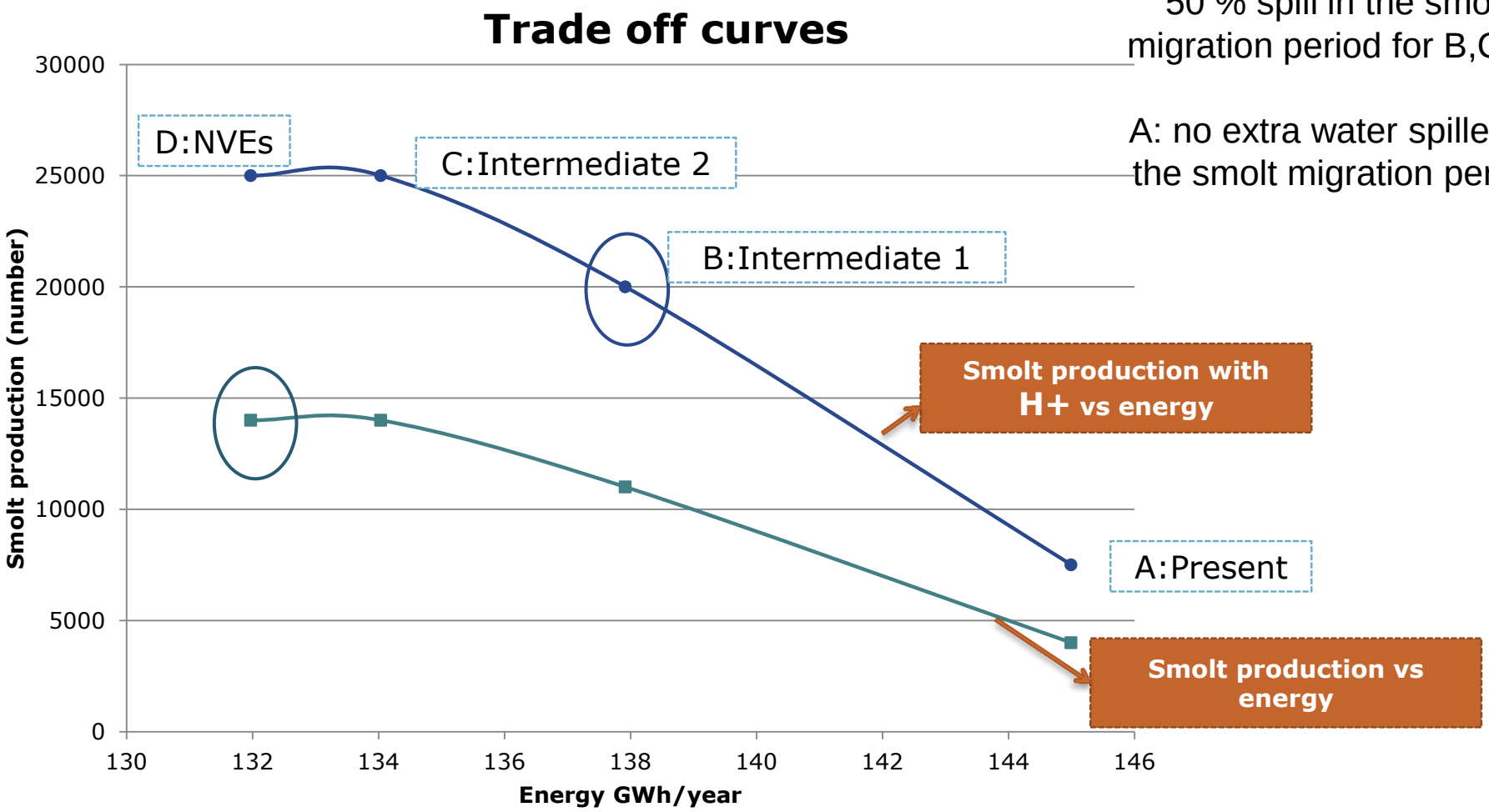
W:1.5
S:3
(m^3/s)



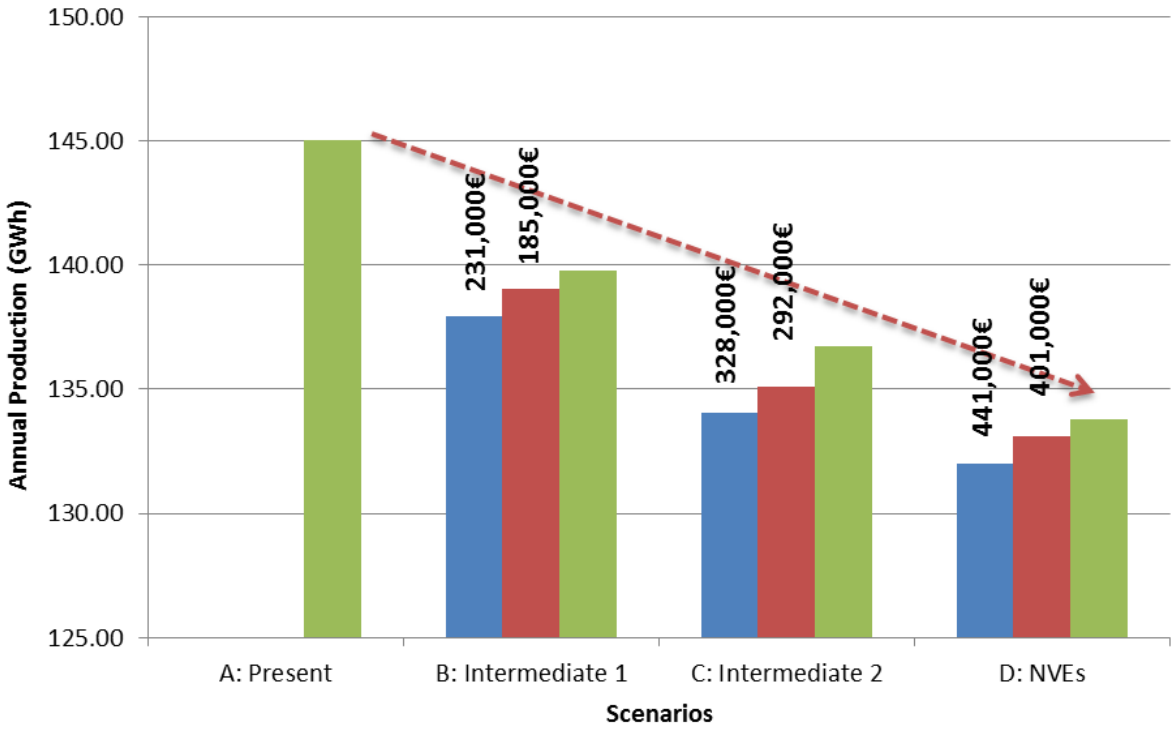
4. Smolt production with /without H+ vs energy

Discharge:
50 % spill in the smolt migration period for B,C,D.

A: no extra water spilled in the smolt migration period



4. Energy estimates



1 GWh = 36,000 €

12.25 GWh= 441,000 €

Other estimations carried out by:

AEP (2010)
28-29 GWh= 1,000,000 €

Sweco (2012)
15-20 GWh= 540,000-730,00 €

NVE
20 GWh/year= 730,000 €

4. Estimated habitat modification cost

Removal of weirs **+** increase of spawning habitat is planned and constructed in the same operation

11 weirs

20 spawning grounds (100 m^2 each)

1 artificial spawning ground (100 m^2) = 12,000 €

TOTAL= 240,000 €

5. Conclusion

- ✓ The impact on smolt production from the NVEs proposed regime can be achieved with lower power loss.
- ✓ Habitat improvement measures alone achieve about the same effect as NVEs water release proposal.
- ✓ The project shows the trade off between physical measures and spill of water.
- ✓ Methodology which can be used in other projects/rivers as a tool to predict effects of changed discharge regimes and habitat modification.
- ✓ The project needs for further data collection to reduce the simulations uncertainty.

5. Way forward

- How can Agder Energi design spill regimes and monitor the impact on fish production in the 5 years trial period?
- Are there aspects in the rules that could be difficult to incorporate in a future strategy (in addition to loss of production)
- Is the scale/boundary of the project correct?
- Can Agder Energi help to improve the energy production calculations, by adding system optimisation assumptions under each scenario?

Thank you for your attention !

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