

Kraftwerk Juchli

Exploitation of Juchli waterfall with a small hydropower plant

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Introduction

The small hydropower plant project Kraftwerk Juchli, proposed by Kraftwerke Oberhasli AG (KWO), would allow using the potential created by the construction in the 1950's of the underground gallery to transfer the water collected from the river Bächlibach to the lake of Grimsel.

The project is situated on the territory of the municipality of Guttannen in the canton of Bern, near the pass of Grimsel (see Figure 1).

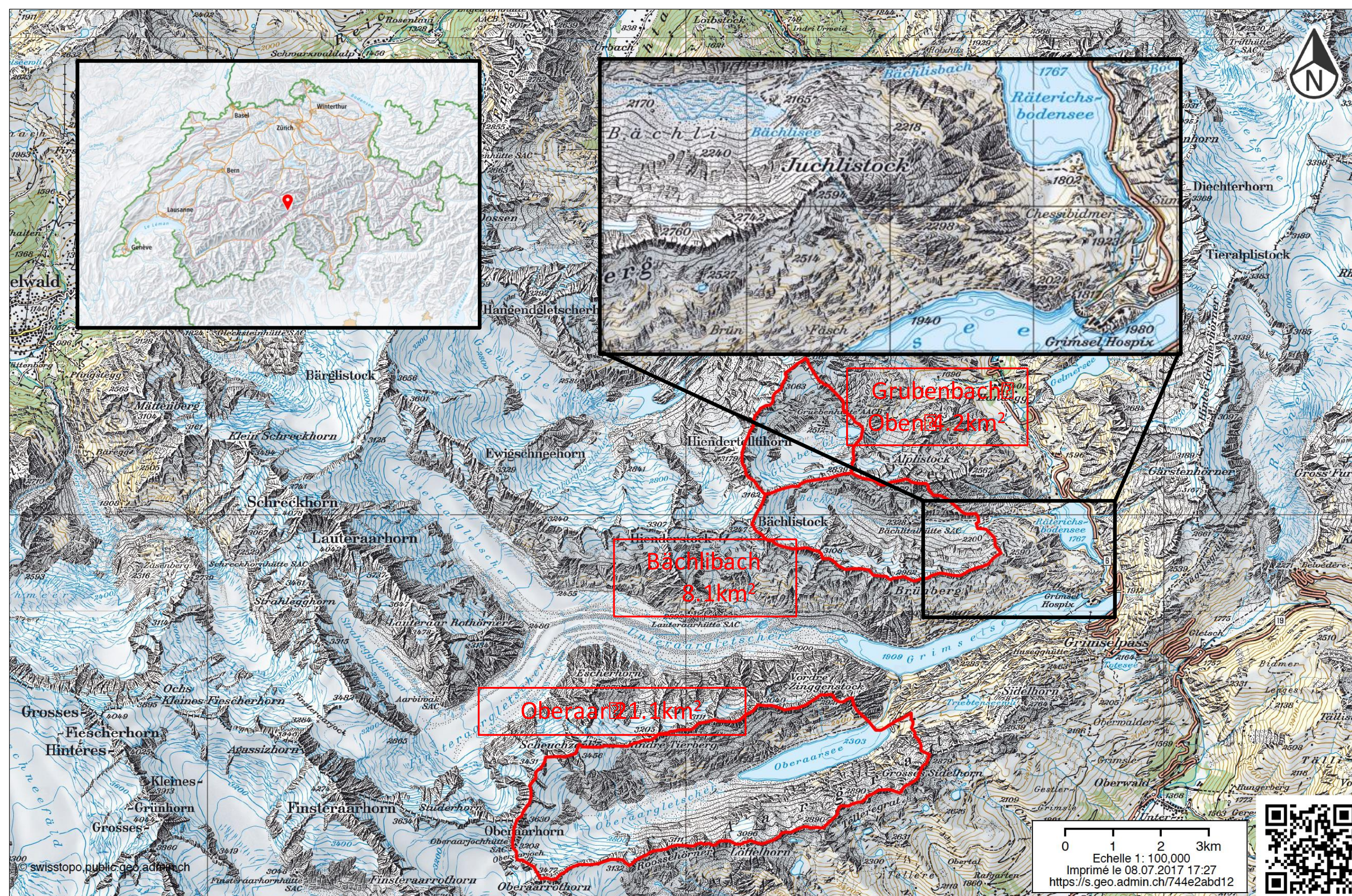


Figure 1. Geographical situation of the Kraftwerk Juchli project and the watersheds studied with the RS Minerve software (geodata © swisstopo).

The adduction gallery concerned by this project is represented in Figure 1. It allows connecting the Bächli lake with the Aar valley at the level of the Grimsel lake by passing under Juchlistock. The tunnel has a total length of 1'348 meters and a slope of 0.75%.

The existing facilities located in the Bächli valley are represented in Figure 2. The area located upstream of the Bächlibach dam is a protected alluvial zone with a national level of importance, forbidding any modification of the environment.



Figure 2. The Bächlibach dam which diverts the water into the Bächli gallery. The water intake is equipped with a trashrack to avoid big stones to enter the gallery. The capacity of the water intake is 7.5 m³/s.

In addition, the former artillery fortress of Grimsel as well as the project of replacing the Spitallamm dam could bring some synergies to the project. Scenarios with or without the extra height of the level of Grimsel lake are to be taken into consideration.

Methods

1. Modelling of the Bächlibach and Grubenbach Obere watersheds on the software RS Minerve. The results of the modeling will supply the discharge data at the exit of the watershed.
2. Study of various alternatives of exploitation of the waters from the Bächli river.
3. The most interesting alternative is chosen for a more thorough study which contains the dimensioning of the hydraulic elements.
4. Study of the project's impact on the environment.
5. Estimation of the cost for the construction of the small hydropower plant.

Concepts of exploitation and alternatives

- Concept of exploitation : Run-of-river.
- Storage and turbine-and-pump are not practicable because of their impact on the environment.

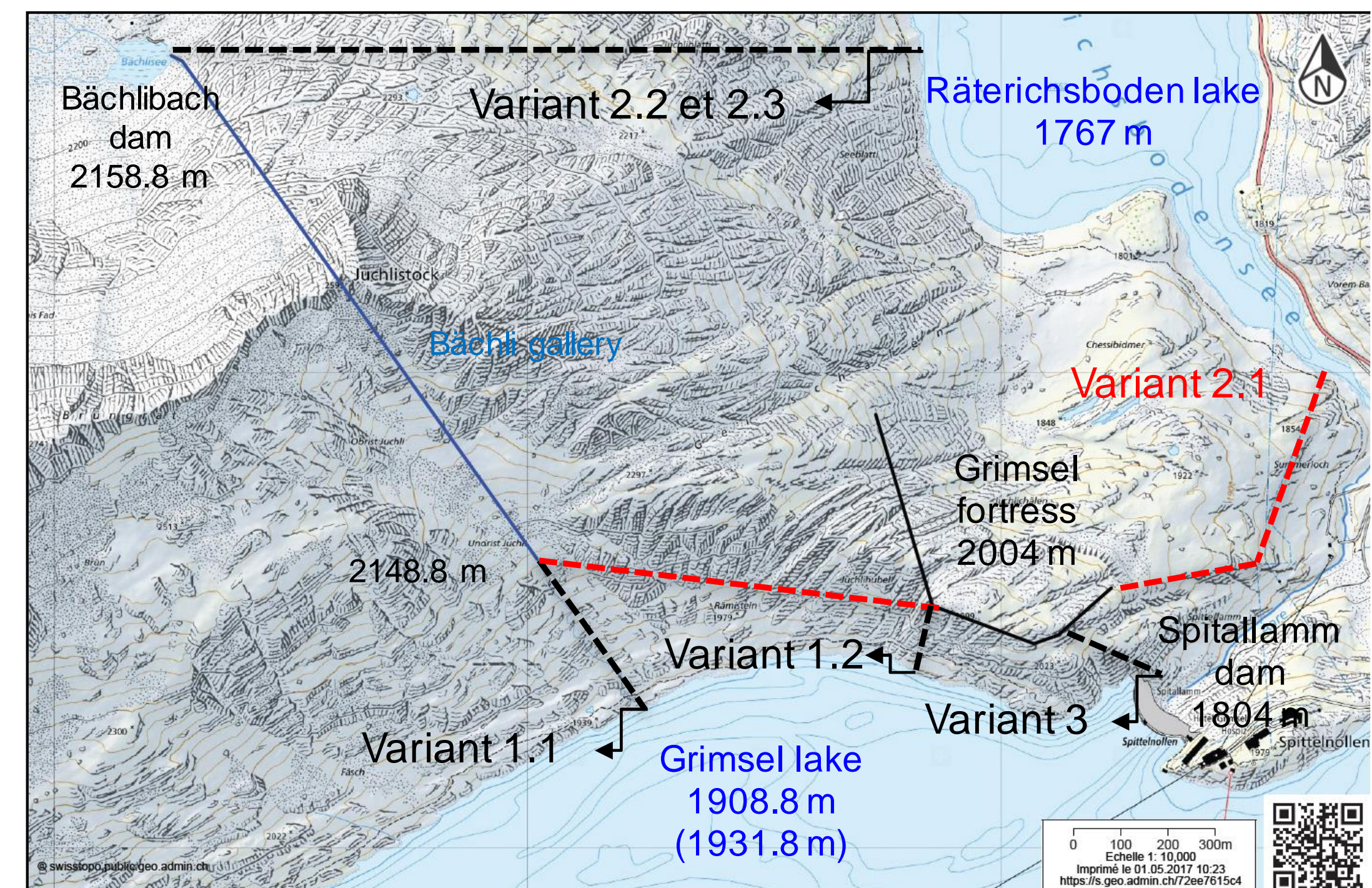


Figure 3. The variants of exploitation for the project Kraftwerk Juchli. The solid lines represent the existent galleries (geodata © swisstopo). Representation of the different existing facilities and their altitude. The maximum elevation of the level of the Grimsel lake is 1908.8 m a.s.l. but a project is in study to raise the level to 1931.8 m a.s.l. The Spitallamm dam is one of the two dams which were built to create the Grimsel reservoir. The Grimsel fortress could be used to install a part of the penstock pipe.

Alternatives

- | | |
|-------------------------------------|----------------------|
| 1. Bächlibach – Grimsel lake | Head : 250 m (227 m) |
| 2. Bächlibach – Räterichsboden lake | Head : 390 m |
| 3. Bächlibach – Spitallamm dam | Head : 353 m |

From the 6 variants proposed, variant 2.1 (see Figure 3) is chosen as the best one for which all works have been designed.

Pre-project of the small hydropower plant

With a designed discharge of 1.7 m³/s, 19.1 GWh/year of net power can be produced by means of one Pelton turbine.

Hydraulic structures :

- Efficiency of the sandtrap : 0.2 mm
- Length of the penstock pipe : 1'830 m
 - 1'355 m : polystyrene reinforced with fiberglass (PRV)
 - 475 m : stainless steel
- Turbine Pelton : 2 injectors and a vertical axe of rotation (see Figure 4)



Figure 4. Picture of a Pelton turbine with two injectors from the power plant Le Lauzet in France (Cerec Engineering):

The engine room is installed in the assembly cave of the Grimsel 1 hydropower plant.

Conclusion

- Installed capacity : 5.8 MW
- Investment cost : 12.2 million CHF
 - Civil works : 8 million CHF
 - Hydromechanical equipment : 1 million CHF
 - Other costs (engineer, capital cost, etc.) : 3.2 million CHF

Economic evaluation

Return period : 25 years, till the end of the actual concession.

Interest rate: 3 %

- **Generation cost** : 4.4 cts/kWh

The profitability of the project is guaranteed if it benefits from the compensatory feed-in remuneration (RPC). Without the RPC, the project can be profitable if the electricity selling price is a bit higher than the actual market price. A renewable energy label could ensure a bonus of 1 ct/kWh.