Restoration of the Old Rhine River

CONTEXT

The Electricité de France (EDF) Group is an integrated energy operator, present in all sectors of the electricity industry and has Europe’s largest generation capacity. It is the major player in the French electricity market with its 96 percent carbon dioxide-free production mainly provided with nuclear and hydropower. With a solid presence worldwide contributing to around half of its €72 billion global turnover, EDF has a historical background of public services, providing energy and innovative services to more than 38 million customers worldwide.

EDF manages the multipurpose uses of water either for its power plants or for providing water for other users and activities such as agriculture, drinking water, tourism, industry, energy, and other domains within a sustainable development perspective.

Commissioned in 1932, the primary purposes of the Kembs scheme – which is comprised of 2 dams, the Old Rhine River, a large powerhouse, one smaller powerhouse, a ship-lock, and a fish ladder – are hydropower, facilitating navigation, and flood control. EDF funded and built the power station and dam as part of a licensing agreement with the French government; EDF also leases the facilities, which earns revenue through electricity generation.

The French State owns the infrastructure, including the ship lock. The license conditions require that EDF maintain water levels in the Grand Canal d’Alsace and Rhine River. In 2007, the license expired, and environmental concerns were a major issue for the relicensing process on the upper Rhine River, which was not the case in 1932.

The site is located on the upper Rhine River (Figure 1), near the Swiss-German-French borders, and the Kembs dam allows derivation of waters for hydropower generation to the ‘Grand Canal d’Alsace’ (GCA) (Figure 1). The GCA is equipped with four hydropower plants, built between 1932 and 1954: Kembs,
Ottnmarsheim, Fessenheim, and Vogelgrun – generating 630 megawatts, 3,760 gigawatt hours per year.
The maximal diverted flow is 1,400 cubic meters per second (m$^3$/s). The mean inter-annual flow of the Rhine at Kembs is about 1,070 m$^3$/s.

Key stakeholders include EDF, the local authorities (France, Germany, Switzerland), and Petite Camargue Alsacienne (PCA), a local non-governmental office in charge of protecting and managing this small artificial island.

**OBJECTIVE AND PROJECT OVERVIEW**
The primary purpose of the project was to ensure the relicensing of the hydropower plant while optimizing benefits in a sustainable way: economic through refurbishment and uprating, social through a better involvement and an increasing benefit sharing with local communities, and environmental through actions for ecosystems. This “integrated project” aims to recover more typical alluvial rhenan habitats, biodiversity, and functions.

EDF chose an integrated environmental approach instead of a strict “impact/mitigation” balance. Therefore, the project simultaneously acts on complementary compartments of the aquatic, riparian, and terrestrial environment to benefit from the synergies that exist between them. Restoration of the “old arm” of the river is one of the three main actions launched along this process.

**THE BUSINESS CASE**
EDF wanted to maintain the right to operate a plant built 75 years ago within a completely different environmental and regulatory context. In addition, EDF hoped to increase local social and environmental benefits and demonstrate the advantage of run-of-the-river hydropower plants to produce renewable and carbon dioxide-free energy in a context of climate change.

**DECISION MAKING PROCESS**
National and local level EDF management teams were involved in the decision-making process. EDF’s Board of Directors made the final decision for the investment in the project.

An alternatives’ analysis was not conducted for this project. However, valuation was used to optimize the loss of power generation against increasing the flow volumes to be released. The result was the construction of a new small hydropower plant to both better manage the new environmental flow and use part of it for generation—however, only around 20 percent of the initial loss in generation is recovered.

**PROJECT DETAILS**
This project included several measures aimed at restoring the biological connection. It created new aquatic connection between the GCA and a network of ponds and small waterways located in the PCA protected area. This new connection (approximately 270 meters long, 1 to 3 m$^3$/s) has various morphological faces, creating new habitat for fauna (Figure 2).

A pass is also planned at the right side of Kembs dam, which will be adapted for beavers and others aquatic mammals, as well as for batrachians and reptiles. To be attractive, this aquatic pass will be vegetated with a variety of local plant species that are attractive to beavers. The pass will follow the drainage canal parallel to the Old Rhine River and will allow fauna to move upstream or downstream of the dam.
Another natural concern was recreating a river (7 m$^3$/s, 8 kilometers long) between the new hydropower plant located at the Kembs dam and the Old Rhine River close to the Kembs plant. This river will be recreated in a former bed of the Rhine, which runs through a large field that has been used for agriculture for the last 40 years, further north in the forest (Figure 3).

Using existing thalwegs reduces the amount of leveling work required (about 340,000 m$^3$ were displaced in the field), especially in the forest area where the ecological issues are of great concern. To minimize the impact in the forest, the width of the channel was reduced along with the flow, which was about 2 m$^3$/s to approximately 5 m$^3$/s return to the Old Rhine River northeast of the field (upstream the forest), allowing fish to migrate (Figure 3). As the Old Rhine River is about 7 meters lower than the field, the connection consists of a rapid section, similar to a natural fish pass. The project team designed this river, with its riparian and adjacent wet habitats, to offer various habitats and morphological diversity for typical rhenan rheophilic fish, including Salmonids. This river will be favorable to Salmonid spawning and growth, which is an important objective for the Rhine.

**Figure 3**: Recreated river (right) takes place in former beds of the Rhine (see topography on left image) and connect Old Rhine and GCA close to Kembs dam.
EDF decided to maximize the expected environmental gain achieved by the river restoration by recreating a number of wetlands of ecological interest in the field that was returned to agricultural use. The surface was large enough (1 square kilometers) to plan an interesting and complementary mosaic of wet/dry, prairie/forest environments. This ambitious project required multidisciplinary expertise (geomorphology, bioengineering, applied ecology) and an important collaboration with partners such as PCA, local natural associations, and scientists (Lachat et al., 2012). This restoration of various habitats aims to allow the return of typical alluvial species of invertebrates, macrophytes, helophytes, batrachians, birds, and mammals. The chance of success is high because the field is included in the PCA-protected area (possible systemic colonization) and it is located in the former minor bed of the Rhine (favorable substrate, presence of underground waters, etc.). The mosaics of recreated habitat in the field will be distributed as shown on Figure 4.

EDF financed the project, and the total budget of the project (the three main actions mentioned in Section 2) was € 24 million.

As the Kembs scheme concerned three countries with various national regulatory frameworks and different views on how to address environmental aspects, EDF undertook a 10-year procedure (until 2010) to design an integrated environmental project instead of a strict ‘impact/mitigation’ balance. This broad approach allowed addressing environmental issues in a comprehensive and global way rather than separately focusing on the mitigation of each single impact. The duration of the works was 4 years, and the “old arm” impoundment was completed in 2014.

LESSONS LEARNED

The main success factor was stakeholder engagement. Where there is a real willingness and consensus to build or co-build natural infrastructure, it is easier, even within the company, to make the decision.

EDF wished to get away from the strict environmental legislation to place its measures in the global context of rhenan ecosystems restoration. This approach had two mains issues:

- Define EDF measures consistent with the objectives and actions of other rhenan environmental stakeholders
- Develop the basis of sustainable partnerships with stakeholders that have the same vision of the sustainable development of the rhenan area

The main challenge was to reach a fair and balanced agreement between three countries with different expectations and needs. EDF focused on optimization in terms of costs/benefits of the different actions to satisfy environmental needs for energy generation.
Figure 5: Areal View Before Vegetation Works.

Figure 6: Connection canal between the drainage canal and the Grand Canal d’Alsace.
FUTURE IMPLEMENTATION AND NEXT STEPS

Natural infrastructure consideration is part of EDF’s Environmental Management System and Hydro Engineering Division. The environmental specialists, with the support of consultants, are providing training courses to civil engineers.

Several internal documents called “Biodiversity Guides” (for different sectors: nuclear, hydro, transmission, etc.) have been developed for sharing best practices and case studies including natural infrastructure.

For this project, systematic environmental monitoring is planned for the long term to verify the good achievement of the targeted objectives.

REFERENCES


ABOUT THE WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT (WBCSD)

The World Business Council for Sustainable Development (WBCSD), a CEO-led organization of some 200 forward-thinking global companies, is committed to galvanizing the global business community to create a sustainable future for business, society and the environment. Together with its members, the council applies its respected thought leadership and effective advocacy to generate constructive solutions and take shared action. Leveraging its strong relationships with stakeholders as the leading advocate for business, the council helps drive debate and policy change in favor of sustainable development solutions.

The WBCSD provides a forum for its member companies - who represent all business sectors, all continents and a combined revenue of more than $8.5 trillion, 19 million employees - to share best practices on sustainable development issues and to develop innovative tools that change the status quo. The council also benefits from a network of 70 national and regional business councils and partner organizations, a majority of which are based in developing countries.

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