Asset Decommissioning

1. INTRODUCTION

The purpose of this report is to assess the state of the art in discussions on asset decommissioning in the electricity sector, as well as to describe the evolution of the Company's actions in this regard.

2. MOTIVATION

Numerous company assets need to be decommissioned or dismantled continuously due to normal operations, especially because of end-of-life or obsolescence. The company adopts best practices in terms of circularity and proper disposal of equipment, inputs, and products used.

Among all Cemig's assets, the most complex to decommission are power generation plants, especially those involving the use of dams.

In this context, the company keeps its engineering teams actively engaged with the topic, evaluating our assets and contributing to technical, regulatory, and environmental discussions, with teams prepared for the moment when this knowledge needs to be applied in actual projects.

3. GENERAL CONCEPTS

Dam decommissioning refers to the removal of hydroelectric generation facilities and often the entire dam. Decommissioning arises as a solution when a dam poses a safety risk, no longer serves its intended purpose, or no longer aligns with current social, environmental, and/or economic values.

The discussion is based on the environmental impact caused by dams and the importance of restoring impacted environments when the useful life of plants or mines ends and they are deactivated.

In the electricity sector, the discussion mainly revolves around reservoir drainage and its positive and negative impacts, especially considering the river environment and multiple uses.

The cost of decommissioning a dam can be very high, considering the environmental aspects and the changes made to the river regime during reservoir operation, which would tend to return to previous conditions upon decommissioning. River dynamics and biota assessments need to be redone, reversing the reservoir formation process. Part of the environmental adaptation that occurred during the long operational period must be reversed as much as possible.

Another relevant point is the evaluation of the volume of sediments retained upstream of the dam, which generally defines the useful life of a project. With the dam's removal, this material tends to move downstream in a short time, with potentially significant sediment volumes.

Usually, no contaminants are generated by the plant's operation, but the sediment composition must be evaluated, especially in urban areas.

Typically, dam projects do not address decommissioning, and its costs are not considered, especially since it is expected to occur 50 or 100 years in the future. However, considering the average age of Brazil’s power generation infrastructure, this situation is already real and needs to be discussed.

Dam removal is also an important tool for river and biota restoration and can often be the main reason for removal.

The increasing number of dam removals has led to a better understanding of the outcomes for rivers and their ecosystems. Rivers must adapt again to the changes and disturbances that accompany dam removal.

Many changes occur quickly and can improve water quality, hydrological flows, and aquatic animal migration. However, some outcomes may take longer, depending on factors such as the life history of key species or the implementation of other complementary river restoration actions.

Additionally, the potential negative impacts of dam removal must be assessed, including issues related to the multiple uses of reservoirs, such as navigation, irrigation, tourism, and shoreline occupation.

Post-removal environmental monitoring actions must be planned and evaluated over potentially long periods, and resources must be set aside for established actions, additions, and/or necessary corrections.

4. NATIONAL AND INTERNATIONAL SCENARIO

In Brazil, the topic is in the early stages of discussion, especially in the electricity sector for power generation dams, with no clear references on how it will be regulated, particularly in environmental and regulatory terms.

Although still new in the country, this practice already occurs in many countries, driven by various factors, whether environmental, economic, or structural obsolescence.

In the United States and Europe, a large number of decommissionings have been observed over the past 10 to 15 years, mainly of small dams.

Aging is the main factor for deciding to remove a dam. Many dams were built in the 20th century and have exceeded their projected lifespan. If a dam poses a safety risk, removal is usually the only option.

Another common reason is sediment accumulation in the reservoir, which increases safety risks, reduces usable capacity, and can damage turbines.

A third common reason is the ecological impact of hydroelectric facilities. As understanding of dam impacts on aquatic and riparian ecosystems has grown, social pressure for removal has increased. Dams may be removed to provide upstream habitat for migratory fish, restore natural flow regimes, and/or reconnect coastal sediment systems.

Ecologically motivated dam removals often occur due to regulatory triggers, as upgrading facilities or operations to meet new environmental requirements (e.g., fish passage or water quality) may not be economically viable.

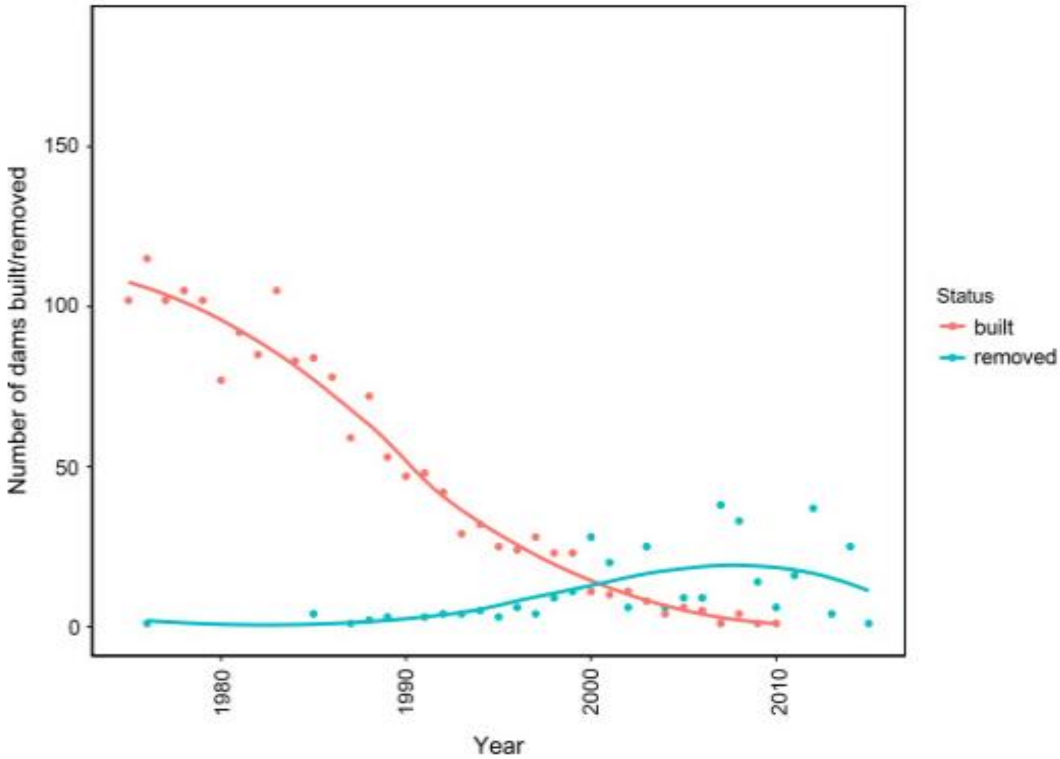
In the U.S., dam decommissioning discussions often arise when a facility needs to renew its operating license. Similarly, in Japan, water rights renewals often trigger debates about dam removal in rivers with declining fish populations.

Analyzing the solutions and challenges faced in these countries can help guide the best policies, methods, and practices for structuring Brazil’s legal and regulatory framework. It can also serve as a reference to prepare for what may soon occur in the electricity sector.

U.S. SCENARIO

Records of dam removals in the U.S. date back to 1916, with the first recorded removal being a dam in Big Spring Run, Pennsylvania. Dam removals were rare until the mid-1970s, when environmental awareness grew and dam impacts became better known.

Dam removal continued to gain momentum over the next 25 years, while dam construction saw a steep decline in the United States. However, until the year 2000, dam construction still outpaced dam removals. Since then, the number of dams removed has exceeded the number of new constructions each year, as shown in the figure below:



Source: U.S. Dams Removed 1912-2021 - Google My Maps

Dam removal gained momentum over the next 25 years, while dam construction declined sharply. Until 2000, dam construction still outpaced removals. However, since 2000, the number of removed dams has exceeded new constructions annually.

Alongside increased knowledge of dam effects, ongoing concerns about aging infrastructure and maintenance costs have fueled interest in dam removal. High-profile removals, such as those on the Elwha River in Washington (Elwha and Glines Canyon Dams), which blocked salmon migration, have amplified this interest.

Although dam removals are seen as a powerful tool for restoring lotic habitats, they can have socio-ecological impacts that must be carefully studied and considered. Ecologically, dam removal can affect downstream spawning grounds, food supply, and community composition.

Cost-benefit analyses are often used to assess whether a dam should be removed, but evaluating socio-ecological systems (e.g., dam removal projects) is challenging. Assigning monetary value to endangered species and ecosystem services is difficult, as these vary across space, time, and stakeholders.

BRAZILIAN REGULATORY FRAMEWORK

Legislative Proposal 4,372/21 establishes rules for the deactivation and dismantling of dams and other structures of hydroelectric plants that reach the end of their useful life, known as "decommissioning." It has been under review in the Chamber of Deputies since 12/09/2021 and has not yet been approved.

According to the proposal, once plants reach the end of their useful cycle, they will be decommissioned and the environment restored, following technical solutions required by the competent environmental authority.

The dismantling of all structures will be carried out by the company operating the plant and must be preceded by an environmental license approved by the relevant authority.

From a regulatory perspective, dam decommissioning is not regulated by ANEEL and only occurs if the plant is deemed unfit for re-licensing. The decision must be aligned and validated by regulatory bodies. All costs and risks arising from decommissioning are the responsibility of the operator.

From an environmental perspective, the process must be individualized, similar to the licensing process for new projects. There are no complete processes in the country to serve as a reference, making this a new path to be explored.

5. CEMIG SCENARIO

Aware of this situation, Cemig is promoting discussions on the topic and defining actions to create a procedure for evaluating the structures of its plants, engineering intervention projects, environmental licensing, and economic-financial analysis of proposed actions and solutions.

In the short term or already underway, Cemig will evaluate the decommissioning of the following plants:

- PCH Pandeiros – project under development for over 10 years

- UTE Igarapé – thermal plant whose operation has ended; technical decommissioning project is under discussion

DECOMMISSIONING OF PCH PANDEIROS

The PCH Pandeiros dam is located on the Pandeiros River in Januária, Minas Gerais, about 637 km from Belo Horizonte.

The hydroelectric facility was built by the São Francisco Valley Commission between 1953 and 1957 and incorporated by CEMIG in 1971.

The plant has a generation capacity of 4.2 MW, distributed across three 1.4 MW units.

The plant is located within the Pandeiros Environmental Protection Area (APA), established by State Law No. 11,901 of September 1, 1995, and the Pandeiros River State Wildlife Refuge, Decree No. 43,910 of November 5, 2004, which impacted the issuance of an Operating Environmental License.

The plant has been deactivated since 2008, with no forecast for resuming operations, although the dam remains operational and monitored.

Since 2015, the definitive decommissioning of the facility has been formally discussed, including the potential removal of the dam. Research has been conducted to assess the impacts of dam removal, especially on fish migration and sediment flow in the Pandeiros Wetland.

Preliminary studies indicated that total or partial dam removal would favor fish migration, with no significant impacts expected on native ichthyofauna due to river reconnection at the dam site and the draining of the marginal lagoon. Regarding sediment flow, minimal impacts are expected in the Pandeiros Wetland, with accumulated sediments likely to settle near the dam.

After the studies are completed in 2024, the reports will be submitted to the competent Environmental Authorities for evaluation and decision regarding the future use of the Pandeiros dam. The next steps of the project will be defined once a formal position is received from these authorities regarding the presented studies.