Lessons learned from dam removal experiences in France

- Some (brief) insights -

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Outlines

- The regulatory background in France
- Dam removal decision:
  non-integration of issues
- 3 dam removal experiences:
  some brief facts & lessons learned
- Concluding remarks
The regulatory background in France (1/2)

2 kinds of Hydro power projects license (Hydro Power Act, 1919):

- **« Concessionnary » license:**
  - P > 4.5 MW – initial duration: 75 years – Renewals for 30 years
  - At license expiration, projects are given back to Government Authority:
    - renewal of license (based on revised requirements and water rights)
    - or project may also be devoted to other water uses
    - or dam removal decision – costs are beared by Government Authorities

- **« Authorized » license:**
  - P < 4.5 MW – initial duration: 75 years – Renewals for 75 or 30 years
  - At license expiration, licensee remains the owner of facilities.
  - If license renewal is rejected:
    - « restoration to natural river conditions » is required with costs beared by licensee
    - or licensee may deliver back facilities to Government Authorities
The regulatory background in France (2/2)

Fish protection - Water & Fish Act, 1984:

- **determines Instream Flow conditions requirements, through a progressive approach:**
  - New projects must comply with new requirements
  - For existing projects, a progressive increase of instream flow is requested until relicensing time when full compliance is required

- **imposes an « effectiveness » requirement for fish passage facilities, as opposed to previous regulatory statements which implicitly suggested that « administrative » facilities would be Ok…
  - … « facilities **MUST ENSURE** effective upstream and downstream fish migration … »
Dam removal decision issue … (1/2)

- Dam removal is primarily resulting from a lack of integration of predominant issues or priorities

... and lack of integration of their foreseen evolution over time
Consequence: the project can no longer meet its assigned goals under cost-effective conditions

Some reasons for the « lack of integration »:

- Lack of past knowledge about physical processes & environmental issues: e.g. watershed approach (vs) local analysis
- Evolution in social concerns & priorities: e.g. energy development needs (vs) environmental impacts
- Centralisation & technical « mono-culture » in former decision-making processes
- No technical and/or economical possibilities for adaptive measures, due to irreversible past technology solutions
- …
3 main dam removal experiences in France

Kernansquillec
*Léguer river*
(1922-1996)

Maisons-Rouges
(EdF)
*Vienne river*
(1920-1998)

St-Etienne
du Vigan
(EdF)
*Allier river*
(1950-1998)

**Key facts:**

- \(H = 15 \text{ m} ; V = 300 \text{ acre-feet} (400,000 \text{ m}^3) ; \text{Vol. sed} = 50\% ; P = 1.3 \text{ MW}\)

**Dam removal reasons:**

- Safety issues: spillway under-designed + dam highly susceptible to overtopping (huge safety concern during floods in 1995)
- Environmental issues:
  - fish passage facility not effective
  - Reservoir eutrophication + sediments generate poor downstream WQ (water-supply withdrawal; fish-habitat)

\[\Rightarrow\text{Cost estimation to comply with Env + safety requirements too high}\]

**Main dam removal issue:**
management of sediment !!

Sediment management process (started Apr 96):

- **1**\(^{st}\) phase: main channel Hydrodredging + slow draining of reservoir
  - \(Q = 300\) l/s diverted into 2 decantation-ponds – 94000 m\(^3\) of sed. removed
  - \(dZ/dt = -3\) cm/day over 4 months
- **2**\(^{nd}\) phase: implementation of 4 downstream siltation-weirs (12000 m\(^3\) of total capacity) + rapid final reservoir draining (flushing):
  - \(dZ/dt = -25\) cm/day in 1 day
  - 10000 m\(^3\) sediments have been trapped; dredged in 8 days in Oct 1997

Dam removal lessons learned:

- Total cost = $1.2 M – Sediment dredging = 65%  \(\Rightarrow\) $7 / m\(^3\)
- Continuous monitoring of Water Quality (O\(_2\), NH\(_4\))
- Preventive over-treatment at downstream water-supply withdrawal unit
- Social acceptance; New recreational opportunities
- Fish population restoration: Salmon: Ok; Eel: ??

Dams removal decision based on a Watershed approach:

*Gov. plan for migratory fish restoration (+ flood protection, & drought management) over the Loire watershed – Jan. 1994*

<table>
<thead>
<tr>
<th></th>
<th>St-Etienne du Vigan</th>
<th>Maisons-Rouges</th>
</tr>
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<tbody>
<tr>
<td><strong>Sediments</strong></td>
<td>sand, gravels (30 000 m³ : not an issue) ; draining during flood</td>
<td>mainly sand : not an issue</td>
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<tr>
<td><strong>Costs</strong></td>
<td>$1.3 M for decommissioning</td>
<td>$2.7 M for decommissioning</td>
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<td></td>
<td>$1.2 M for compensatory measures</td>
<td>$5.3 M for compensatory measures</td>
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<tr>
<td><strong>Other main issues</strong></td>
<td>Loss of taxes</td>
<td>Reservoir uses :</td>
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<td>No real local planning to design an alternative project for the area : recreation and related activities</td>
<td>- Water intakes for irrigation</td>
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<td>- Water sports, campground</td>
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<td></td>
<td></td>
<td>=&gt; Reservoir became part of the local « natural » / cultural legacy</td>
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<tr>
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<td></td>
<td>Loss of taxes =&gt; huge local reluctance</td>
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<td><strong>Fish migration benefits</strong></td>
<td>- Significant increase of upstream spawning areas</td>
<td>- Shad : + +</td>
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<tr>
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<td>- slight progressive increase of salmon adults passages</td>
<td>- Marine Lamprey : + + +</td>
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<tr>
<td></td>
<td></td>
<td>- Salmon : +</td>
</tr>
</tbody>
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Bottom line

- Lack of issues integration often resulted in the dam removal decision
  => don’t miss integration of issues for the dam removal business itself!
- Economics:
  - Sediment management + Social compensatory measures: potential big parts
  - Cost-benefit analysis of multiple scenarios, including full-cost accounting, were never used to support removal decisions
- Watershed approach (vs) local concern:
  - Local social reluctance and conflict: loss of taxes; dam/reservoir became part of cultural, economical, and «natural» legacy
  - Transformation of the Hydro business from local «turbine operator» towards «water resources managers»
- Need for decision-support framework to handle «integration of issues» when dam removal is envisioned or questioned:
  - Full-cost accounting (externalities) if «1D» metrics (economy) makes sense?
  - How to find a consensus about priorities among issues/perspectives when multiple metrics are necessary?
Thank you!