www.water-alternatives.org Volume 16 | Issue 2

Flaminio, S. and Reynard, E. 2023. Multipurpose use of hydropower reservoirs: Imaginaries of Swiss reservoirs in the context of climate change and dam relicensing. Water Alternatives 16(2):

Multipurpose Use of Hydropower Reservoirs: Imaginaries of Swiss Reservoirs in the Context of Climate Change and Dam Relicensing

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ABSTRACT: In the context of climate change, hydropower dams and reservoirs are being promoted as mitigation and adaptation tools. The reoperation of dam reservoirs is also being considered, particularly in countries where dams are currently undergoing relicensing procedures. In Switzerland, a country that is often considered to be the water tower of Europe, concerns are being expressed about the future of water resources. These concerns are reinforced by the fact that the country's water system is heavily impounded by hydropower dams whose licenses are about to expire. Discussions are emerging on future hydropower production and on multipurpose projects in the context of hydropower dam reservoir reoperation. Building on previous studies in political ecologies of water and on studies of environmental and sociotechnical imaginaries, and relying on policy documents and interviews with water and energy stakeholders, we investigate the way in which multiple use of hydropower dam reservoirs is envisioned in Switzerland and in the Valais canton. At the moment in Switzerland, the idea of multiple use of dam reservoirs is far from being recognised as a water and energy management paradigm; it is, however, strongly associated with climate-related socio-environmental changes in the water sector and with changes in ideas about water, dam futures, energy and the social structure. We highlight the coexistence of three different environmental and sociotechnical imaginaries and connect these imaginaries with ongoing and future hydrosocial change.

KEYWORDS: Environmental and sociotechnical imaginaries, dam futures, multiple use of dam reservoirs, dam relicensing, hydropower, reservoir reoperation, Switzerland

INTRODUCTION

Dams have been at the centre of many debates in terms of their social and environmental consequences (see, for example, World Commission on Dams, 2000; McCully, 2001; Baghel and Nüsser, 2010). In the context of climate change, they have again become the focus of attention. A first discussion concerns the return to dam building, despite growing knowledge about the weak capacity of impounded rivers to face the effects of climate change. Since the end of the 2000s, plans for hydropower dams have multiplied in response to the imperative of reducing greenhouse gas (GHG) emissions and extending renewable energy production; some authors even speak of a 'boom' in dam building (Zarfl et al., 2015). Research in the social sciences has shown how this dam-building boom is sustained by the framing of hydroelectricity as a renewable, 'clean' and 'green' energy (Fletcher, 2010; Ahlers et al., 2015; Warner et al., 2017) and more generally by a discourse on climate change mitigation (Crow-Miller et al., 2017). Hydropower is being reimagined as "integral to the transition to renewable energy" (Gutierrez et al., 2019: 110). While the availability of dam sites is limited in post-industrial countries, existing dams can be enhanced; projects

such as increasing dam height or installing pumped storage power stations are being implemented (Pittock, 2010; Pittock and Hartmann, 2011; Ehsani et al., 2017). Recent papers in the environmental sciences, however, have demonstrated that dams are not always an advantageous option in times of climate change in that reliance on reservoirs can worsen water and energy shortages (Di Baldassarre et al., 2018) and the impact of climate change on impounded rivers can be greater than on free-flowing ones (Palmer et al., 2008). A second discussion relates to the reoperation of dam reservoirs. Reoperation is generally defined as the modification of dam operations in terms of the flow released (for a discussion on the definition of dam reoperation see Turley et al., 2021). The reoperation of dam reservoirs is being increasingly discussed in hydrology and hydraulic engineering. It is being considered as a means of adapting to climate change and to changing hydrological conditions (Watts et al., 2011; Marston and Cai, 2016), as a way of guaranteeing water supply, and of flood prevention (Kim et al., 2009). Reoperation is also being advanced as an opportunity to better manage the negative impacts of dams on river systems and as a way to minimise some of the effects of climate change on impounded rivers (Pittock, 2010; Pittock and Hartmann, 2011; Watts et al., 2011; Benson, 2018). Relicensing of existing dams – that is, negotiation of new contracts on their water use – can be the ideal moment to reflect on such changes (Pittock and Hartmann, 2011; Kellner and Brunner, 2021) and on the purposes fulfilled by the dam reservoirs. As some scholars have shown, reoperation is often framed as a purely technological matter involving merely adjustments; it stems, however, from debates on water allocation such as how water from reservoirs is being used to fulfil different, and sometimes diverging, social and environmental demands (Turley et al., 2021). Reoperation can thus be controversial, particularly in the context of water scarcity (Turley, 2021).

While Switzerland is often considered to be the 'water tower of Europe' (Viviroli and Weingartner, 2004), political stakeholders, environmental organisations and scientists have been expressing concerns about the country's future water resources in the context of climate and anthropogenic change (Köplin et al., 2012; OFEV, 2012a; Schneider et al., 2014; Milano et al., 2015a, 2015b; Muelchi et al., 2020; FOEN, 2021; Lanz et al., 2021). Swiss dams, unlike most dams globally, have been designed almost exclusively for one purpose, hydropower production; indeed, according to the World Register of Dams, 87% of Swiss dam reservoirs are used solely for electricity production and only 2.4% of Swiss dams fulfil more than one purpose (ICOLD, 2018). In recent years, however, there has been a growing discussion about multiple use of dam reservoirs, particularly in the context of increasing summer water shortages (Brunner et al., 2019b). New hydropower and multipurpose dam projects have been put forward (Kellner, 2019) and there has been an increasing call for the reoperation of existing hydropower dam reservoirs and for material adjustments such as raising dam heights and installing pumped storage plants (Thut et al., 2016; Jossen and Gurung, 2018; Kellner et al., 2021). Studies have highlighted that hydropower reservoirs could contribute to the water supply of municipalities and to the irrigation of agricultural land (Björnsen Gurung et al., 2018; Kellner and Weingartner, 2018). Several reports by Switzerland's Federal Office for the Environment (FOEN) and the Swiss Federal Office of Energy (SFOE) also mentioned the need to assess the possible multiple use of reservoirs (OFEV, 2012a; OFEN, 2019). At the same time, various other studies have focused on the hydrological effects of climate change on hydropower production in Switzerland (Job et al., 2011; Farinotti et al., 2012; Schaefli et al., 2019). The complexity of the Swiss debate on dams increased in 2022 due to a particularly hot and dry summer and a fear of winter energy shortages. In the summer of that year, some reservoirs displayed particularly low water levels (for example, the reservoir of the Salanfe Dam, in Switzerland's Western Alps, which is located in a karst area, i.e.; a zone prone to high rates of infiltration due to the presence of permeable limestones); others overflowed due to large amounts of glacial meltwater (such as the Gebidem Dam, downstream from the Aletsch Glacier). In some cases, such as at the Hongrin Dam in the Geneva Lake area, environmental measures such as morphogenic floods were suspended in order to store water for winter.

In this paper, we investigate the idea of multiple use of hydropower dam reservoirs in Switzerland. In order to focus conceptually on changes in water – society – dam relationships, we mobilise political

ecologies of water and environmental and sociotechnical imaginaries frameworks. Previous studies have scrutinised imaginaries relating to dam projects and dam building (see, for example, Kaika, 2006; Hommes et al., 2016). Exploring the evolving imaginaries of different stakeholder groups around existing dams is crucial for anticipating future needs with regard to water management and conservation, and for building more integrated hydrosocial futures. Here we ask:

- How has the idea of multiple use of hydropower dam reservoirs been introduced in discussions on the future of dams in Switzerland, and what meaning has been given to this idea by the different stakeholders who mobilise it?
- How is the idea of multiple use of hydropower dam reservoirs connected to (new) environmental and sociotechnical imaginaries in the context of climate change and dam relicensing?

To address these questions, in the following section we present our conceptual framework. We provide some background information on the management of water and dams in Switzerland and in the Canton of Valais and we then present the material that we collected, produced and analysed. In Section 4, we explore and analyse the ways in which the multiple use of dam reservoirs is envisioned. In Section 5, we discuss how these different visions reveal and reflect three main environmental and sociotechnical imaginaries, and we connect these imaginaries with ongoing and future hydrosocial change.

CONCEPTUAL FRAMEWORK FOR EXAMINING DAM FUTURES: POLITICAL ECOLOGIES OF WATER, ENVIRONMENTAL AND SOCIOTECHNICAL IMAGINARIES

Political ecologies of water – notably hydrosocial research (Karpouzoglou and Vij, 2017; Ross and Chang, 2020) – have deeply explored historical evolutions involving water, infrastructure, space, society and power. The 'hydrosocial cycle' (Linton, 2010; Linton and Budds, 2014) is defined as, "[a] socio-natural process by which water and society make and remake each other over space and time" (Linton and Budds, 2014: 175). Through the use of such concepts, many authors have focused on the coproduction of water and society, often over a long time span (see, for example, Linton, 2010; Noble, 2019). The hydrosocial approach invites us to pay attention to the interactions among biophysical processes, technology, infrastructure, and the social structure (Linton and Budds, 2014), that is to say, the "power geometries" that exist among social actors (Swyngedouw, 2009). Recent studies have used this hydrosocial framework to focus on ongoing climate change-related changes in regions that are considered to be water towers. They have reflected on the capacity of climate change adaptation measures to reconfigure hydrosocial relations. As stated by Mills-Novoa et al. (2017: 395), "climate change and subsequent adaptation pose major interventions in the hydrosocial cycle that can fundamentally alter hydrosocial relationships".

Political ecologies of water, while seeking to shed light on the materiality of the production of water and on its less-tangible dimensions, have paid attention to 'modernity' and 'modernisation' as a 'project' or a 'vision' (Hommes and Boelens, 2018) that is tightly connected with the idea of progress, development, growth and emancipation. This project or vision is one that supports the building of large hydraulic infrastructure, notably dams (Swyngedouw, 1999; Kaika, 2006; Hommes and Boelens, 2018; Shah et al., 2019). It is grounded in an ontological divide between nature and society (Linton, 2010; Hommes and Boelens, 2018; Santoire et al., 2021; Flaminio, 2021) that is particularly visible in the quest to conquer and control nature through dam building (Kaika, 2006; Nüsser and Baghel, 2017). It is a vision that rests on discourses (Boelens et al., 2019) and imaginaries that have been developed by stakeholders who play a dominant role in water management and development (Hommes and Boelens, 2018; Duarte Abadía et al., 2019; Teräväinen, 2019).

In this paper, we consider imaginaries to be, "collectively held beliefs and understandings that not only explain how the world works, but do work in the world" (Cidell, 2017: 169). Previous studies from the hydrosocial literature have shown how different groups of stakeholders produce different imaginaries and how dominant imaginaries often conflict with alternative or counter-imaginaries

(Hommes et al., 2016). Hommes et al. (ibid: 13), for example, identified divergent and competing imaginaries relating to the Ilisu Dam project in Turkey. They highlighted how the Turkish state authorities developed an "imaginary of energy as scarce and water as relatively abundant", while other stakeholders promoted counter-imaginaries that focused on the environmental or social impacts of the dam project. Such studies have shown how territories, in particular, are continuously made and remade from imaginaries (Hommes and Boelens, 2018), and how imaginaries become "cemented" into hydraulic infrastructure (Hommes and Boelens, 2017). Imaginaries of new and aging water infrastructure (Hommes, 2022; Takman et al., 2023) and imaginaries of water (Berry and Cohn, 2023) have been increasingly investigated in recent years in order to study processes relating to water governance (Whaley, 2022). Hydrosocial studies, in defining imaginaries and building their analytical frameworks, often refer to two different bodies of literature; they look to: (1) political ecology and social and cultural geography on 'environmental imaginaries', and (2) science and technology studies (STS) of 'sociotechnical imaginaries'.

Building on Peet and Watts (1996), Davis (2011: 3) defines an environmental imaginary as, "a constellation of ideas that groups of humans develop about a given landscape, usually local or regional, that commonly includes assessments about that environment as well as how it comes to be in its current state". Such a constellation of ideas can be operationalised in the form of specific projects regarding the landscape and environment (Davis, 2011). More recently, to highlight the role of science and technology in the production of environmental imaginaries and to shift the focus to the role of imaginaries in the production of environmental futures, some political ecology papers, such as those of Helliwell et al. (2020) and Hirsch (2020), have bridged literature on environmental imaginaries and literature on sociotechnical imaginaries.

STS has highlighted how scientific and technological innovations are enmeshed in the social order and involved in their reinvention (Jasanoff, 2015). To better understand the motivations that push societies to follow specific paths regarding science and technology, and to make sense of debates on science and technology, Jasanoff and Kim (2013, 2015) have invited scholars to analyse sociotechnical imaginaries. These can been defined as "collectively held, institutionally stabilized, and publicly performed desirable futures animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff, 2015: 4). This definition invites us to consider changes in imaginaries over time and to think about the ways in which imaginaries contribute to shaping the future. Indeed, Hirsch (2020) shows how evolving practices in river restoration and environmental management, particularly in a time of climate change, reflect emerging imaginaries that are both environmental and sociotechnical; these new imaginaries no longer have dams and river regulation or, more generally, 'technological modernity' at the forefront of river management. Inspired by STS literature, hydrosocial research has from the beginning taken infrastructure and technology into consideration, technology being one of the three elements of the hydrosocial cycle according to Linton and Budds (2014); indeed, recent studies have further deepened these connections from both empirical and theoretical perspectives (Germaine et al., 2019; Teräväinen, 2019).

Following Hirsch (2020), in the case of dams we consider the notions of environmental and sociotechnical imaginaries to be interwoven. Debates on dams reflect expectations concerning technology (Teräväinen, 2019) and technology's capacity to respond to social problems; such debates also refer to visions of "what an environment was, is and should be" (Helliwell et al., 2020: 1350). Adaptation to climate change projects is also often embedded in broader imaginaries (Mills-Novoa et al., 2022) and we thus expect upcoming relicensing plans to be intertwined with environmental and sociotechnical imaginaries. Our purpose here is not to untangle the technological from the environmental; rather, it is to explore how the imaginaries of different stakeholders reflect and transform a hydrosocial cycle which, in Switzerland, is strongly characterised by hydropower.

STUDY AREA AND METHODS

Water management and dams in Switzerland and Valais canton

Most of Switzerland's dams are situated in the alpine region, more specifically in the cantons of Valais, Bern, Ticino, Uri and Graubünden. In this study, we focus on the federal level and on the Canton of Valais. Among the cantons, Valais is the most important power producer, contributing nearly 30% of the country's hydropower (Schneider et al., 2014). Our focus on Valais can also be explained by the fact that, in this canton, dams are situated in the vicinity of irrigated areas as well as villages and towns, making the multipurpose use of hydropower reservoirs a credible option for future reservoir reoperation; moreover, and although it is not common knowledge, some dams in Valais already fulfil other uses than hydropower production (Maurer, 2020).

In Switzerland, hydropower is regulated by the 1916 Federal Law on Hydropower Production (Loi sur les forces hydrauliques, LFH, RS 721.80). According to this law, energy producers are allowed to exploit the surface waters of specific watersheds for a period of up to 80 years in exchange for *concessions* (licensing fees), which they pay annually to the river and glacier owners, cantons and *communes* (municipalities). Ten years before the end of the license, a procedure is initiated which allows for a renegotiation of the terms of the license, and at the end of the license the public authorities automatically become owners of the part of the infrastructure that is in contact with water. Until now, only a few cases of relicensing have taken place in Switzerland; most of the 80-year licences will be renewed between 2030 and 2050. The debate on relicensing is thus only now emerging in the public sphere, particularly at cantonal and local levels.

Switzerland's hydropower projects and their impact on livelihoods, landscapes and river ecosystems have been debated since the 1920s. These debates have led to conflicts (Mauch et al., 2000; Mauch and Reynard, 2004) that have at times resulted in project stalemates (Kellner, 2019). As early as 1951, some hydropower dam projects were abandoned in response to local protests, an example of which is the Urseren Valley dam in Andermatt (Hafner, n.d.). During the 1980s, environmentalists actively campaigned against a series of dams in Graubünden and several projects were cancelled due to their potential ecological impact; these included the Greina, the val Madrisa and the val Curciusa projects (Lehmann, 1998; Hartmann, 2020; Scapozza and Ambrosi, 2021). During that decade, controversies also arose when hydropower producers advanced projects that were aimed at expanding existing hydropower plants (for example Cleuson-Dixence; see Reynard, 2000). Controversy arose at the same time around the absence of environmental flows downstream of existing dams (Romerio, 2008). Following various campaigns by environmentalists and anglers, and in a particularly conflictual context (Truffer, 2010), the 1991 Federal Law on the Protection of Waters was voted in (Loi fédérale sur la protection des eaux, LEaux, RS 814.20) (Tonka, 2015). According to this law, the operation of relicensed power plants must be adapted, with hydropower companies being obliged to implement residual flows. It is only at the time of relicensing, however, that the requirements in terms of minimum flows come into force; this is the case even though environmental adaptations have been negotiated with hydroelectric producers over the last three decades, particularly in terms of hydro-peaking and residual flows. Such adaptations have been fiercely debated and have led to federal trials (Tribunal Fédéral, 2012).

Tensions between hydropower producers and environmentalists increased again when Switzerland passed its 2016 Energy Law (Loi sur l'énergie, LEne, RS 730.0), which highlighted the strategic importance of hydropower in the reduction of CO_2 emissions and dependence on nuclear power. Tension arose again in 2022, as right-wing and liberal politicians called for a reduction, or even suspension, of minimum residual flows in order to help face the winter's uncertain energy supply which was being exacerbated by the war in Ukraine; the Swiss parliament, at the same time, called for an increase in the production of renewable energy (CEATE-E, 2022). As energy production and environmental flows are currently on the 2023 parliamentary agenda, the Green Party (Les Vert·e·s suisses, 2023), environmental organisations

(WWF Suisse, 2022), and some scientists (Schmid, 2023) have taken public stances regarding the importance of maintaining residual flows, even though such flows are now much lower than the flows that are expected to be implemented with dam relicensing. For such reasons, when relicensing does take place, a heightened tension can be expected between those advocating increased residual flows and those who are in favour of increasing hydropower production.

In terms of water management more generally, Switzerland's water policy is poorly integrated and "the management of water infrastructure and water resources has been highly professionalised"; this has led to "a bias toward large infrastructure" (Hering et al., 2012: 112). Since the beginning of the 2000s, a shift towards more integration has been initiated (Agenda 21 pour l'eau, 2011; OFEV, 2012b; Dazio, 2017) and a move away from large infrastructure has begun to take place. These trends in water management and infrastructure were brought up in the interviews we conducted on the multipurpose use of dam reservoirs, and we thus mention them here.

Materials collected, produced and analysed

In a similar way to many studies focusing on imaginaries (see, for example, Jasanoff, 2015; Hommes et al., 2016; Hirsch, 2020; Helliwell et al., 2020), our analysis rests on both documents and interviews. In the winter of 2020/2021, when we were carrying out our research, debates on environmental flows and on relicensing were present in the public sphere, in reports by environmental organisations, and in the media; the subject of multiple use of hydropower reservoirs, however, seemed to be absent from the public discourse. We therefore decided to focus our document analysis on parliamentary messages and on reports produced by Swiss water and energy administrations. We constructed a corpus of documents and reports that were produced and published by the Federal Office for the Environment, the Swiss Federal Office of Energy, and the Valais canton environment and energy services; these are documents that focus broadly on water management and hydropower. To identify them, we used the websites of the Swiss and of Canton of Valais administrations. Each report from this corpus of 68 documents (Table 1) was reviewed for mentions of multipurpose use of reservoirs and for elements regarding the future of hydropower dams.

We also conducted 22 semi-structured interviews with 24 stakeholders who had expertise in hydropower, water management and water conservation in Switzerland and in Valais (Table 2). The interviewees of the federal and cantonal administrations were selected by contacting administrative heads, including the heads of the hydrology section, the federal energy office, the hydropower section, the agriculture section, and the Valais Department for Forest, Waterways and Landscape; most often, we were asked to contact their collaborators. We also contacted hydropower stakeholders; these included an organisation in charge of water and hydropower planning at the national level, and one of the main hydropower companies in Valais, Forces Motrices Valaisannes (FMV). The latter is a private-law company that has been charged by the Canton of Valais to look after the public interests of the canton. We also reached out to the main organisations defending environmental flows and opposing hydropower development; these included World Wildlife Fund (WWF) Switzerland, ProNatura, and the Swiss Fishing Federation. Despite several attempts, we were not able to secure an interview with WWF Switzerland. Researchers from universities and engineering schools were selected on the basis of research they had conducted relating to multipurpose use of reservoirs. For the interviewed politicians, we did not seek to encompass the diversity of the political spectrum or a broad range of opinions regarding dams and water allocation; rather, we aimed at understanding the ongoing discussions regarding dams and their uses in different spheres. The politicians were selected on the basis of public statements they had made regarding hydropower and dams. We interviewed politicians from different parties, including the Liberal-Radicals, the Centre, and the Valais Christian Social Party. We also contacted a Green Party politician who declined our request for an interview. Overall, we were able to interview stakeholders with different interests. Some were focused mostly on water and environmental protection or on management of water for a diversity of uses; others were focused on hydropower production. Our aim was not to build a sample

Table 1. Corpus of documents on hydropower and water (n = 68).

Type of document	Authors/publishers	Number of documents
Federal documents/national scale		
Messages regarding laws on energy and water addressed by the Federal Council (government) to the Federal Assembly (1912 to 2013)	Federal Council	5
Reports on water and/or hydropower (1994 to 2021)	Federal Council	1
	Swiss Federal Office of Energy (SFOE)	15
	Federal Office for the Environment (FOEN)	33
Reports on hydropower by other institutions or organisations (2011 to 2019)	Association Suisse pour l'Aménagement des Eaux (ASAE)	1
	Swiss Academy of Sciences/Swiss Society of Hydrology and Limnology	1
	Swiss Competence Center for Energy Research	1
Valais		
Messages regarding the law on hydropower addressed by the Council of State (government) of Valais to the Valais parliament (2015)	Council of State of Valais	1
Reports on water and/or hydropower (2007 to 2020)	Canton of Valais	10

Table 2. Stakeholders interviewed

Stakeholder group	Federal level	Valais	Other
Hydropower sector	1	3	0
Environmental organisations	1	0	1
Public administrations related to water or energy (Federal Office for the Environment; Swiss Federal Office of Energy; Valais Department for Forest, Waterways and Landscape; Valais Department for Agriculture; Valais Department for Energy and Hydraulic Power)	3	3	0
Academia (from engineering to social sciences)	0	0	7
Other organisations or consulting firms involved in water management	1	1	0
Current or former members of parliament	2	1	0
Total	8	8	8
	24		

that could be considered quantitatively robust. The questions focused specifically on multipurpose dams and on the possibility of diversifying the uses of hydropower dams. We asked: What meaning is given to 'multipurpose dams' in the Swiss context? Since when have multipurpose reservoirs been discussed? Which stakeholders are involved in multipurpose reservoir issues? To which spaces and scales are they associated? We also asked, more broadly, how interviewees imagined the future of dams in Switzerland.

The interviews were conducted mainly in French, except for three that were conducted in English; all were recorded and transcribed. We coded the transcripts with the qualitative data analysis software ATLAS.ti. Our aim was to identify the different ideas that were expressed about multipurpose dams, that is, the key constituents of imaginaries (Gandy, 2006; Davis, 2011; Helliwell et al., 2020); we also noted other key elements that interviewees mentioned in connection to multipurpose dams. We then classified the main ideas in order to identify different and diverging environmental and sociotechnical imaginaries. Throughout the analysis and discussion, we refer to quotations from the interviews and from French or German reports; in all cases, the quotations have been translated into English by the authors.

ANALYSIS: IDEAS RELATING TO MULTIPLE USE OF DAM RESERVOIRS IN SWITZERLAND AND VALAIS

Multiple use of dam reservoirs

The document analysis shows that until recently, the multiple use of dam reservoirs was only rarely defined in federal and cantonal reports. It was often only mentioned as a possibility and it was unclear whether such a possibility concerned existing dam reservoirs or new projects.

The multiple use of dam reservoirs was evoked in only 13 of the 49 federal reports. The notion appeared for the first time in a report published in 2012, in a sentence regarding the evolution of river system yields: "it will be necessary to clarify the additional needs for (multipurpose) reservoirs" (OFEV, 2012a: 44). The notion was defined for the first time in a 2019 report by the SFOE and it included existing infrastructure:

> The notion includes reservoirs that are not only used for energy production, but also for other purposes such as agriculture, drinking and industrial water supply (snowmaking, firefighting) or flood protection. Some reservoirs are already managed in this way (especially for flood protection) and some concessions are linked to other services, such as water diversion for irrigation (OFEN, 2019: 27).

More recently, multipurpose reservoirs have been evoked in the synthesis report of the FOEN-led project Hydro-CH2018 (OFEV, 2021). Their characteristics have been investigated in detail in three scientific reports (Brunner et al., 2019a; Thür et al., 2020; Kellner et al., 2021) as part of the Hydro-CH2018 research programme. In these reports – in which the authors call for further studies – the potential of existing reservoirs to fulfil new purposes was estimated to be limited; the reasons were, first, because of the distance between the reservoirs and the regions which will most likely be confronted with future water shortages and, second, because the different uses are seasonal and would therefore be difficult to coordinate (Kellner et al., 2021). The reports conclude, nonetheless, that for some regions such as the Southern Alps and Valais there is a potential for reoperating hydropower dams as multipurpose infrastructures to alleviate water scarcity (Brunner et al., 2019b).

In Valais, the notion was first mentioned in a 2016 report. It focused on adaptation to climate change, stating that, "With changing rainfall patterns and more variable river flows, the importance of dam reservoirs as storage facilities for multiple uses (drinking water, tourism, agriculture, power generation, flood control, firefighting) will grow" (Nauser, 2016: 8). The notion appeared again in a recent report on hydropower that was edited by the FMV. The multiple use of reservoirs was presented as a possibility that needed to be studied with regard to existing infrastructure and future reservoirs, in light of the idea of sustainable water management. As stated in the report, "The baseline study should identify the protection interests as well as the potential for multifunctional and sustainable water use. This may

involve, for example, converting existing dams into multipurpose reservoirs or building new reservoirs" (FMV, 2020: 6). Analysis of the interviews highlighted the extent to which the idea of the multiple use of dam reservoirs is recent and still emerging. Some interviewees admitted that they had not heard of the notion until the interview and that they believed it to be currently limited to the sphere of water and hydropower managers and scientists. As one political stakeholder explained, "At the political level, when we talk about hydraulic infrastructure, we talk about electricity production. Before this interview, I had never spoken about the multifunctionality of our dams" (Interview 22, 2021). This liberal politician was among the few stakeholders we interviewed who highlighted that dam reoperation appeared to be unnecessary and costly, due to the technical and infrastructure adaptations that it would require.

Most interviewees, regardless of the stakeholder group to which they belonged – federal or Valais administrations, NGOs, or even the hydropower sector – associated the idea of the multiple use of reservoirs with paying more attention to different potential uses. Irrigation was particularly discussed by the interviewees, and nearly half evoked the production of artificial snow; flood prevention and water supply were also mentioned. In Valais, most of the stakeholders interviewed established connections between multipurpose dam reservoirs and the idea of water as a multifunctional resource involving various groups of stakeholders with different interests; this was a conception introduced in the water strategy of the Valais canton (Comité de pilotage Eau Valais, 2013). The interviewees who were familiar with the idea of the multiple use of dam reservoirs established connections between future multipurpose uses of reservoirs and the notions of sustainability and of planning according to economic, social and ecological needs. Some scientists and engineers connected the notion with integrated water resources management (IWRM). Some who had spent time researching water-related issues highlighted that multiple use of dam reservoirs could and should be part of a paradigm shift in a country like Switzerland where IWRM is not strongly formalised (see Section 3.1). The legal context was also evoked in the interviews. Although no federal or Valais laws relating to energy or water mention the multiple use of dam reservoirs, some stakeholders from administrations and the hydropower sector connected the discussions on the multiple uses of dam reservoirs to recent changes in the Energy Act or to the implementation of laws on water protection. As put by a stakeholder from the hydropower sector who shifted the discussion from the multiple use of dam reservoirs to the multiple uses of water, "the legal bases are clear, it [multiple use] must be done. This multipurpose vision (…) in water everything is linked. Everything is integrated" (Interview 11, 2021).

There is no set meaning of 'multipurpose use' of hydropower reservoirs, however the emergence of discussions on this topic can be connected with broader discussions about ongoing and future environmental change and possible water shortages. First, some stakeholders viewed a conversion to multipurpose dams as being part of a strategy of adapting to climate change and hydrological evolution. This idea was consistently brought up in the reports published during the past three years. A 2019 report by the Swiss Competence Center for Energy Research stated that, "hydropower reservoirs in Switzerland may be required to provide additional services in the future. Especially in dry periods, the demand for multipurpose uses can be expected to increase significantly, for example for agricultural irrigation" (SCCER-SoE, 2019: 17). This is even more obvious in a scientific report mandated by the FOEN, which states that, "In Switzerland, the multi-purpose use of existing and new reservoirs represents a climate adaptation measure for prolonged dry periods" (Thür et al., 2020: 4). Second, some administrators and some stakeholders from environmental organisations highlighted that in the context of climate change – which may create new sites for dams and reservoirs (e.g.; new proglacial lakes) and new water demands – existing hydraulic infrastructure and new projects were being advanced as fulfilling multiple uses in order to increase their acceptance. Some interviewees from the hydropower sector did admit that single-purpose reservoirs encounter more resistance than multipurpose ones and therefore putting forward the multiple uses of reservoirs is also an opportunity for the hydropower sector to promote new dam projects or projects to enhance existing dam reservoirs. The acceptance of multipurpose projects was also highlighted in some reports; one such report from OFEN stated that, "Multi-purpose reservoirs also offer

opportunities for new infrastructure projects; indeed, exploiting synergies with other possible uses can increase acceptance and therefore the likelihood of the project's implementation" (OFEN, 2019: 27).

Only a few stakeholders brought up the question of using reservoirs to fulfil nature, river and water conservation aims such as adapting the operation of reservoirs to provide environmental flows; among those who mentioned this were individuals who were particularly concerned by such issues, such as state employees involved in hydropower mitigation measures. The environmentalists did not spontaneously consider the multiple use of reservoirs as an interesting possibility from an ecological point of view. This can be explained by the fact that these stakeholders did not consider conservation as a 'use' and therefore did not associate it with the idea of multiple purposes of dam reservoirs.

These different elements reveal that the vision of the multiple use of dam reservoirs is neither stable nor structured although it is often associated with climate and hydrology changes and their possible socio-economic impacts. Discussions on multiple use of dams and hydropower reservoirs are still emerging in Switzerland and are not (yet) conflictual; clearly, these ideas – however vague – need to be more broadly connected with opposing and conflicting ideas on dam futures, water, energy, and the social structure.

Dam futures

When asked about the future of dams, a scientist replied that in Switzerland, "we don't have a common sense about the future" (Interview 10, 2021). Indeed, discussing the future of dams raised many questions among the interviewees, and rare were the individuals who were convinced of the path that Switzerland would follow in the years to come.

Most stakeholders nonetheless considered that the number of dams in Switzerland would stay the same or could even increase. While a member of an environmental organisation said that he hoped for a future with fewer dams, he highlighted that dams were mostly perceived by society as eternal infrastructure, even if their operation might be jeopardised by climate change. Other interviewees voiced concerns about the massive financial investments that dams would require in the next decades as the existing infrastructure ages. Such questions were also raised in a recent report on the economy of hydropower; it underlined that if the economic situation of the European energy market did not evolve, then the renovation of certain power plants might not be economically interesting (Filippini et al., 2018). Despite such fears, no stakeholder – apart from one member of an environmental organisation – evoked the possibility of decommissioning Swiss dams; most stakeholders, with the exception of the environmentalists, also believed that even if the uses of the dams changed, they would continue to play an important role in the future.

Despite the absence of a clear and common view regarding dam futures, when asked, nearly all the respondents highlighted that relicensing was the appropriate moment to reflect on the future of dams and their uses. As explained by an employee from one of the federal institutions, "if you miss [the opportunity] now, then you won't have another chance until the end of the century" (Interview 20, 2021). A recent report on the relicensing procedure by the Valais department in charge of energy and hydropower suggests that a future strategy for dam relicensing should include identification of the multiple uses to which a reservoir can be put (SEFH et al., 2021). Interviewees from the hydropower sector also recognised that discussions on the uses of reservoirs should be introduced in the relicensing process. As one interviewee explained,

> These discussions on the multifunctionality of water converge very well with relicensing. Because relicensing really creates a powerful dialogue between the different Valais administrations and stakeholders, the municipalities and the canton, the canton which has its strategy on hydraulic power, its strategy on water, and there is really a great convergence (Interview 11, 2021).

According to many interviewees, relicensing may offer one of the best opportunities for introducing measures and obligations regarding drought situations; however, some interviewees who had followed relicensing procedures in recent years stated that multiple use of the reservoirs had not yet been brought up. Moreover, although relicensing negotiations begin 10 years before the expiry of the existing license, for many stakeholders relicensing "seems vague and rather far away" (Interview 18, 2021). It may thus be concluded that, until now, the multipurpose use of dam reservoirs in Switzerland has not been systematically brought up during the few relicensing procedures that have taken place. As relicensing procedures will develop in the next decades, we can expect the tensions regarding dam reoperation – which so far seem to be latent – to turn into open conflicts. Indeed, political signs suggest that the question of the residual flows that are to be implemented after relicensing (following the 1991 Law on Water Protection, or the Loi fédérale sur la protection des eaux, LEaux, RS 814.20), may be reopened for discussion and reduced, and that the priority may be set on energy production (see Section 3.1).

Water, energy, and the social structure

Questions on the multiple use of dam reservoirs and on the future of Switzerland's dams led interviewees to express ideas related to water, energy and the social structure and opinions about the relationships between different interests and stakeholders.

In 11 of the 22 interviews, water was described as a 'resource'. It was represented by some stakeholders as a resource that needed to be 'rationalised'. As highlighted by an interviewee from the hydropower sector (Interview 11, 2021), the notion of 'rational use' of water is indeed present in the Swiss Constitution (Article 76). Such a view of water recalls the modern idea that every single drop of water should be managed such that it serves a purpose (Swyngedouw, 2014).

Other stakeholders considered water to be less a resource and more an element of the broader environment – the river – which needs to be managed in order to improve its ecological quality and reduce the negative impacts of water infrastructure. As one interviewee said when asked if he associated multiple use of dam reservoirs with water management,

> Not really. I wouldn't spontaneously associate the multiple uses of dams with water management, because for me a dam doesn't really "manage water", dams are hardly a water management tool, because they prevent the natural dynamics of a river. Dams deprive the watercourses from their water (…) now, we can manage a dam poorly or we can manage it well, but even in the latter case, we are managing the impact of the dam (Interview 5, 2021).

Such a quotation illustrates how some stakeholders believe that rivers in Switzerland need to be better managed and cared for and that dams, even reoperated in such a way that they could provide environmental flows, will never constitute an appealing river management option.

Ideas on the multiple use of hydropower dams are also connected with ideas on energy development and on the prioritisation of energy production. Some of the stakeholders from the hydropower sector and some of the politicians presented energy as a priority, arguing that energy security would continue to grow in importance. Some of these stakeholders indeed even argued against any expansion of dam usage. A few interviewees – notably engineers – underlined that although some uses may fulfil essential needs such as irrigation for food production, these uses were associated with sectors that were in deficit positions, for example agriculture. For such interviewees, this justified the idea that energy production should remain the main use of dams. Despite the sector's recent difficulties, hydropower continues to be perceived as one of the most lucrative uses of water.

Interviewees from various groups who expressed interest in the possibility of reoperating hydropower reservoirs to expand their uses highlighted the necessity of focusing on other than energy production and of taking into account the entire array of interests relating to water. Such interviewees, who could be found among various stakeholder groups, insisted on a variety of different, and sometimes opposing,

water uses and water users. A notable distinction was evident between 'public' uses such as water supply and flood prevention, and 'private' interests such as power production. In most cases in Switzerland, the shareholders of hydropower companies are public agencies and administrations; according to some interviewees, however, they are nevertheless not necessarily concerned with the 'public interest'. As one interviewee (a scientist) commented, "They are far away from this idea because they are energy producers, they want to have energy, and they are not thinking about other issues" (Interview 10, 2021). These different elements reveal how the issue of the multiple use of reservoirs is tightly linked to discussions relating to the definition of public interest and to financial profit.

Regarding power geometries, scientists and engineers working in universities often highlighted the fragmentation of the different institutions and companies involved in water management in Switzerland (see Section 3.1). This fragmentation was viewed as an obstacle to the building of integrated water futures within the country and the canton. The Swiss Constitution states that water management is a cantonal prerogative; indeed, in the case of Valais it is mostly a municipal one since rivers (except for the Rhône) are the property of the communes. Some interviewees regretted the limited guidance that the federal offices were thus able to provide to the cantons. The emerging discussions on multipurpose dam reservoirs, however, were also often viewed by the interviewees as opportunities to include more stakeholders in water management, to reinforce the relationships between different stakeholders, and to democratise the discussions on future water management.

The power of the hydropower companies and the way their power could be affected by changes in dam operation was often brought up in the interviews. Some scientists highlighted that the hydropower sector was concerned about changes in electricity production and financial profits that could affect their power. Their concern can also be explained by the changes in European energy prices in the years preceding our study, which were not favourable to Swiss hydropower companies. These economic difficulties were mentioned in various reports (see, for example, Filippini et al., 2018; OFEN, 2018) and were also evoked during the interviews. Some interviewees – who were mostly, but not all, from environmental organisations – drew the conclusion that the development of a rhetoric on the multiple use of dam reservoirs was a strategy that had been put in place by the hydropower companies to 'fix' their own difficulties; that is, as hydropower becomes less lucrative, hydropower producers may be seeking to diversify their activities and financial assets. After conducting a survey of hydropower producers, scientists and environmental organisations, the SFOE concluded that, "according to the few responses received on the subject, multi-purpose use should have a minimal impact on hydroelectric production" (OFEN, 2019: 27). The hydropower stakeholders we interviewed did not express such concerns and were confident that hydropower production would remain the primary use of the reservoirs. At this stage, this suggests that changes in social structure and power geometries will remain limited even if hydropower dams are reoperated as multipurpose.

DISCUSSION: ENVIRONMENTAL AND SOCIOTECHNICAL IMAGINARIES RELATING TO MULTIPURPOSE DAMS AND HYDROSOCIAL CHANGE

In this section, we show how different ideas on multipurpose reservoirs, dam futures, water, energy and the social structure can be summarised into three main environmental and sociotechnical imaginaries. Different imaginaries can overlap in the narratives of interviewees; however, we sketch out how the three imaginaries prevail in different stakeholder groups, the apparent dominance or marginality of each imaginary, and the ways in which the imaginaries conflict with each other. We then discuss the extent to which these imaginaries can be considered as new and how they reflect hydrosocial change.

Three imaginaries revealing different degrees of reliance on technology and ideas on future socio-environmental challenges

The first environmental and sociotechnical imaginary (Table 3) is based on reliance on technological projects and on their capacity to solve future problems that are considered to be essentially socio-economic. This imaginary is mostly advocated by federal politicians and by some interviewees from the hydropower sector. It recalls a 'modern' imaginary of, "national development through advanced science and technology" (Kim, 2015: 159). In this imaginary, water is viewed essentially as a 'natural' resource which can be harnessed to serve human needs. A hierarchy is established between different uses, with energy as the most important. This imaginary supports the hydropower sector and gives it a prominent role in the social structure. Stakeholders who endorse this imaginary thus have little or no vision of the multipurpose use of dam reservoirs. Flood protection can be perceived as compatible with energy production and therefore is sometimes envisioned as a secondary use that hydropower dams will be able to fulfil in the future, all the more so if adjustments are made to the reservoirs' capacities. This imaginary also supports hydraulic projects that could contribute to increased hydropower production and its central position in energy transition policy. As mentioned above, some stakeholders endorse this imaginary, while others consider it to be a residue of Switzerland's dam-building era and no longer suitable as a guide to public policy. Strategic reports such as the International Energy Agency's (IEA) Energy Strategy 2050 have played a role in the promotion of new hydropower projects, as have international incentives around climate mitigation and the energy transition (Kellner, 2019; Kellner and Brunner, 2021). These may contribute to the revival and updating of an 'old' (pre-1990s) imaginary that dominated water management policies (Varone et al., 2002; Mauch and Reynard, 2004). These results also corroborate previous findings on the renewal of hydropower imaginaries in the context of climate change and climate mitigation (Fletcher, 2010; Ahlers et al., 2015; Finley-Brook, 2017; Gutierrez et al., 2019). These show, for example, how hydropower is being rebranded as, "fulfilling urgent energy needs in ways that also mitigate the effects of climate change" (Ahlers et al., 2015: 201). This imaginary was only embraced by a few of the stakeholders that we interviewed in 2021. During the summer and autumn of 2022, however, it started to be more enthusiastically promoted, particularly by right-wing and liberal politicians. Through public statements and media broadcasts in the context of a potential energy supply crisis, they began contesting the idea of increasing environmental flows (*Tribune de Genève*, 2022a, 2022b; *Forum*, 2022; *La Matinale*, 2022; Jauslin and Nordmann, 2023).

The second imaginary (Table 3) also considers technology to be a mean to address social and environmental problems and climate change adaptation. This imaginary was embraced by most of the stakeholders we interviewed, including some from the hydropower sector, most of the politicians, nearly all members of cantonal and federal administrations, scientists, and engineers. In this imaginary, the conception of water could also be described as 'modern', insofar as it rests on an ontological divide between nature and society. Water is represented as a resource that fulfils human needs, although the resource itself and the physical context of which it is part are also recognised as needing protection. The emergence of this imaginary is tightly connected to narratives on water scarcity (Kellner and Brunner, 2021). This conception insists on the importance of sharing the resource between different users and recalls the idea of water that is encapsulated in the concept of integrated water resources management (Allan, 2003). Energy is viewed as a use among others, with a specific historical and economic background. It is recognised as having been the dominant use of dam reservoirs until now; it is also considered to be the most profitable use, but not necessarily the most essential one. This imaginary thus supports the integration of as many stakeholders as possible into discussions on dam reservoir futures and on water management in general. It calls for further democratisation of debates around water in a country with a strong democratic tradition. In this imaginary, the transformation of hydropower dams into multipurpose infrastructure through their reoperation may contribute to a paradigmatic change towards a more inclusive management of water and infrastructure. According to our analysis, however, the multiple use of dam reservoirs in Switzerland is not yet ingrained as an idea; this imaginary is thus

only beginning to emerge and there are no firm plans to translate it into actual dam management. This second imaginary was dominant among our sample of interviewees, and the stakeholders endorsing it were often enthusiastic about integrating new dam uses; however, case studies on multipurpose reservoirs in Switzerland have shown that the idea is often put aside when the priority becomes the energy transition (Kellner, 2019; Kellner and Brunner, 2021). This observed tendency for the discussion to shift away from multipurpose dam use may be explained by the fact that our study did not focus on a specific case study; it could also be because federal and cantonal discussions about water management paid more attention to the question of expanded dam usage until the summer of 2022, when concerns were expressed during the drought and in anticipation of a possible energy shortage.

The third imaginary (Table 3) reflects caution and doubt about the capacity of technology to respond to new socio-environmental problems such as droughts. This imaginary is subscribed to mostly by stakeholders who are members of environmental organisations, although it was also present in the narratives of some of the employees of cantonal and federal administrations (particularly narratives relating to environmental protection). As one interviewee stated, it promotes a future with no new – and possibly fewer – dams. According to this imaginary, in the future the operation of dams must comply with environmental flow regulations. Water is viewed as part of a broader ecological system that encompasses a myriad of elements such as rivers, sediments, vegetation, fish and invertebrates. Energy conservation measures are central to this imaginary and increases in power production do not play a central role. It also views the social structure as dominated by stakeholders such as hydropower producers; this may explain why multipurpose reservoirs are also viewed as essentially a rhetorical statement supporting new infrastructure projects, and as a 'nirvana' concept (Molle, 2008) that has been forged to facilitate controversial developments.

Despite some overlaps, the three imaginaries compete with each other. The first one appears as irreconcilable with the second and third, as the latter two could only come about through different modes of dam operation. Opposing ideas on water and on dam futures are regularly expressed in debates in the Swiss and Valais parliaments, as well as in media and in public statements by environmental organisations. The second imaginary, however, remains mostly below the public radar, as do discussions on multipurpose dams in general. It is thus too soon to tell which imaginary and which stakeholders are 'winning' and which are 'losing' with regard to multipurpose use of dam reservoirs. Stakeholders who endorse the third imaginary fear that multipurpose use of reservoirs will increase water extraction and divert water policies from environmental and river protection; to our knowledge, however, multipurpose use is not yet being contested by environmental organisations in the public sphere. In the next years, conducting case studies on dam reservoir relicensing may allow for better observation of the extent to which these three imaginaries compete with one another. Indeed, it is often when explicit water management and infrastructure plans are announced that pre-existing antagonisms crystallise (Utz et al., 2017), and recent studies in different contexts have shown that dam reoperation can be particularly conflictual (Turley, 2021).

Imaginaries and hydrosocial change

In this last subsection, we discuss whether and how the three identified imaginaries reflect and suggest past, ongoing and future transformations in the hydrosocial cycle in Switzerland and Valais canton.

Previous studies have shown that climate change adaptation plans may contribute to the reinforcement of current hydrosocial cycles that are characterised by social inequalities and forms of exclusion and ignorance; adaptation plans could thus be "missed opportunities to reenvision more inclusive hydrosocial relationships" (Mills-Novoa et al., 2017: 393). The Swiss hydrosocial cycle is undergoing transformations in the context of climate change. While the first imaginary mostly promotes "continuity" (Delina, 2018), the second and third are much more synonymous with "transformation" (ibid). The rise of the second imaginary attests to a change in the hydrosocial cycle; such a change began

Table 3. Three main environmental and sociotechnical imaginaries relating to multiple use of dam reservoirs, dam futures, water, energy, power and the social structure

Environmental and sociotechnical imaginaries Ideas	Imaginary 1: Reliance on technology to meet socio-economic challenges	Imaginary 2: Reliance on technology to meet new socio-environmental challenges	Imaginary 3: Distrust and uncertainties regarding the capacity of technological adaptations to meet new socio-environmental challenges
Multiple use of dam reservoirs	Unnecessary and costly No ideas expressed on multipurpose use; no true vision	Multiple use of dam reservoirs as a new paradigm for the management of existing and possibly future infrastructure	Not complete rejection, but no strong belief that multiple use of dam reservoirs will allow us to meet future socio-environmental challenges; multiple use of dam reservoirs is viewed as a rhetorical statement that is made in order to increase acceptance of new infrastructure or technological adaptations of existing infrastructure
Dam futures	For already-existing infrastructure, maintain the status quo regarding dam reservoir management Promote new hydropower infrastructure, possibly new dam reservoirs; increase dam height; develop pumped storage hydropower plants	Adaptation of the operation of dam reservoirs if recommended by studies on water demands	No new infrastructure if possible Adaptation of existing infrastructure to ecological concerns Possible dam decommissioning
Water	A resource to be exploited	A resource to exploit and to protect, to share between different uses (IWRM)	A component of an ecological system with a need for protection
Energy	Energy production as a key challenge and a priority for the future	One use of water among others; lucrative, but not necessarily a priority use	Not a key concern
Power and the social structure	Support of the hydropower sector	Call to democratise water-sharing and management processes	Distrust of the stakeholders who are operating and exploiting water

some years ago as suggest evolutions in water management policies (Mauch and Reynard, 2004). It calls for the inclusion of more stakeholders in discussions on the future of dams and dam management, and it does not overlook the negative impacts of dams. This inclusive approach has been included in recent discussions on renewable energy needs and possible new infrastructure. Indeed, an agreement has been signed in December 2021 between the federal offices for energy and environment, the alpine cantons, the main energy producers, and the principal environmental associations to facilitate and accelerate the construction of new infrastructure for increasing hydropower production in Switzerland within the context of energy transition. The third imaginary appears to be marginal in policy documents and was only endorsed by a few of the stakeholders we interviewed; however, it hints at more radical changes in the hydrosocial cycle that imply a shift towards a different economic model and to more importance being given to nature.

Our study of imaginaries nevertheless helps to identify knowledge gaps, limits and possible obstacles to hydrosocial change. The analysis shows that the first imaginary has not entirely declined and that, if more infrastructure projects are put forward without opposition in years to come, this imaginary may again 'cement' itself (Hommes and Boelens, 2017), especially after a year that has been characterised by a heatwave, a drought, and a possible European-scale energy shortage. The second imaginary, for a number of reasons, may also fail to fully trigger hydrosocial transformation.

The first reason for the weak impact of the second imaginary is technology's perceived continued importance to future water supplies; this suggests the persistence of a capitalist and liberal political economy in seeking a 'technical fix' for its crises (Swyngedouw, 2015). Political discussions at the Swiss federal parliament in the autumn of 2022 on the possible winter energy crisis corroborate the fact that energy production is largely viewed in relation to the prominent use of dam reservoirs; according to right-wing and liberal politicians in particular, this should, if anything, be enhanced in the future.

Second, as of today, and to our knowledge, there are no real plans to implement the second imaginary. Studies in hydrology suggest that multiple use of existing hydropower dam reservoirs may only be interesting as an adaptation strategy in regions such as the cantons of Valais and Ticino (Brunner et al., 2019b). Local climate change adaptation plans, however, are still necessary; they should consider the current and future uses of hydroelectric dam reservoirs and should integrate a reflection on water conservation. Future research on such plans will help clarify whether statements on the multiple use of hydropower dams are merely rhetorical, with the aim of rebranding the current operation of the dams by insisting on small secondary purposes. Such a rebranding is indeed not impossible, as previous studies have shown that the multipurpose rhetoric has been used to obscure broader political and economic aims of energy-related projects (D'Souza, 2003). Such rhetoric can also be strategically used to delegitimise opposition, and it does not necessarily translate into the implementation of multipurpose infrastructure that enables an expansion of uses (Hidalgo-Bastidas and Boelens, 2019). At this stage of our research, the multipurpose use of dam reservoirs calls for the expanded usage of dam reservoirs appear to emerge from a desire to present a consensual 'fix' to climate change; such calls risk 'depoliticising' the debate on water resources and on the future of dams in a way that echoes other water policies that have been implemented in Switzerland (Buletti Mitchell and Ejderyan, 2021). This may come as no surprise since, even in countries where radical changes such as dam decommissioning are taking place, there are not necessarily any clear hydrosocial paradigm shifts or transformations (Hommes, 2022).

Third, it is still unclear whether the very fragmented institutional framework will evolve towards more integrated management models, as underlined in the interviews and in previous publications (Furger, 2012; Hering et al., 2012); it also remains unclear whether dam reservoirs could play a central role in integrated water management at the catchment scale. At the moment, Swiss water policy does not consider integrated water resources management as a central instrument and very few cantons have adopted basin-scale management instruments in their policies (Buchs, 2016, 2018).

Fourth and finally, while the stakeholders we interviewed mostly agreed on the necessity of considering the multipurpose use of dam reservoirs during the relicensing process, it is not yet obvious whether this question will actually be brought up when the time comes. Kellner and Brunner (2021) showed, for example, that such a question was not considered during the licensing discussions related to a new dam project. Our own observations on ongoing relicensing procedures in the Canton of Valais also seem to show that even if the multipurpose use of water is often put forward as a slogan, concrete negotiations remain focused mainly on energy production.

CONCLUSION

In this paper, we investigated the notion of multiple use of dam reservoirs in Switzerland. We explored ideas relating to dam futures, water, energy and the social structure; we also identified environmental and sociotechnical imaginaries and considered their current state and ongoing evolution.

From a political ecology perspective, and on a conceptual level, approaching the multiple use of dam reservoirs through environmental and sociotechnical imaginaries helps decipher underlying tensions that are likely to materialise into conflicts when dam relicensing takes place. The idea of multiple use of dam reservoirs contains the promise of a paradigmatic change in terms of water management and, notably, a promise of the democratisation of water management. In a way similar to previous work on the instrumentalisation of multipurpose use of reservoirs and on the principles guiding water management (IWRM, participation), one can reflect on, and question, the promise of a paradigmatic change in water management and the capacity of multipurpose use to transform the hydrosocial cycle and promote just water futures in times of climate change.

Analytically, we first showed how the idea of multiple use of hydropower dam reservoirs has emerged in Switzerland and we explored the different meanings given to it by different stakeholders. The idea appeared at the beginning of the 2010s in federal reports on climate change by the Federal Office for the Environment (FOEN) and in scientific publications. It gained momentum in the second half of the 2010s, when the importance of water and energy grew on the political agenda, both at the federal level and in Valais. The FOEN's Hydro-CH2018 research project led to more developed reflections and studies on the multiple usage of the country's dam reservoirs; even so, this notion remains fuzzy for many water and energy stakeholders who envision it in very different ways. This can be explained by diverging ideas on dam futures (more infrastructure, reoperation, decommissioning), water (for example, as a resource to exploit or to protect, or as a component of the ecosystem rather than a resource), energy (such as whether hydropower is considered to be a priority or is not a key concern), and the social structure (for example, should the power of the hydroelectric sector be supported, should there be a call for more integration, and what prominence is given to public interest).

Second, we discussed how the idea of multiple use of hydropower dam reservoirs reflects the burgeoning of new environmental and sociotechnical imaginaries and the endurance of old imaginaries, in the context of climate change and dam relicensing. We disentangled ideas on multipurpose use of dam reservoirs, dam futures, water, energy and the social structure, and we suggested the coexistence of three diverging imaginaries. The first is essentially advocated by the hydropower sector and some politicians. It was inherited from the early days of hydropower development and can be described as a reliance on technology to meet socio-economic challenges. It supports hydropower above all other uses and carries little vision for the expanded use of reservoirs. The second imaginary dominated the narratives of our interviewees in 2021; it was particularly shared by cantonal and federal administrations and by scientists and academics. This imaginary relies on technology to meet new socio-environmental challenges and relates to the development of integrated water resources management. It views multipurpose reservoirs as an option for the future. The third imaginary is clearly opposed to the first and partially conflicts with the second. It is endorsed mostly by environmental activists and by some

employees from cantonal and federal administrations. This imaginary doubts the capacity of multipurpose dam reservoirs to build an environmentally inclusive hydrosocial future.

The coexistence of these three imaginaries suggests that there is a possibility of a hydrosocial future that is less focused on hydropower and is more inclusive of other uses and users and of environmental concerns. More studies are needed to analyse how these imaginaries translate locally, particularly during upcoming discussions on dam relicensing.

ACKNOWLEDGEMENTS

The authors thank Alpiq collaborators – in particular Chrystelle Gabbud, Xavière Schröder and Raphaël Leroy – and Stéphane Nahrath, Andréa Savoy and Christophe Clivaz from University of Lausanne for their advice and fruitful discussions on the project *Diversifying the Purposes of Dam Reservoirs?*. The authors are indebted to all the stakeholders who accepted to participate in their study and thank them warmly.

This study was funded by the Institute of Geography and Sustainability of the University of Lausanne.

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