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Physicalities in Transition: The Case of Hydropower Dams in French Alpine Valleys

Emmanuelle Santoire, Jean Desroche et Romain Garcier

Introduction

- 1 Over the past two decades, questions of materiality and materials have gained considerable prominence in the social sciences (Bennett, 2004; 2009; Miller, 2005) and geography (Weber, 2014; Garcier *et al.*, 2017), building on perspectives seeking to reclaim the social role of technical objects (Latour, 2006 [1991]). As early as 2006, Bakker and Bridge noted a “rematerialization” of the discipline, noting that studies of resources, including energy, provided a bedrock for such developments (Bakker and Bridge, 2006). Questions of materiality indeed take on a particular tone when they are asked to energy systems. Energy is not a thing. Rather, its capture and expression rely on the mobilization of material objects. According to Gavin Bridge, approaching energy from a material point of view allows us to counter “energy as a conceptual abstraction” (Bridge, 2018). There is now a body of research that analyses the materiality of energy systems (Balmaceda *et al.*, 2019), whether in terms of energy sources (Mitchell, 2013; Hecht, 2012; Baka, 2014), infrastructure (Barry, 2013; Nadai and Labussière, 2018), local energy governance (Rutherford, 2013), etc.
- 2 This literature makes two general claims about materiality that this paper will draw upon. First, materiality is always relational (Moss *et al.*, 2016). Certain things are material and possess a set of defining properties: size, mass, texture, color, smell, etc. But the list of these properties is not limitative: we never fully know in advance what the material consists of, how it will perform and what it will create, as its properties depend on dispositives, assemblages or metabolisms in which it is included. The relationality of the material turns it into a locus of endless creativity. So, when we say

that an energy system is “material”, we have to specify which properties are going to stand out as important, and why.

- 3 At the same time, materiality is socially and culturally interpreted. It is not a reality “opposed to the social” (Bakker and Bridge, 2006). Within assemblages, material objects are always invested with values and linked to social and political practices (Akrich, 2010; Bridge, 2009). The research agenda on “*material politics*” (Barry, 2013), for example, calls for an investigation into the role of materials in political and economic life. Materiality provides a critical perspective (Mitchell, 2013) and a methodological entry into the various material elements constitutive of power relations (Cronon, 1992).
- 4 These considerations are particularly significant when applied to the energy transition (Moss *et al.*, 2016). By seeking to substitute renewable energy for fossil fuels and encouraging technical and organizational innovation at all spatial scales, the transition involves a broad reassessment of the energy mix, infrastructure, governance, consumption practices and equipment that enable them (Fontaine, 2020). In this paper, we build on these reflections to explore how the materiality of hydroelectric dams is involved in the energy transition. Much of the literature on transition focuses on new capacities, new forms of energy supply. But what about existing low-carbon energy facilities? Are they changing? Are they staying the same? To answer these questions, we consider the material “assemblages” created around the structures and introduce a distinction drawn from the work of the anthropologist P. Descola, between their materiality and their physicality. By applying this distinction to a case study of the Sautet concession in the French Alps (Fig. 1), we show that the call for a European energy transition (better consideration of aquatic environments, support for renewables in the mix, market liberalization) do not modify the materiality of the dam. On the other hand, its physicality changes for strategic reasons.

Fig. 1: Location map

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- 5 The article is organized as follows. First, we introduce the distinction made by P. Descola between materiality and physicality and discuss its usefulness for technical objects. We then present our case study and methodology. From there, we detail three aspects through which the energy transition modifies the physicality of dams: how they are supposed to regulate river flows; how they acquire a territorial dimension; and how capital interferes with their materiality. We conclude on the usefulness of the term physicality for observing energy transition changes in practice.

Ontology, Materiality and Physicality

- 6 The notion of “ontology” has recently gained traction in critical water studies (Flaminio, 2021). Ontologies refer to the different ways of knowing and experiencing the world and the entities that populate it. The notion aims to go beyond the distinction between reality (unique) and its representations/perceptions (multiple and situated) and to take seriously the contribution of anthropological studies that analyze the way different human communities interpret the world. P. Descola, in particular, has noted that there are four “ontologies”, that is, four modes of identifying the respective positions of humans and other natural beings in the world: animism, totemism, analogism and naturalism (Descola 2014). They can be analyzed from two variables: “physicality” (exteriority) and “psychism” (interiority). The physicality of a being is not its materiality: its physicality consists of all the visible and tangible dispositions (i.e., ways of acting) that arise from its morphological and physiological (material) characteristics. Materiality answers the question “what is a body made of” and physicality answers, “what can a body do”. It is quite obvious, then, that the answer can be manifold.
- 7 Such theoretical insights are useful to geography for two reasons. First, the notion of physicality echoes the geographical idea that materiality is both relational and interpretive: the physicality of a thing functionally exceeds its material composition and includes all the elements that allow it to “engage with the world out there” (Descola, 2014). In this, physicality allows us to de-fetishize the notion of materiality and introduces the idea that the same materiality supports various physicalities. Second, these ideas can be applied to a wide variety of assemblages, not only of living beings, but also of technical objects. Here, we suggest that the physicality of structures (i.e., the way they are supposed to function) may change, while their material characteristics remain the same. This suggestion is all the more relevant as it allows us to go beyond a “modernist ontology” of water where it is extracted from social entanglements as a pure hydrological reality and productive resource (Flaminio, 2021). The dam, a machine, transforms an inert substance into a commodity, electricity. But what if the same dam could function differently? If its materiality could create different physicalities? This is precisely what we will argue, based on the case of the Sautet in the Drac Valley.

The Sautet Dam and the Drac Concession

- 8 Large dams are by definition mountainous installations. By exploiting waterfalls, they have accompanied the industrialisation and development of the Alpine valleys

(reinforcement of the gorge reliefs, creation of reservoir lakes, relocation of dwellings). Dams thus present two modes of mountain development: productive and territorial. Both existing, they are remobilized in the context of European energy transition.

- 9 In France, the dams of the Alpine corridor are an essential link in the national transition path. Hydropower is the second-largest source of electricity after nuclear power (12% of total production), and the high (over 300 m) and medium (30 to 300 m) dams are particularly productive. Among the 96 lake power plants (9200 MW of maximum gross power) producing 17 TWh (against 2000 run-of-river power plants [8500 MW] producing 32 TWh), a quarter are alpine. These are tools that can be rapidly mobilised during consumption peaks, offering a unique adjustment and storage solution.
- 10 Built between 1930 and 1935, the Sautet dam is a remarkable example of technical equipment for Alpine rivers (Dalmasso 2008). Located at the meeting point of the Matheysine and Trièves plateaus in the Southern Alps (Fig. 1), the dam consists of a 126-metre-high concrete vault, which crosses the Drac gorges and retains a lake of about 350 hectares (Fig. 2). An underground hydroelectric power station transforms the water flow into decarbonated electricity of high commercial value. In 1941, a complementary hydroelectric plant (Cordéac plant) was built downstream, using a concrete penstock to generate electricity (Martino, 1946). The two plants are highly productive and have a combined capacity of 140 MW. The complex is emblematic of Alpine developments both materially and functionally.

Fig. 2: The Sautet complex: main characteristics

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- 11 However, rather than profiling an Alpine model, large dams in the Isère region bear witness to a French hydroelectric model, built on a public monopoly, in an emblematic

post-war legal and economic situation. Since 1946, the complex has been managed by Électricité de France under the concession regime created by the law of 16 October 1919. This regime is applicable to installations with a capacity of more than 4.5 MW. Under a concession, the State owns the land and infrastructure, but construction and operation are delegated to a company for several decades, in return for an annual fee. The 1919 law is part of a modernist water ontology: the concession system aimed at maximizing power generation and dams were seen as productive devices only (Haghe 1998), a source of economic patriotism. The free flow of water is minimized (the “in-stream flow”), with power generation as the main parameter of the contract.

- 12 This situation, which was stable until the 1990s, has since been brutally challenged by three political changes that placed dams at the interface between market strategies and environmental concerns (Santoire *et al.*, 2020). Firstly, the liberalisation of the electricity markets at national and European levels (Directives 96/92/EC and 2003/54/EC), have threatened the comfortable historical relationship between the State and EDF. Secondly, environmental concerns have influenced a paradigm shift (Barraud and Germaine, 2017) in the assessment of dams (2006 law; Directive 2000/60/EC). Finally, the European transition program has emphasized hydropower as a source of green electricity. These joint changes have profoundly altered a system that had kept dams out of the competitive market and environmental issues for decades.
- 13 Now, since 2010, the European pressure has intensified to liberalize the concessions, while limiting the environmental impacts of dams. In France, existing dams are then considered as drivers of an ecological and territorial transition. Indeed, when the first concession contracts ended in the 2010s, in the midst of a controversial liberalization, dams were strategically re-evaluated as territorial infrastructures. Le Sautet is a good example of this since its concession, which was to be part of the first tenders, has still not been reallocated.

Materials and Methods

- 14 This research is part of a study on the texts and uses of law for the energy transition. It is based on two sources of data: texts and interviews. A first work of identification of the legislative and regulatory documents made it possible to study the qualification of dams in law. Focusing on the concession regime, this research progressively integrated territorial planning and water management documents. Subsequently, a campaign of semi-directive interviews was carried out in the Drac Valley, in Grenoble, Lyon and Brussels, gathering the perspectives of thirty field actors. The main characteristics of these interviews, conducted in 2014, 2019 and 2021, recorded and anonymised are presented below (fig. 3). It should be noted that this article uses only a limited part of them, focusing in particular on the explanations given by the local MP. This situation illustrates the inequalities of access to information in a very complex political and legal situation where knowledge of the law is a source of power.

Fig. 3: Presentation of the corpus of interviews

	Local elected officials	Parliamentarians	French and European State workers Local agents and associations	Firms	External experts (academics, journalists)
Interviewees (nb)	15	1 (3x) 2014, 2019 and 2021	5 (fr DG, DREAL, CLE, CLEDA, UE DG COMPET) + 1 fishing association	5 (EDF, Enedis, a competitor)	2
Type of interview	In-person : 1 on the phone	2 in-person, 1 visio	In-person	2 in-person, 4 on the phone, 1 visio	1 phone, 1 written contact
Length	1h to 1h30 for in-person interviews 30mins for phone interviews	3h total	Between 1h and 1h 30 each	Between 1h and 1h 30 each	40mins
Type of interview grid	1. General economy of the municipality and major recent changes 2. The place of hydroelectricity and the role of the concessionaire in the life of the the municipality 3. Knowledge of the situation renewal and positioning 4. Use of law	1. Progress of the concession file 2. Role in the development of legislation 3. Local relations 4. Role in local water parliaments	1. Role and responsibility of the service 2. Representation of hydropower 3. Relations with local elected officials and the concessionaire 4. Progress of the concession file	1. Role of the concessionaire in a territory 2. Progress of the concession file and opinions 3. Changes in strategy 4. Local relations	1. Legal developments around hydropower 2. Progress of the concession file 3. Transition issues
Data analysis	Qualitative approach, triangulation with legislative and regulatory texts				

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Dams as River Regulation Objects

- 15 From the 2010s onwards, the new legal environment has modified the qualification of dams: they are now presented in discourse and practice as objects of river regulation. This implies a re-evaluation of their physicality in relation to water, and in particular a reassessment of the balance between energy production and water flow (low water support, flood control and other uses).
- 16 Attention to water has fluctuated in local memories since the construction of the Sautet dam, engulfing the village of the same name. In the late 1930s, the flow of the Drac downstream of the dam was based solely on productive needs, with little consideration for the ecological implications of such an artificial water supply. The hydraulic and environmental disturbances induced by the infrastructure included reduced flow, reduced solid transport and impacts on fish populations. The concession contract only marginally specified how the lake and river were to be managed with respect to water flow. It briefly mentioned the needs for low-water support and irrigation for agriculture. After 1946, EDF ensured that local communities had a minor role in the management of water flows and signed contractual agreements (“water rights”) with them to ensure sufficient water for local economic and ecological uses. Gradually, the most strategic agreements were then those negotiating a lake level compatible with the development bathing and nautical activities on the lake and riverbanks.
- 17 In recent years, several constraints have yet changed the focus on water quantity and quality. In an interview (2014), the local MP insisted that dams are “a public water management tool as well as an energy management tool” before noting that they have long struggled to be considered as such. Since 2006, the LEMA law on water has increased the reserved flow and obliges dam operators to restore a “good” or “very good” ecological status of rivers. It protects migratory fish and preserves ecological continuity (construction of riprap blocks, lifts and passes). While ecosystem concerns are asserting themselves against energy issues, the physicality of dams is thus undergoing a profound evolution, encouraged by environmental organisations. France Nature Environnement, a federation of associations, has declared that the renewal of concessions was an opportunity to improve their environmental management by insisting on ecological continuity, taking advantage of the competitive emulation.
- 18 In so doing, dams are part of the local geopolitics and specific but emblematic actions affect the very materiality of the structures. An EDF representative convincingly mentioned the new fish pass financed on the Romanche, built before the legal

obligation. To which a competitor was more critical, considering these actions as a form of *greenwashing* or light corruption: they should be avoided or regulated “for the sake of objectivity and to avoid a form of... because you don’t see how far it can go”.

- 19 Finally, the reaffirmation of the material link between dam and watercourse finds a paradoxical expression in a new concept introduced by the 2015 law for the energy transition and green growth: the notion of “hydraulically linked facilities” (art. L521-16-1 of the Energy Code). This concept legally formalizes the hydraulic link between several hydroelectric facilities operating on the same watercourse, thus constituting a functional unit that is difficult to separate into distinct concessions. The MP in charge of this law proposal justifies it as follows: “This also shows that for too long hydroelectricity has been considered as a production tool and not as a water management tool” (2021). In so doing, the seizure of the dam in a hydraulically linked whole amounts to a revision of its physicality, with clear ecological and economic implications, but also political ones. Indeed, the law was explicitly designed to create an obstacle to the liberalization process. By grouping together various concessions ending at different dates, the French government was able to postpone the new call for tenders to a median date and protect the interests of EDF.

Dams as Territorial Objects

- 20 The materiality of dams has made a surprising comeback in the discourses and practices of actors, thanks to the renewal of concessions. The uncertainty associated with the liberalisation process (Santoire *et al.*, 2020) and the more general context of transition, have contributed to the valorisation of hydropower and strengthened collaborative initiatives between EDF and local actors. In this section, we examine how dams have been revalued for their territorial role, thus bringing out a new physicality of the structures.
- 21 The 2010s marked a return of the monumental materiality of dams in local representations, which had paradoxically long been euphemistic. Associated with disasters (dam failures, releases), unemployment and mono-industry, dams had become simple productive objects, dedicated to the sole management of hydroelectric flows. However, the competitive perspective has brought a return of interest in dams, notably through what the MP has called a “partnership culture” or informal agreement with the historical operator EDF. Discussions about hydropower have become more frequent between the concessionaire and elected officials (phone calls, meetings). In the office of one of the mayors, we saw the business cards of EDF employees on the notice board. These simple interactions allow us to reactivate attention to the materiality of dams in the daily management of medium-sized mountain territories in difficulty.
- 22 This political economy of dams is rooted in a new paradigm of territorial governance, where physicality is central. Two material elements are particularly highlighted and reinterpreted: the lake, in its additional uses as a recreational facility, and the dam, as a tourist and heritage attraction (fig. 4). The elected officials interviewed for the survey cited their “good fortune” to have lakes in their territory and the local MP considered them “both strategic and vital”. Indeed, the lakes are popular for summer outdoor activities and thus have a major economic value, in a valley affected since the 2000s by several dynamics of depletion (decline of agriculture, loss of population, deindustrialisation in the Dauphiné coal mines, and automation of hydroelectricity

management). Recreational activities are now the primary source of income in the region. This renewed interest in the dams reinforces the overall attractiveness of the area. The lake increases land, property and rental values. Houses in La Loubière, a hamlet of St Jean d'Hérans, are built at a high price and the largest campsite in the Isère is in a neighbouring village, Mayres-Savel.

Fig. 4: Recreational facilities on the Sautet site

Author: E. Sautoire, 2021

- 23 Henceforth, insofar as lakes have been made into a condition of territorial development, the mayors vehemently defend their access to the lakes in the event of the arrival of a new operator, in a context of increasing scarcity of water resources and growing tensions over its sharing. All the mayors expressed their fears about liberalisation: “Canadians, Norwegians, it doesn’t matter! But how will they manage our water properly?” Consequently, this situation has made the current operator aware of the territorial role of the lakes. A representative explained that the respect of a recreational dimension is done “totally outside the official specifications. And without any specific remuneration”. Another insisted that such support serves both parties —“they want to enhance their territory and we also seek to enhance our works”—to which a competitor responded that these activities are “secondary” and criticized a form of overbidding in the face of tourist concerns.
- 24 Nevertheless, the EDF members interviewed insisted that this new paradigm was initiated before the prospect of liberalisation. The most emblematic project is the national programme “one river, one territory” through which the Romanche-Drac-Isère agency provides financial and technical support to local small and medium-sized enterprises (SMEs) in the field of water, energy and the environment. In this sense, the liberalisation dynamic has rather accelerated the deepening of existing relations

between EDF and local authorities, in a triple process of concession, collaboration and territorialisation, modifying the physicality of dams.

Dams as an Abundant Source of Income

- 25 Finally, a third element of change in the physicality of dams is their appreciation as a source of local revenue. The study reveals that the appropriation of dams by local communities is based primarily on their economic value. The cash flows derived from hydropower come mainly from the presence of the facilities on the territory of the communities, but also from a variety of physical elements (pylons) and actions (subcontracting, sponsorship, financing) that go well beyond the concrete implementation of the facilities. In this sense, capital flows contribute to the renewal of the physicality of dams, understood as benefiting the economy of an entire territory. This is why, when the time comes to open up the market to competition, these flows blur the distinction between public service and the actions of a limited company with majority State capital.
- 26 In municipal discourses, dams do not strictly refer to a material infrastructure, but rather to a continuum of financial flows. The first element cited by the mayors, even before the monumental architecture of the works, is the former professional tax. For EDF, these taxes represent a third of their expenses. Taxation is an essential source of income for these small municipalities where the operator is either the only or the largest company. In this respect, the tax reform of the inter-municipalities raises a multitude of concerns for some mayors as this tax windfall is unevenly distributed over the territory. It is estimated at €3 million spread over 20 communes (i.e., on average, €150,000 each), but varies from €106,800 to €300,000 (2013 data). The presence and proximity of heavy infrastructures remain vital. A historical anecdote even reports that the unequal distribution of the Sautet turbines was the result of a political tug of war between the two municipalities on either side of the dam (fig. 1). However, punctual elements such as pylons and source stations suggest the wider fiscal footprint left by hydropower in the region. These flows sketch a reticular geography of hydropower.
- 27 The dams contribute to a local economy that is not limited to direct employment. While 30 people are employed on site, the operator estimates its local subcontracting expenses at 53 million euros. This territorial rationale is also reflected in extensive and diversified project funding, from sponsorship of events (“Trail des Passerelles”, “Festival du Lac”) to the signing of partnerships (notably with the Local Water Commission for a €500,000 fund to finance water and sanitation projects), a €750,000 subsidy for “water and tourism” projects and a €300,000 fund as part of the “One River, One Territory” programme. From 2009 to 2014, this financial commitment amounted to a minimum total of €3 million, equivalent to the taxes paid annually in the territory. The investments are aimed at creating “economic, ecological and tourist value”, and the cooperation between the operator and the mayors is seen as having always existed (interviews in 2019).
- 28 This financial physicality of dams has become more complex in the context of liberalisation. The local deputy explains: “the arrival of competitors in the sector made the elected representatives aware of the value of the dams”. To oppose European legislation pushing towards a private conception of hydroelectric production, the mayors have therefore valued the dams as public structures. The deputy insists: “90%

consider EDF as a public service”. Like most of the mayors, one of them exclaimed: “it’s national, so it’s us!” In their discourse, liberalization is privatization: “what is scary is that they are going to privatize the dams”, “the Sautet dam is going to be privatized”. This account of a damaging ‘privatization’ contrasts sharply with the European agenda, which considers energy as a liberalized, competitive and therefore private matter. The operator’s involvement in various activities of public interest, through a local political economy and the entanglement of financial flows, makes it all the more difficult to separate what is considered public management by a company from what would be possible to achieve without state capital. The result is a form of political hybridity of dams, between public and private statutes and practices, made possible by a territorial reappropriation of the materiality of dams by local elected officials.

Conclusion

- 29 This study demonstrates that the materiality of dams is not imposed on the social world, but is relational. What is at stake in the European liberal transitional trajectory and its oppositions is a renegotiation of what counts in a dam, between different scales of interests. This renegotiation involves a reassessment of the physicality of dams.
- 30 By proposing to use the notion of physicality, we seek to move away from a fixed reading of dams as objects, to which the entry through materiality can lead. On the contrary, we show that they possess a physicality (i.e., a capacity to act) that is evolving and often strategic for Alpine territories subject to numerous challenges.
- 31 Between 2014 and 2020, we observed several changes in the physicality of the Sautet hydroelectric complex, while its tangible features underwent only minimal transformations. The examples deployed in this article are the most salient observed changes. They concern the link to water, to the territory, and to capital. They invite us to think of the hydroelectric territory beyond the physical location of the concession, to better understand the place of hydroelectricity in mountainous areas. Finally, they point to a progressive evolution of the ontology of water that is moving away from its modernist vision to become much more composite.
- 32 The case of Sautet, however, presents a type of situation, in which physicality and materiality do not evolve together. It is a starting point for thinking about the productivity of this theoretical difference. Other examples could show how a re-evaluation of the physicality of dams can also lead to major material changes. This is the case of obsolete structures, scattered along the rivers without great productivity but with heavy ecological consequences. The Romanche-Gavet project (replacement of 6 power plants and 5 dams by a dam-power plant complex), north of the study area, is emblematic of this.

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RÉSUMÉS

Cet article propose de repenser la matérialité des barrages hydroélectriques dans les vallées alpines, alors que l’hydroélectricité gagne en importance sur la scène des énergies renouvelables. Il pose une question simple : la transition énergétique affecte-t-elle la matérialité d’infrastructures qui sont appelées à demeurer ostensiblement identiques ? Pour répondre à cette question, nous mettons au travail la distinction faite par Philippe Descola entre matérialité

et physicalité et nous l'appliquons à une étude de cas : le barrage du Sautet dans les Alpes françaises. En effet, la transition énergétique européenne repose en partie sur la réalisation d'un marché unique libéralisé et le renouvellement concurrentiel des concessions de barrages est une étape clé dans ce processus. Or, nous soutenons que pendant ces changements, la matérialité du barrage étudié reste sensiblement la même, alors que sa physicalité change pour des raisons stratégiques. L'opposition locale à la libéralisation engage une réévaluation de la physicalité des barrages (c'est-à-dire de la façon dont ils sont censés fonctionner) selon trois aspects : leur rôle dans la régulation des cours d'eau ; leur dimension territoriale ; et leur rôle de médiatisation financière et fiscale. L'étude montre ainsi que la matérialité hydroélectrique est un élément relationnel, sujet d'interprétation entre des valeurs et des intérêts concurrents.

This article aims to think afresh about the materiality of hydropower dams in Alpine valleys, an old-new energy hotspot expected to resume its central position on the renewable stage. It asks a simple question: does the energy transition agenda affect the materiality of infrastructures which remains ostensibly identical? To answer this question, we use Philippe Descola's distinction between materiality and physicality and apply it to a case study of the Sautet hydroelectric dam in the French Alps. Indeed, the European energy transition is partly based on the realization of a single liberalized market and the competitive renewal of dam concessions is a key step in this process. Yet, we argue that amidst these changes, the materiality of the studied dam remains substantially the same, while its physicality changes for strategic reasons. Local opposition to liberalization engages a re-evaluation of the physicality of dams (i.e., the way they are supposed to function) in three aspects: their role in river regulation; their territorial dimension; and their financial and fiscal mediating role. The study shows that hydroelectric materiality is a relational element, subject to interpretation between competing values and interests.

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Keywords : hydroelectric dams, concessions, physicality, water ontologies, Alps

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